ACRP

REPORT 26

AIRPORT COOPERATIVE RESEARCH PROGRAM

Sponsored by the Federal Aviation Administration

Guidebook for Conducting Airport User Surveys

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AIRPORT COOPERATIVE RESEARCH PROGRAM

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Guidebook for Conducting Airport User Surveys

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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 project director was Matthew Bol of Jacobs Consultancy, replaced by David Biggs of Jacobs Consultancy when Mr. Bol retired toward the end of the project. The co-principal investigators were David Biggs and Geoff Gosling of Aviation System Consulting, LLC. Other authors of the report were Jennifer Franz of JD Franz Research, Inc.; Paul Cripwell of J. P. Cripwell Associates; and Jim Baker of Jacobs Consultancy.

FOREWORD

By Theresia H. Schatz
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ACRP Report 26: Guidebook for Conducting Airport User Surveys provides methods and useful information for conducting effective user surveys at airports. The guidebook introduces the basic concepts of survey sampling and the steps involved in planning and implementing a survey; describes the different types of airport user surveys; and provides guidance on how to design a survey and analyze its results. This guidebook will be of value to airport operators, planners, designers, and other stakeholders that need to survey airport users to obtain useful information to plan and operate their facilities appropriately and efficiently. Airport facilities can include all aspects of airport terminal buildings, parking lot operations, surface transportation, food and retail services, and employee accommodations, among others.

ACRP Report 26 complements several ACRP airport terminal design–related reports. Specifically, *ACRP Report 23: Airport Passenger-Related Processing Rates Guidebook* and *ACRP Report 25: Airport Passenger Terminal Planning and Design,* among others in progress, provide a set of guidance tools to assist airport operators and their planning teams. In addition, the contractor's final report for ACRP Project 03-04 documents the research process that was used to develop ACRP Report 26 and is available on the TRB website (www.trb.org) by searching for "ACRP 03-04".

Airport user surveys are the primary source of information for airport operators and other agencies on airport user characteristics and airport ground access mode use, and they play a critical role in airport planning and air travel forecasting. The planning, development, conduct and analysis of airport user surveys can be complex, expensive, and subject to a number of pitfalls. For example, surveys are often conducted at infrequent intervals and by different contractors, and often a lack of continuity exists between successive surveys for the same airport. The lack of comparability between surveys at airports in multi-airport regions can be a particular problem for analyzing airport selection decisions or performing studies of traffic leakage to airports in adjacent regions.

Also, a number of technical issues arise with airport surveys that are often not well understood. These issues include selection of sample size and appropriate sample design; how to handle responses from large parties, such as tour groups or sports teams that have been encountered in the survey; and how to appropriately weight individual survey responses in presenting the survey results. While there is a considerable body of knowledge on sound survey methodology in general, the airport environment presents many unique situations and challenges. The specific guidance on airport user surveys provided by this guidebook should be particularly helpful to organizations undertaking such surveys.

The objective of ACRP Project 03-04 was to provide guidance for planning, designing, conducting, and analyzing airport user surveys. The research was conducted by Jacobs

Consultancy of Ottawa, Ontario, with Aviation System Consulting, LLC; JD Franz Research, Inc.; and J. P. Cripwell Associates. To meet the project objective, a survey of 216 airports, metropolitan planning organizations, state aviation organizations, and consulting and survey firms was conducted by the research team to obtain information on their experience with airport user surveys. As expected, the main reason for conducting surveys was found to be in order to obtain information on air passenger/airport user characteristics. Follow-up interviews were then conducted with 13 organizations to obtain more information about the survey practices and experiences. Guidance was prepared based on these interviews, the experience of the project team, and other information collected during the research.

CONTENTS

SUMMARY

Guidebook for Conducting Airport User Surveys

Airport managers and planners require a wide range of information to support their planning activities and decision making. While some of the information needed for effective planning and management of airports can be obtained by direct observation or from statistics that are routinely collected, much cannot. Some airport user attributes are not directly observable and some statistics are not routinely collected. Airport user surveys are the only way to obtain information of this type, examples of which include air passenger characteristics, customer satisfaction with airport facilities and services, ground access trip origins, and use of ground transportation modes.

This guidebook has been developed to help airports and other survey sponsors plan, design, conduct, and analyze surveys of airport users. It is intended to improve understanding of the issues involved in planning and implementing such surveys and to provide practicable methods and techniques to overcome these issues. There are a number of different categories of airport user, and surveys of a particular category of user involve issues common to all surveys as well as issues specific to that type of airport user survey. The guidebook first addresses those issues that are common to all airport user surveys. These sections are followed by a sequence of chapters that address issues that are specific to the following categories of airport user:

- Air passengers
- Airport-based employees
- Airport tenants
- Area residents
- Area businesses
- Air cargo activities

Planning a Survey

Thorough planning is absolutely essential to the success of any survey effort. Unfortunately, this task is often allotted insufficient time and attention, resulting in inaccurate or inadequate data. The first steps in planning any survey is to clearly define the purpose of the survey and then to decide who should be involved in the planning process. These steps will lead to the formation of two distinct teams. The survey planning team will be responsible for the planning, design, and overall conduct of the survey, as well as reporting the results. The survey implementation team will comprise the interviewers, supervisors, and support personnel who will actually perform the survey. Some of the members of the survey implementation team will also serve on the survey planning team.

A key step in planning a survey is choosing the appropriate survey method. The principal survey methods comprise intercept surveys using interviews or self-completed questionnaires,

mail or telephone surveys, or World Wide Web–based (Internet) surveys in which respondents complete the questionnaire online. Intercept surveys are the only practical method for air passenger surveys. A second major consideration is when to perform the survey and whether the survey should be performed over several different periods to account for seasonal variation in airport user characteristics. Decisions will be needed on where to perform the survey and whether it will be necessary to contract out all or part of the work. If the survey is to be performed in the secure area of the airport, it will be necessary to obtain security clearance and identification badges for the survey personnel who do not already have these; this need will affect the staffing requirements and schedule. At this point, it will be possible to prepare a detailed budget and establish a preliminary schedule and target dates.

Statistical Concepts

The third chapter of the guidebook is intended to provide the non-statistician with an understanding of the basic statistical principles behind sample design, the terminology involved, and the importance of considering how the sampling approach and the sample size interact to determine the statistical accuracy of the resulting data. Although it is not unusual to present the results of airport user surveys without any real discussion of the likely accuracy of those results, such presentation is not good practice. The proper approach to planning any survey is first to decide how accurate the results need to be and then to design the survey accordingly, as well as ensure that decision makers using the survey results are aware of the likely accuracy of the results.

One of the most fundamental questions in planning a survey is deciding how large a sample size is required, because sample size has a major influence on both the cost of conducting the survey and the accuracy of the results. The required sample size is in turn influenced by the sampling approach adopted. The most straightforward approach to obtaining a representative sample from a population is to select the members of the sample randomly from among the members of the population. However, in practice random selection is often difficult to achieve, particularly in an airport environment. Furthermore, it has the disadvantage that the sample will include relatively few members of particular subgroups of the population that compose only a small proportion of the total population. To address these concerns, other sampling methods that are often used include sequential sampling, stratified sampling, and cluster sampling. The chapter discusses the difference between these approaches and shows how for each approach the sample size required to achieve a given level of accuracy can be determined.

Survey Design

Many aspects of designing an airport user survey are common to all types of survey. These aspects include defining the population of interest to be surveyed, developing a sampling strategy and sampling plan, and addressing issues involving the design and wording of the survey questionnaire. Consideration needs to be given to ways to maximize response rates, including explaining the purpose of the survey to potential respondents and having field staff wear identification badges and distinctive attire that indicates that the survey is an officially sanctioned activity. In some cases it may be desirable to translate the survey questionnaire and supporting materials into other languages, although the choice of which languages to use is often problematic.

The increasing use of electronic data collection devices for performing survey interviews presents both opportunities and technical and logistical constraints. They can support much

more complex survey questionnaires and eliminate the need for a separate data entry step. They can also be programmed to perform real-time data checking. However, consideration needs to be given to who will do the necessary programming. Commercial software packages are available and the choice of the most appropriate package will usually involve a tradeoff between cost and required features, as well as compatibility with the chosen equipment. The choice of equipment also involves tradeoffs between cost, capability, and ease of use. Such factors as screen size and clarity, data storage capability, key size and keypad layout, battery life and recharge time, data export capability, and weight and handling will influence both cost and usability.

Other steps in survey planning include interviewer selection and training, testing of the questionnaire and survey procedures, arrangements for data entry and quality control, analysis and reporting of survey results, post-survey analysis and identification of any lessons learned for use in future surveys, and documentation of the entire survey process for future reference. Where survey responses are recorded on paper forms, it will be necessary to enter the data into a computer file and verify that the data has been entered correctly. Although the use of electronic data collection devices will eliminate much of the data entry and verification task, the data will still need to be checked for consistency and any obvious or apparent errors made in entering the survey responses. Identifying and correcting errors in the response data can be a very time-consuming task, but essential to the quality of the resulting information.

Air Passenger Surveys

Air passenger surveys are the most common type of airport user survey, but they involve many complex issues that need careful consideration if the results are to be useful and accurate. The more important issues include whether to interview passengers or use self-completed questionnaires, where to perform the survey, when to perform the survey and for how long, and how large a sample size is required. Development of an appropriate sampling plan and development of a well-designed and carefully worded questionnaire are major factors that influence the accuracy and usefulness of the survey results. Because air passenger characteristics vary by time of day and day of the week, the sampling plan should cover all the hours of the day and at least a complete week. Even so, the survey responses are unlikely to completely match the distribution of air passengers over the week and across different market segments; therefore, the survey responses will need to be weighted to obtain an accurate profile of passenger characteristics at the airport.

The choice between self-completed questionnaires and interviews involves a balancing of cost and desired accuracy. Self-completed questionnaires generally cost less per response, thus allowing a larger sample size for a given budget. However, there is no opportunity to clarify questionable responses, ensure that all relevant questions have been answered, or tailor questions in the light of answers given to previous questions. Where self-completed questionnaires involve open-ended questions, such as trip origin addresses, there may also be a problem interpreting handwriting. The use of electronic data collection devices for interview surveys facilitates tailoring questions to previous responses and more complex skip patterns than is usually possible with printed forms. With suitable programming, they can also perform real-time validity and consistency checks of respondent answers, and prompt the interviewer to probe for clarification of questionable responses. This capability is particularly valuable for air passenger surveys, where many respondents may use incorrect or ambiguous terminology in their answers, or misunderstand the question.

While the majority of air passenger surveys are performed in the airline gate lounges, this location presents a number of potential sources of bias in the survey results. The most

obvious is that responses are usually limited to passengers in the market served by the next flight departing from the gate where the survey is performed, but other sources of potential bias arise from the fact that passengers are arriving in the gate lounge as the survey is being performed and passengers arriving just before or after boarding begins are unlikely to be surveyed. An alternative approach is to intercept passengers as they exit security screening. This approach allows a reasonably random sample of originating passengers, although passengers clearing security shortly before their flight is due to board will not have time to complete the survey. However, this location is likely to miss most or all of the connecting passengers.

Air passenger characteristics vary seasonally as well as by time of day and day of the week. Therefore any survey performed over a relatively short period of time will necessarily not reflect this seasonal variation. Depending on the use to which the survey results will be put, it may be desirable to perform the survey in several waves at different times of the year. Alternatively, a continuous or quasi-continuous survey could be performed on an ongoing basis throughout the year. Use of such a survey period would not only provide information on how air passenger characteristics vary seasonally, but also require fewer survey field staff for a given sample size, simplifying the logistics of performing the survey and allowing the field staff to be better trained and become more experienced in conducting the survey.

The sequence and wording of air passenger survey questions can significantly affect the reliability of the responses that are obtained. Particular care is needed to word questions in a way that will be understood by the traveling public. Local terminology for different ground access modes varies widely across the country, and may mean a very different thing to a visitor from another region or country than to a local resident. The sequence of questions can also affect how respondents interpret them, either positively by introducing questions in a logical sequence that helps respondents interpret the question correctly, or negatively by creating potential ambiguities over which aspect of the trip a question is addressing.

Performing an air passenger survey involves a large number of logistical details that need to be carefully planned. If the survey is being performed in the secure area of the terminal, as is usually the case, the survey field staff must be issued security badges. This process can take a significant amount of time to complete and some potential field staff may be rejected by the required background check. Other considerations include arranging for the use of a field office where equipment and supplies can be stored, and data downloaded from electronic data collection devices if these are used, as well as arrangements for pre-testing the survey questionnaire, selecting and training field staff, and performing pilot tests to identify potential problems with the survey logistics.

Groundside surveys of vehicle occupants form a special type of air passenger survey that can be used to obtain detailed information for planning airport groundside facilities. These surveys can provide detailed information on vehicles, greeters, and well-wishers as well as passengers and are performed at various locations on the airport landside, including terminal curbs, parking facilities, and shuttle bus or public transportation pick-up and drop-off stops. Because the sampling rate varies widely from location to location and time to time, the results need to be weighted using counts of vehicles at different facilities as well as counts of originating and terminating air passengers.

Employee Surveys

Surveys of airport-based employees are conducted for a variety of reasons, including assessing satisfaction with facilities and services, obtaining information for transportation or concession planning, or addressing employee-related issues such as communication and

knowledge of airport procedures. Two approaches can be used: developing a list of all employees on which to base the survey or conducting intercept surveys at suitable locations on the airport. Questionnaires can be distributed to the selected sample of employees by mail or distributed by employers, and responses can be returned by mail or at drop boxes in break rooms or other suitable locations. Alternatively, employees can be contacted by email or mail and invited to participate in a Web-based survey. Questionnaires are usually self-completed, but an on-site intercept survey could collect responses through interviews. The time needed to complete the survey should be no more than 5 to 10 minutes if employees are expected to complete the survey during a break.

Tenant Surveys

Surveys of airport tenants are usually conducted to collect information for studies of the economic impact of airports or to determine tenant satisfaction with the airport as landlord. The best method for conducting these types of surveys is to send invitations to participate by email with a link to a Web-based survey. These surveys should be conducted by respected third parties and provide assurances that the responses will remain confidential. "Mystery shopper" surveys form a different type of tenant survey. These surveys collect detailed information on the performance of airport concessions by having survey staff make anonymous purchase and return transactions and subsequently complete an assessment questionnaire that evaluates the quality of the customer service and other attributes of the concessions.

Surveys of Area Residents

Most surveys of area residents are conducted to obtain information for marketing and airport planning purposes, particularly studies that explore the use of different airports by local residents in situations where they have a choice of airport. These surveys are typically performed by telephone using random-digit dialing, although this method presents a number of potential sources of bias, including unwillingness of those called to participate in the survey, households without telephones or only cellular phones, and numbers that are not answered after repeated calls. To minimize the rate of incomplete surveys, the survey should be kept to no more than 10 minutes.

Surveys of Area Businesses

Surveys of area businesses and other organizations are undertaken for a number of reasons, including collecting information for use in economic impact studies and collecting information on the air travel needs of local businesses and their travel characteristics. Various methods can be used for such surveys, including mail surveys, telephone surveys, in-person interviews, and Web-based surveys with an initial contact by email. Defining an appropriate sample of organizations to contact to request participation in the survey and assembling the appropriate contact information in each case can require a significant level of effort. Questionnaires should be kept as short as possible, consistent with the goals of the survey, to maximize response rates. Particular thought should be given to how to handle local branches of larger organizations. Care also should be taken in wording questions to determine whether any reasons or opinions provided by respondents are those of the person responding to the survey or represent the position of the organization as a whole.

Cargo Surveys

Surveys of air cargo activities and operations at an airport represent a particularly challenging type of survey, because information on shipment characteristics and detailed cargo flows is typically regarded as highly proprietary. Because the cargo itself cannot be surveyed, the organizations involved in handling the cargo must be surveyed. While some information may be obtained from truck surveys, truck drivers are generally reluctant to spend much time answering detailed questions or may not feel authorized to reveal information about the shipments they are transporting. In spite of these difficulties, cargo surveys provide an important addition to the information that can be obtained from cargo traffic statistics that are routinely reported, which typically only provide very aggregate measures of the weight of cargo moved and little to no information about the commodity type, weight, value, density, and the origin and destination of individual shipments. Surveys of air cargo carriers, freight forwarders, or selected shippers will typically take the form of an in-person interview. Respondents may be able to provide useful information in general terms, even if they are not willing to provide detailed data on individual shipments. The advent of automated truck-tracking capabilities through the introduction of Intelligent Transportation Systems programs and weigh-in-motion systems at truck inspection stations may provide useful information in certain corridors that can be combined with other survey data to better understand air cargo flows, although this aspect is not well understood and could benefit from future research.

CHAPTER 1

Introduction

1.1 Purpose of This Guidebook

This guidebook has been developed to help airports and survey sponsors plan, design, conduct, and analyze surveys of airport users. It is intended to improve understanding of the issues involved in planning and implementing such surveys and to provide practicable methods and techniques to overcome these issues. The guidebook does not cover observational surveys of the activities of airport users.

As requested by the ACRP, the team that developed this guidebook conducted research on the current state of knowledge and practice in performing airport user surveys. The research included a review of the literature, an Internet survey, and detailed interviews with selected airports and agencies regarding their current survey practices. This research and the expertise of the research team are the basis of this guidebook. A summary of the research is provided in Appendix A.

The guidebook will be of interest to airport managers, planners, analysts, and consultants. It will provide airport managers with a better understanding of when surveys are required; basic survey concepts and methodologies; and the time and effort required to plan, develop, and implement surveys. Planners and analysts who have little experience with surveys will benefit from the detailed review of the basic concepts and the practical considerations related to specific types of surveys, such as passenger and tenant surveys. It is hoped that the guidebook will prove equally useful to readers who already have experience with surveys, by confirming that their practices have been reasonable and by providing advice and insights to augment their experience.

This introduction outlines the following:

- The role of surveys in airport planning, development, and management.
- Basic survey concepts, such as target population and survey sampling.
- The main types of surveys and survey methods.
- How the guidebook can be used.

1.2 Role of Surveys in Airport Planning, Development, and Management

Airport managers and planners require a wide range of information to support their planning activities and decision making. The quality of plans and decisions depends on the quality of the information on which they are based. In particular, in any customer-serving organization, such as an airport, two considerations are critical to effective planning and management:

- Understanding the market.
- Understanding the customer.

Airports function within the air transportation system and indeed within the larger transportation system therefore, airport managers and planners must understand the nature of the market being served. This includes such issues as the trip purposes and travel patterns of passengers using the airport, as well as the nature of goods being shipped through the airport. Where the local travel market is served by more than one airport, it is helpful to understand relative market share and the factors that influence this. Depending on the length of the trip, travelers and shippers may also have a choice between air and surface transportation (i.e., car, bus, truck, rail, or sea).

Effective planning and management of airport facilities and services also require an understanding of the characteristics, needs, and satisfaction of the customers using the airport, principally the air passengers and shippers but also the intermediate service providers, such as the airlines, freight forwarders, and ground transportation providers. This customer information might include air travel party sizes and the amount of baggage checked by air passengers, as well as customer satisfaction with the services provided by the airport and suggestions for how they can be improved.

While some of the information needed for effective planning and management of airports can be obtained by direct observation or from statistics that are routinely collected, much cannot. Some airport user attributes are not directly observable and some statistics are not routinely collected. Airport user surveys are the only way to obtain information of this type, including the following:

- Air passenger characteristics for facility planning, such as arrival time before flight departure or the number of well-wishers accompanying passengers into the terminal.
- Customer satisfaction with airport facilities and services.
- Air passenger and airport employee satisfaction with existing concession services and likely use of additional services.
- Ground transportation used by air passengers and airport employees to travel to and from the airport, particularly public transport.
- Trip origins and destinations of airport users within the region served by the airport.
- Use of competing airports and the factors affecting the choice of airport.
- Economic impact of the airport on the surrounding region.

Having good information on the wide range of issues typically addressed by airport user surveys improves the quality of planning and decision making. At the same time, obtaining good information costs money. In deciding how much effort to devote to collecting this information, consider how the information will be used and the likely costs of poor planning, design or operating decisions. In general, where information will be used in planning new facilities, the cost of a survey will be small compared to the cost of the facilities. The ability to appropriately size the facilities and phase future expansion could significantly reduce the cost of a project or forestall the need for expensive modifications after construction has commenced or the facilities have been opened.

In planning an airport user survey, or even deciding whether one is necessary, airport planners and managers need to consider what information is already available, what additional information is needed and how accurate that information needs to be, and then balance the cost of the survey against the value of the resulting information. This is not an easy task. One goal of this guidebook is to help airport planners and managers address this issue.

1.3 Survey Concepts

For readers who are considering performing a survey for the first time or have limited experience with surveys, this section provides an overview of the basic concepts and some of the common terminology used in survey practice.

The purpose of an airport user survey is to gather information about the characteristics or opinions of a defined group of airport users, such as air passengers using the airport or those employed at the airport. This group is referred to as the *target population* to be surveyed (often shortened to *population*). In general, it is not practical to gather the desired information from every member of the target population, so a subgroup of the target population is selected. This subgroup is referred to as the *sample.* The process of performing a *survey* involves selecting an appropriate sample, requesting the desired information from each member of the sample, analyzing the responses and reporting the resulting findings. The process of performing a survey starts by planning each of these steps.

When planning a survey, consideration needs to be given to clearly defining the target population, as well as deciding how large a sample is required and how to select the sample of respondents. These are not always obvious decisions. For example, in performing an air passenger survey, is the target population all passengers using the airport in a given period, including those connecting between flights, or only those starting their air trip at this airport? Is the target population only departing passengers, or does it include arriving passengers as well? The answers to these questions will affect the survey methodology as well as the approach to selecting the sample. Guidance on addressing these issues is provided in Chapter 4, "Survey Design."

Ideally, a survey sample would be randomly selected individuals from the target population, where random selection means that any individual in the target population has an equal likelihood of being selected. This random selection is necessary to be able to make inferences from the sample about the characteristics of the target population with known statistical confidence.

However, in practice such random selection is often difficult to achieve. The methods used to select survey respondents inevitably constrain the selection so that it is rarely completely random. For example, if an air passenger survey of selected flights is conducted in airline gate lounges, the sample is necessarily restricted to those passengers in the lounges in question, who are generally passengers on the flight about to depart from that gate. The respondents on any given flight will generally have a different distribution of characteristics from the target population as a result of the specific market served by the flight, the time at which the flight departs, and possibly other factors, such as the airline in question. Even if the flights to be surveyed have been randomly selected, it is unlikely that the selected flights will cover all possible combinations of market, airline, time of day, and day of week, because of budgetary limitations on the number of flights that can be included in the survey. The smaller the number of flights sampled, the less likely it is that the characteristics of the passengers on those flights will correspond exactly to those of the target population as a whole.

A sample in which the distribution of characteristics in the sample differs from the population is referred to as a *biased* sample. An important aspect of planning a survey is designing a *sampling strategy* to reduce potential bias and applying techniques to control for any bias that remains. These techniques involve assigning *weights* to each response, so that the *weighted results* more closely correspond to the expected distribution of the characteristics of the target population. Of course, this implies some knowledge of that expected distribution and a method to calculate the response weights. These issues are discussed in more detail later in this guidebook, in the chapters specific to each type of survey.

Having selected the sample, the survey *respondents* are then asked to provide the desired information through the use of a *survey instrument* or *questionnaire*[1]. The design of the survey

[1] *Survey instrument* is broader than *questionnaire* as it includes, for example, data recording sheets in observational surveys. The airport user surveys discussed in this guidebook exclude observational surveys and the term *questionnaire* is used throughout this guidebook.

instrument is critical, because the wording and sequence of questions will affect the responses that are obtained. Consideration needs to be given to how the survey will be performed, including how respondents will be selected and whether they will be interviewed by survey staff or complete a questionnaire themselves.

Once an initial design of the questionnaire has been completed, it should be *pre-tested* on potential respondents to make sure that the wording of the questions is clear and the survey generates the desired information. The results of the pre-test may call for some redesign of the instrument and possibly another pre-test. When the questionnaire has been finalized, a *pilot test* is usually performed to test the survey procedures in the field. Typically, the pilot test will involve a representative group of the survey interviewers, or field staff, and should be performed well enough in advance of the full survey that any logistical issues can be resolved before the survey gets underway.

After the survey data collection has been completed, the data will generally need to be checked and *cleaned* to correct identifiable errors (e.g., misspellings) and determine whether to eliminate incomplete or invalid responses before the results are *tabulated* or analyzed. Depending on the length and nature of the questionnaire, data cleaning can involve a significant amount of work. However, this step is crucial to the quality of the results.

In summary, the basic survey concepts are:

- Target population—a defined group of airport users for which information is required.
- Survey sample—a subgroup of the target population selected to provide the desired information.
- Sampling strategy—a strategy to reduce and control potential bias in the survey sample (i.e., the extent to which the characteristics or opinions of the sample differ from the target population).
- Questionnaire—the mechanism to collect information from the survey sample.
- Surveying method—the method used to collect information from the sampled respondents.
- Pre-test—testing of a questionnaire with a small number of potential respondents.
- Pilot test—testing of the entire survey process.
- Data cleaning—correction of identifiable errors and elimination of incomplete or invalid responses before the survey results are tabulated and analyzed.

These concepts are dealt with in more depth in subsequent sections.

1.4 Main Survey Types and Methods

Airport user surveys come in many types, each with its own set of goals and objectives. The main types considered in this guidebook are passenger surveys (Chapter 5), employee surveys (Chapter 6), tenant surveys (Chapter 7), surveys of area residents (Chapter 8), surveys of area businesses (Chapter 9), and air cargo surveys (Chapter 10).

Passenger surveys are the most common type of airport user survey and tend to focus on passenger characteristics, passenger demands on facilities, or passenger satisfaction with the airport. Passenger surveys are used for airport planning and management.

Employee surveys are typically conducted to measure satisfaction with airport facilities and services, obtain information for transportation or concession planning, and address issues such as communications and knowledge of airport procedures.

Tenant surveys tend to focus on tenants' satisfaction with the airport as a landlord and on gathering information to help determine the economic impacts of the airport.

Surveys of the general public can be undertaken for a variety of reasons. Perhaps the most common purposes are determining the public's perceptions of an airport, investigating the factors

that influence airport choice, and assessing the extent to which area residents are choosing to fly from other airports.

Surveys of area businesses are frequently done as part of studies to determine the economic impact of the airport and its value to the community. Surveys may also be conducted to collect information on travel by local business people and their use of all the airports in the region to assist in airport planning and air service development studies.

Air cargo surveys address any aspects of the movement of air cargo at the airport, including cargo moving on all-cargo aircraft or in the belly holds of passenger aircraft, and transit cargo that arrives and departs by road.

1.5 How to Use This Guidebook

The guidebook has been structured so that readers can easily find the information that is most important to them.

Topics and the chapters in which they are addressed follow:

- The role of surveys, basic concepts, and main survey types: Chapter 1.
- The steps and related considerations in planning and implementing any survey: Chapter 2.
- Underlying concepts of sampling and statistical accuracy required for airport user surveys: Chapter 3.
- The factors—such as sampling strategy, questionnaire design, survey period and interviewer training—that will need to be considered in the design of a particular survey: Chapter 4.
- Specific issues and advice related to passenger surveys: Chapter 5.
- Specific issues and advice related to employee surveys: Chapter 6.
- Specific issues and advice related to tenant surveys: Chapter 7.
- Specific issues and advice related to surveys of residents of the area served by an airport: Chapter 8.
- Specific issues and advice related to surveys of area businesses and other organizations: Chapter 9.
- Specific issues and advice related to surveys of air cargo activities: Chapter 10.

The table of contents provides a detailed listing of the topics covered in the guidebook and can be used to locate information on particular topics that may be of interest.

CHAPTER 2

Planning a Survey

Thorough planning is absolutely essential to the success of any survey effort. Unfortunately, this task is often allotted insufficient time and attention, resulting in inaccurate or inadequate data. This chapter describes the factors that need to be considered in planning a well-defined survey project:

- The purpose of the survey (why the survey is being conducted).
- The survey method.
- The frequency and timing of the survey.
- The involvement of external agencies in funding, planning, and conducting the survey.
- Budgeting.
- The role of the survey planning team.
- Scheduling.
- The location of the survey.
- The use of external resources.

2.1 Defining the Purpose

2.1.1 The Purpose

At the outset, it is important to clearly define the purpose of the survey. In essence, this is the answer to the question, "Why are we doing this?" If the replies from the people commissioning the survey are vague—"The information would be interesting" or "It would be nice to know"—the best next step is to stop. To be useful, surveys should yield results that are **actionable.**

It is often helpful to begin a survey at the end. This approach suggests that an airport first consider the actions it wants to take and the decisions it wants to make on the basis of the survey results, determine the information that will be required to make those decisions, and only then start to consider the target population and questions that will provide the necessary information.

This approach also helps to prevent errors of omission and commission. An error of omission, often not discovered until the end of the survey process, has occurred when someone asks, "Why didn't we ask that question?" and when the unasked question represents information important to the making of a decision or to another use of the survey results. A good example (which actually occurred in an air passenger survey in the San Francisco Bay Area not so long ago) would be failing to ask how long departing air passengers resident in the region served by the airport will be away on their air trip when the survey data is intended to be used for airport ground access studies. The air trip duration of course determines the cost of parking a car while away on the trip, an important consideration in airport ground access mode choice modeling.

An error of commission occurs when, due to a poorly worded question or other problem with the way the survey is performed, the survey does not obtain the information that the survey designer

expected. An example would be asking air passengers "Where did you begin your trip to the airport today?" with the goal of obtaining trip origin location information for airport access trips. This question is ambiguous for air travelers who are surveyed on the return leg of a one-day round trip.

Typically, a survey's purpose will be articulated using goals and objectives. Goals are broad, general statements of the information the survey is intended to obtain; objectives are more specific. For example, the goal might be to gather information on air passenger ground transportation use; the objectives might be to determine where passengers began their trip to the airport, which ground access modes they used, how they got to those modes, and why they chose the particular modes they used. Well-defined goals and objectives will provide the necessary guidance for the development of useful and appropriately worded questions.

2.1.2 The Planners

A strong leader or project manager is needed to clearly define the purpose of a potential survey. Planning by committee has a tendency to be time consuming and awkward. Nonetheless, the project manager may need to involve a few key people.

Who should be involved in the planning process? The following groups should at least be considered:

- Decision makers—those who are expected to make the decisions or take the actions the survey is supposed to address.
- Data users—those who are expected to use the data to support the decision makers in planning, modeling or marketing.
- Potential partners—organizations that might share an interest in the results and might therefore provide support or even financial assistance.
- Potential duplicators—those who might be conducting the same or similar research at the same time and thus get in the way. Having two surveys conducted at the same airport at the same time by different parties is generally not a good idea.

This is not to say that all of these groups need to be involved. It is important, however, at least to consider each of them and their potential either to help or to hinder the survey effort.

In addition, two distinct teams will participate in the survey:

- The survey planning team will be responsible for the planning and design of the survey (refer to Section 2.6).
- The survey implementation team will conduct the survey and will consist of the interviewers, supervisors, and support personnel (refer to Section 4.5.2). Some of its members will also serve on the survey planning team.

2.2 Selecting the Survey Method

A key step in planning a survey is choosing the appropriate survey method. The survey methods discussed in this guidebook include passenger intercept, mail, telephone, and Internet.

Choosing the appropriate method for any survey involves consideration of a wide variety of factors. Perhaps the key tradeoff, however, is between *cost* and *quality*. As a general rule, the higher the quality desired, the more expensive the survey will be. Quality in this case includes the following:

- **Data quality**—Will the questions be understood and elicit the desired information? Will all of the questions be answered? Will the answers be accurate? Will answers to any open-ended questions be clear and complete?

- **Response rate**—Will the survey methodology achieve a high enough response rate (the ratio of those responding to those approached to participate in the survey) to be able to generalize the results to the population of interest? It is clear from the literature that respondents often differ from non-respondents in material ways (Dillman, 2000; Groves and Lyberg, 1988; Lessler and Kalsbeek, 1992; Montaquila et al., 2007), and of course the survey team cannot know much about those who do not respond.

Although experts differ on this point, a general rule of thumb is that the response rate needs to be at least 50% for a researcher to be reasonably confident that the results are representative. However, lack of response bias (difference in the mean value of the characteristics of interest between respondents and the population being surveyed) is more important than a high response rate (Babbie, 1973). Regardless of what is considered an acceptable response rate, the lower the response rate, the more caution must be used in interpreting the data. Response rates vary widely by survey method and are generally fairly high for interview surveys of air passengers, but much lower for surveys conducted by mail or telephone.

The survey methods and their advantages and disadvantages are outlined below; more details can be found in the chapters devoted to the specific types of surveys.

Intercept surveys, generally undertaken with passengers, are performed by approaching potential respondents as they pass a particular location, such as when they enter the terminal building or leave security screening. They are usually performed as an *interview survey,* in which survey staff ask the questions and record the responses. Interview surveys can also be performed by selecting respondents in a particular location, such as an airline gate lounge, using a defined sampling rule to identify who to approach. The main advantage of interview surveys is the potential for a high response rate and high data quality resulting from the use of professional interviewers. In addition, sample control can be maximized using this approach. The primary disadvantage of interview surveys is their cost, which can be substantial.

Self-completed surveys that are handed out, completed by the respondent, then returned, either in person or by mail, are frequently used with air passenger, employee and tenant surveys. The key advantage of this approach is its relatively low cost, as one interviewer can hand out a large number of questionnaires in a given time period. Disadvantages of this approach include lower response rates and inferior data quality. Length and complexity are also concerns; generally, airports try to keep such surveys short and simple to maximize the number of responses and completeness of the information they get back.

Mail surveys are infrequently used by airports but could be useful for tenants who are spread out across the airport's premises. Their main advantage is their relatively low cost. Key disadvantages are similar to those of surveys that are handed out: low response rates, inferior data quality, and the need to keep the survey short and self-explanatory.

Telephone surveys are useful for surveying households and businesses in the area served by the airport, but are not a practical way to survey air passengers because there is usually no way to obtain a list of telephone numbers of a representative sample of air passengers. The key advantages of this method are the ability to obtain a representative sample of a large and dispersed target population, such as area residents or airport employees, and a reasonable level of quality control due to the use of professional interviewers. Disadvantages include their moderately high cost and the need to allow a long enough survey period for the call center to maximize the response rate and the representativeness of the sample (see Section 7.3).

Internet surveys have become increasingly popular in recent years for some types of surveys, partly because they are extremely inexpensive. They are also easy to program and deploy with

software that is readily available and inexpensive or even free. This software allows researchers to upload questionnaires to the World Wide Web (Web) and send out email invitations to participate. Responses are entered directly on the Web and stored in a database by the software. Branching to only appropriate questions and control of valid responses are possible. Tabulated responses and simple graphics are usually created by the software, and the data can be downloaded for more detailed analysis. Often respondents can save partially completed responses and return later to finish them, which can increase the response rate. Some programs also allow researchers to track respondents and non-respondents so that reminders can be sent only to those who have not yet responded. However, it is important that the survey include a large enough sample to be representative.

Internet surveys have three main disadvantages. First, not everyone has access to the Internet, particularly in their homes, but also in the workplace. (Consider the workplace example of an airport: office staff usually have Internet access at their desks but other types of staff, such as ramp personnel, probably do not have Internet access at all.) Second, response rates to Internet surveys are generally the lowest of any type of survey, reducing the likelihood of obtaining a representative result. Third, Internet surveys have to be fairly short and simple. The reasons for this include different technological capabilities among respondents, the absence of anyone to clarify issues the respondent may have, and perhaps people's general expectation that online transactions should move rapidly.

Other issues that should be considered when selecting the survey method include the following:

- **Speed:** How quickly does research need to get done? As examples, mail surveys take a long time to come back; surveys that are handed out to passengers are returned almost immediately if they are returned at all.
- **Complexity:** How complicated are the inquiries? The more complicated the questions, the more important it becomes to have a person available to clarify issues the respondent may have and provide assistance, as with an intercept interview.
- **Flow control:** Does the order in which questions are asked need to be controlled? If so, then certain methods, such as handouts and mail, are excluded. An example of the need to control flow might be asking what airports in the area come to mind, then following up by naming and inquiring about all airports not mentioned; the second question in effect "gives away" the possible answers to the first.
- **Visual aids:** Are visual aids needed? An example might be a stated preference survey on the likely use of a proposed new ground access mode, in which respondents are shown images of the proposed mode in order to ensure that they have a clear understanding of what the mode would be like to use. Methods such as telephone surveys that do not permit the display of such aids would be excluded.
- **Confidentiality:** How important is confidentiality to the study? In many cases, airport surveys are not asking particularly sensitive questions and confidentiality is not a major issue. Passenger surveys, however, frequently ask about the origin of the trip to the airport, which often means home addresses. In this case, confidentiality is obviously of high importance. It bears remembering that in an age of identity theft and widespread consumer fraud, concerns about confidentiality are legitimate.

  Some survey methods are more confidential than others. Mail surveys can be designed with no identifying information on the survey response form so that respondents can remain anonymous if they wish; in-person interviews and Internet surveys perhaps raise the most concerns about confidentiality, but the latter can be made quite secure with the proper hardware and software.

The main advantages and disadvantages and each survey method are summarized in Table 2-1.

Table 2-1. Advantages and disadvantages of each survey method.

Survey Method	Advantages	Disadvantages
Intercept Interviews	• High data quality • High response rate • Allows for complex surveys	• High cost
Mail-back and Hand-back Intercept, and Mail	• Lower cost than intercept • Useful for short and simple surveys	• Lower response and data quality than intercept • Slow for mail and mail-back surveys
Internet	• Low cost • Automated data processing	• Low response rate • Requires access to the Internet • Limited complexity
Telephone	• Allows representative sample of large and dispersed populations such as business firms	• Moderately high cost and time to implement survey

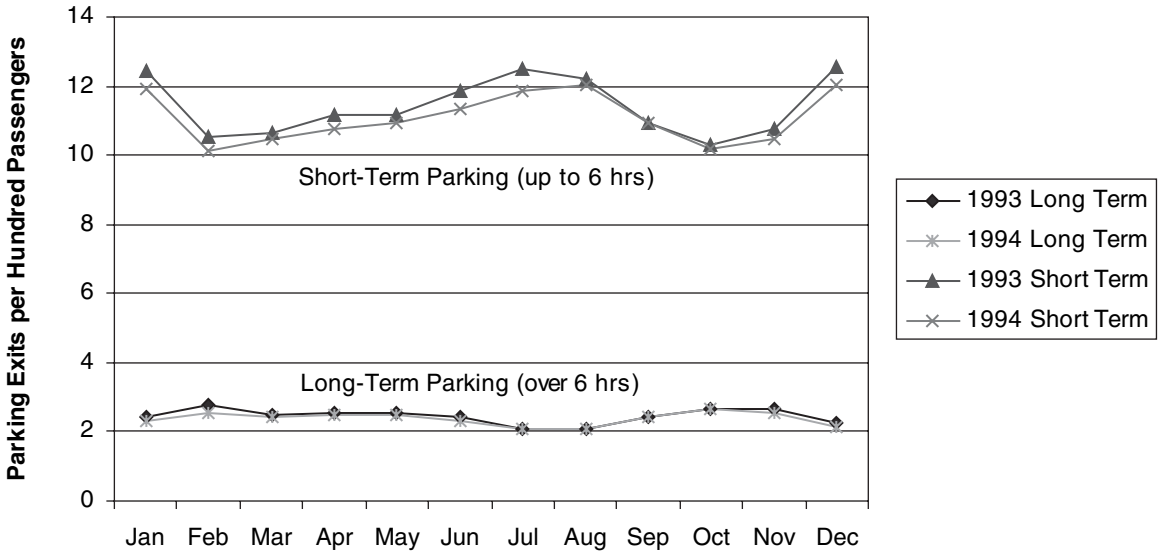
2.3 Survey Frequency and Timing

2.3.1 Dealing with Seasonality

Several aspects related to timing and frequency need to be considered in planning an airport user survey project. The pattern of air travel at most airports varies seasonally. Performing a passenger survey at only one time of the year will not reflect the variation in traveler characteristics and thus may give a biased picture of the composition of the air travel market over the year. On the other hand, if data on air traveler characteristics are needed for planning airport facilities for their peak use, then the survey should be performed during the peak demand period. While it is common practice to design airport terminal facilities for the average day of the peak month, some thought should be given to likely conditions during other peak periods, and it may be desirable to collect passenger survey data at those times as well. The highest hourly demand on airport facilities may not in fact occur during the busiest month, but rather may take place around holiday weekends at other times of the year, such as Thanksgiving.

Seasonal changes in the composition of the air travel market can have a particular influence on airport ground transportation mode use. Figure 2-1 shows the monthly variation in use of short-term and long-term parking at Los Angeles International Airport over a two-year period in the early 1990s, expressed as parking exits per hundred passengers (Gosling, 1996). Use of short-term parking varies inversely with use of long-term parking: Short-term parking use is highest in the summer and in December and January, both times associated with higher levels of non-business travel. Long-term parking use is highest in the spring and fall, months with generally higher levels of business travel. Similar seasonal patterns have been observed at other airports and for other ground access modes. It is clear from Figure 2-1 that depending on the month in which an air passenger survey is performed, the use of airport parking indicated by the survey results would differ considerably.

It should be noted that the monthly volume of passenger traffic through the airport and the composition of the traffic are really two different issues, as illustrated in Figure 2-1, which has been adjusted for the variation in air passenger traffic. One approach to accounting for seasonal variation in calculating the market composition for the year as a whole is to use a weighted average of results obtained during two survey periods, in a peak traffic month and an off-peak traffic month. While the market composition during the peak traffic month is usually different from that during the off-peak months, in fact the composition is likely to vary throughout the year. The market composition for the year as a whole will generally be different from that given by the weighted average of results obtained during a peak traffic month and any one off-peak traffic month.



Source: Adapted from Gosling, 1996.

Figure 2-1. Variation in parking use—Los Angeles International Airport.

A number of methods can be used to deal with seasonality:

- If the attributes being measured are for use in assessing facility requirements and capacity constraints, values of these attributes during the peak planning period may be of interest; if so, conduct the survey during this period.
- Conduct the survey in a shoulder month that is considered to be the most representative of average traffic over the year.
- Conduct the survey in several waves, such as each quarter, each month, or during peak and off-peak months.
- Use continuous or rolling surveys conducted throughout the year to allow the seasonal variation to be measured directly.

The use of continuous or rolling surveys has a number of advantages besides providing good information on seasonal variation of market composition. These advantages include the need for far fewer survey personnel, who in consequence can be better trained and will become more experienced, improving the quality of the survey results. This approach also makes the survey results far less vulnerable to distortion from atypical events that happen to occur during a survey conducted over a much shorter period, such as unusually bad (or good) weather, major sporting events, or labor unrest. A survey performed on an ongoing basis from year to year will also provide some early indication of trends in market composition that might be missed (or misinterpreted) if surveys are conducted only periodically.

The continuous survey approach has been adopted by the United Kingdom Civil Aviation Authority (UK CAA) for its program of air passenger surveys undertaken at the 14 largest U.K. airports (UK CAA, 2006). The survey teams spend several days at each airport before moving on to another airport, returning to each airport every few weeks.

2.3.2 Multi-Year Considerations

In addition to accounting for seasonal changes, a related consideration is how often airport user surveys need to be performed to identify changes in market composition that are occurring

from year to year. Some airports perform user surveys, particularly air passenger surveys, every year. Others perform them much less frequently, perhaps every five years (Gosling and Maric, 2006). Airport user surveys performed by other organizations, such as metropolitan planning organizations, are typically performed less frequently than every year. For example, the San Francisco Bay Area Metropolitan Transportation Commission has sponsored air passenger surveys at the three Bay Area primary airports every five years. As a result, there is a fairly good historical record of long-term changes in market composition. However, significant changes can occur over five years, as evidenced by the changes in the economy and the airline industry after September 2001. With surveys spread five years apart it is difficult to pick up recent trends or even determine whether differences from one survey to the next are part of a longer-term trend or just a feature of the specific year the survey was performed.

2.3.3 Dealing with Daily and Weekly Variability

User characteristics can also vary by time of day and day of week. Early morning and late afternoon periods typically have more origin-destination passengers, while midday flights have more connecting passengers. Morning flights tend to have more local residents, while afternoon flights have more visitors. Weekday flights have more business passengers, while weekend flights have more passengers traveling for personal reasons. Most departures from the U.S. West Coast to Europe are in the late afternoon to evening, with the corresponding arrivals spread through the afternoon. Therefore, it is desirable that the sampling period covers all hours of the day that flights operate, over at least one complete week. If the survey is conducted for fewer than seven days, the proportion of the target sample on weekdays and weekends should be set equal to the proportion of passengers during those two periods. However, failure to provide survey coverage for some hours or days will give results that are not completely representative of the target population, because it will provide no information on the characteristics of airport users during those periods. While weighting of survey results can partially correct for known sample bias due to oversampling some periods (e.g., having more responses from passengers on a given day than the share of the total weekly traffic on that day), there is no way to correct for the unknown bias due to not sampling some periods.

2.3.4 Sample Size

While the issues of survey timing and frequency need to be decided on the basis of the survey purpose, the particular data needs and the availability of resources, the issue of frequency is also related to sample size. Conducting surveys with a smaller sample size several times each year may produce better information for decision making and planning than conducting less frequent surveys with a much larger sample size every few years, for much the same overall cost. The results are likely to be more robust than those from a single survey of equivalent size conducted at a single point in time, because the multiple survey waves will better reflect changes in traffic composition over time. The results of multiple survey waves over several years can always be combined when a large sample is required to permit detailed analysis.

2.4 External Agencies

The results of an airport user survey are likely to be of interest to organizations other than the survey sponsor. Other organizations may have information needs that could be met by expanding the scope of a planned survey. For example, information on the use of ground transportation by travelers is likely to be of interest to regional transportation planning agencies as well as public agencies and private-sector operators providing ground transportation services at the air-

port. Other agencies that are likely to have an interest in the results of airport user surveys include local air quality management agencies, state aviation agencies and transportation departments, local economic development or tourism organizations, the Federal Aviation Administration, and other federal transportation agencies involved in funding airport ground transportation infrastructure. Conversely, an airport user survey that is sponsored by an agency other than the airport operator may provide an opportunity to gather information that the airport operator is interested in, but is of less interest to the survey sponsor.

Even in cases where the survey sponsor and other organizations are interested in obtaining information on the same broad issue, such as ground transportation mode use, the detailed needs of each agency may differ. For example, regional transit agencies may be interested in how airport travelers using public transit access the transit system, whereas this may be of less interest to the airport operator. Modifying the scope of an airport user survey to meet the information needs of other agencies will generally increase the cost and complexity of the survey but will generally be less costly and provide more comprehensive information than performing separate surveys. It may also present opportunities for cost sharing.

If there are other organizations that are likely to have an interest in the results of the survey, it is a good idea to coordinate with them at an early stage in the planning process to discuss whether the survey can meet their specific information needs. It may be helpful to form a coordinating group with representatives from the survey sponsor and the other organizations. This group can provide input on planning and design of the survey. The extent to which staff from external agencies should participate directly on the survey planning team will depend on the scope of the survey and the level of involvement of those agencies in funding the work.

2.5 Preparing the Survey Budget

Part of the planning process is preparing the survey budget. Ideally, this takes place after defining the survey purpose, determining the survey method and considering the survey frequency. The budget will need to consider the tasks involved in further planning and then implementing the survey project. If a budget has already been set, it is important to check whether it is realistic. If not, the project manager may have to change the scope of the survey or seek additional funding.

2.5.1 Project Tasks

The first step in preparing a survey budget is to identify all the tasks that are required to perform a successful survey. The following list may assist the survey sponsor in developing the preliminary budget.

- Survey design—includes specifying sampling strategies, designing questionnaires, estimating the required number of interviewers required, and determining which parts will be done with internal resources or by a contractor.
- Pre-test and pilot tests—required unless repeating a well-established survey with experienced staff, as discussed in Section 4.7.
- Survey setup—includes the hiring of temporary staff, any necessary equipment and software (rental or purchase), printing of forms, and other survey logistics.
- Conducting the survey.
- Data entry and cleaning—electronic transfer or manual data entry, as well as the cleaning of the data for inconsistencies and transcription errors. The cleaning phase is frequently underestimated.
- Data analysis—discussed further in Section 4.11.

- Reports and presentations—discussed further in Sections 4.11 and 4.13.
- Project management.

2.5.2 Approvals

After a preliminary budget has been prepared, the next step is to obtain the necessary approvals to conduct the survey. Senior management and executives need to be convinced that the survey will be a worthwhile expenditure and that it is being managed wisely.

It may be necessary or advisable to give a briefing or presentation to senior management. Such a briefing could include the following, for example:

- Need for the survey:
  - What information is needed for planning new capital projects that a survey would provide?
  - What data are not available from existing sources?
  - How might having this information affect the costs of these projects?
- Purpose of the survey:
  - Goals and objectives.
  - Population to be surveyed.
  - Data to be collected.
- Types of results and analysis expected.
- Management of the survey:
  - Composition of the survey planning and implementation teams.
  - Planned schedule.
- Cost of the survey:
  - Estimated costs.
  - Cost relative to potential costs of projects.

It may be necessary to update the initial budget and seek further management approval as the planning of the survey project proceeds.

2.6 Survey Planning Team

By this stage of the project, the goals of the survey have been set, an initial budget has been defined and, most important, approval has been obtained to go ahead with further planning of the survey.

Until this stage it is likely that the work on the survey has been confined to a few people, perhaps only one person. The time has come to create a survey planning team. This team will be responsible for the design and conduct of the survey and reporting of the results. This section describes the kinds of expertise that should be considered for this team.

2.6.1 Core Personnel

The core survey planning team will see the project through from beginning to end. The composition of the core team will depend on the expertise needed for the survey type and method being proposed but will likely include the following:

- Project manager: This is the person who is going to pull it all together and who will serve as liaison with senior management and other departments within the airport and external agencies. The project manager should be familiar with the procurement process and preferably have some experience with the issues involved in performing surveys.
- Survey technical expert: This person knows the airport user survey world and all its subtleties. Many different issues will arise during the survey planning process, and this is the person who

must deal with each one and make recommendations so that appropriate decisions can be made. Detailed survey design, such as the development of the questionnaire, will be the responsibility of the survey technical expert. Unless surveys are conducted on a regular basis, this expertise may not reside within the sponsoring agency and therefore may have to be contracted.

- Data analyst: This person will be responsible for the eventual analysis of the survey data and any documentation of the survey results, and should be involved from the beginning of the project. During the initial design stages, the data analyst may provide little input to the team, but will need to understand how the data will be collected and ensure that it will meet the survey goals and purpose. This will be important when performing the cleaning, management and analysis of the data at the conclusion of the survey. The data analyst and survey technical expert are often the same person.
- Survey logistics manager: Guided by the survey technical expert and the requirements for the specific survey type, this person will be responsible for coordinating all the arrangements that are necessary to conduct the survey and, more important, for setting everything up in advance so that the survey runs smoothly. In the case of on-site interviews, for example, this advance work includes such aspects as providing a training facility and transportation for interviewers, arranging parking and badges for survey field staff, and assigning field staff to shifts (these aspects are discussed further in Section 4.5). In addition to the advance arrangements, this person will ensure that sufficient interviewers are available for each shift.
- Survey administrator: This person provides administrative support for the survey team.

Exactly how many staff are required will depend on the size and complexity of the survey as well as the availability of personnel. Note that in some cases one person may have the required expertise to play a number of roles.

Depending on the structure of the organization, these team members may come from the same department or various departments. Either way, it is important that all staff and managers involved understand the importance of the survey and the role of each team member. Designated office space for the survey planning team is preferable for large surveys and surveys that will take a relatively long time to complete.

2.6.2 Other Departments and Agencies—The Extended Team

The survey planning team may wish to benefit from available expertise in other parts of the agency or beyond. It is also possible that the goal and purpose of the survey will inherently involve multiple departments or agencies. For example, a survey on attitudes toward the various functions of the airport might require input from such organizations as:

- The marketing department regarding shopping concessions.
- Planning and maintenance departments.
- A security agency and possibly a police authority if security screening is a consideration.

In some cases these other departments and external agencies may wish to participate on the survey planning team. If this request is granted, the roles and responsibilities of each extended team member must be clearly defined and understood by all.

The process of coordination with other departments and external agencies should include soliciting comments on the scope of the planned survey. These comments can be important to the success of the survey, because they might reveal one or more of the following:

- Some of the data being sought through the survey already exists within the agency.
- Other surveys are scheduled to take place in the future that might conflict with the planned survey or cause undesirable "survey burden" on the airport users.
- It would be desirable to include additional questions that would not conflict with the planned survey flow but would produce a substantial added value.

- The questionnaire needs to be reworded to allow comparison of the results with those of other surveys.

2.7 Preliminary Schedule and Target Dates

Certain components of the survey project will define the critical path. Information to be derived from the survey is often needed for a specific planning application and therefore is required by a certain time to fit into that process.

The hiring or contracting of temporary staff and obtaining their airport security badges is often a critical determinant of the schedule, especially for small surveys.

If a contractor is going to be involved, the contractor will have to be selected several months in advance to give the contractor time to prepare and activate the requisite resources. Given a target date for starting the survey, the survey planning team should work backwards through the steps in the process, including the decision process, developing a Request for Proposals (RFP), issuing the RFP, evaluating proposals and selecting a contractor, entering into a contract, and having the contractor undertake the required activities to prepare for the survey.

If contract support involves more than just providing temporary staff, such as assisting with the detailed survey planning and design, this needs to be reflected in the schedule.

Depending on the size of the survey and the extent of contract support required, the target date may be several months to more than a year in the future. A number of considerations must be taken into account when forming a preliminary schedule, and these must be resolved by the survey planning team. The following is a list of points to consider:

- Date when the information derived from the survey is required for input into planning or other processes—relates to the purpose and goals of the survey.
- Lead time—the time required to complete all the survey preparation, design, contracts and other details.
- Season—whether survey results are needed for peak, non-peak, or shoulder activity, which depends on the uses to be made of the data collected. Seasonal traffic patterns at the airport will be a major consideration. Surveying during the Thanksgiving weekend, Christmas, or other abnormal traffic periods is generally not a good idea, unless survey results are specifically required for those periods.
- Other surveys—whether other departments are planning to conduct routine or one-time surveys during the period under consideration. If possible, such dates should be avoided to reduce the "survey burden" on airport users and the potential for confusion.
- Weather—a consideration for surveys taking place at any outside location. Periods when very cold or very hot weather is likely should be avoided if possible.
- Availability of temporary staff—may or may not be an issue depending on how temporary staff will be obtained. Use of students as temporary staff will generally be easier during the summer break.
- Special events—dates of any known major events, such as large conferences or sporting events, should be avoided.
- Pre-tests and pilot tests—if planned for the survey, the time required for these must be factored into the schedule.
- Required duration of the survey period.
- Time to enter, clean, and analyze the data; document the findings; and prepare any required presentations.

Thorough discussion of each of these constraints will be needed to develop a realistic target date for the start of the survey. Setting a target date with very tight timelines is generally not advis-

able, especially if the survey is one of the first of this type to be done by this survey sponsor or at this airport. The risk of unanticipated events causing slippage in the schedule is very high. In fact, it may be wise to let the whole schedule slip a year, if necessary, to meet seasonality criteria, rather than put the survey results in jeopardy from an overly ambitious schedule.

With the target date set for the beginning of the survey, the survey planning team can work backwards and forwards from that date and set other key dates for the project. These dates will include, for example, the following events or milestones:

- Distribution of the RFP.
- Award dates for key contracts.
- Survey planning complete.
- Survey forms/questionnaire design complete.
- Acquisition schedule for materials, surveyor supplies, forms, etc.
- Printing of questionnaires, return envelopes, letters, etc., as required.
- Acquisition of survey equipment, if required.
- Preparation of training material.
- Selection of survey field staff.
- Badging and security clearances.
- Training time.
- Pre-tests and pilot tests complete.
- Start of data collection.
- Data collection complete.
- Data entry and cleaning complete.
- Analysis complete.
- Preparation of results complete.
- Presentation of results.

2.8 Survey Location and Security Clearance

The choice of location to perform a survey will depend on the information that the survey is designed to obtain and the practicalities of surveying the desired respondents. This issue primarily affects surveys of air passengers and associated greeters and well-wishers, because surveys of airport employees and other groups of airport users will generally not use the intercept method.

It has become fairly standard practice to perform passenger surveys in the airline gate lounges while passengers are waiting to board their flights. This location has the advantage that passengers are often sitting down with little to do except read a book or magazine. However, the increasing use of laptop computers and cell phones in recent years has meant that many people in the gate lounges may be working or talking on their cell phone. The choice of location is dealt with in detail in Chapter 4.

Performing surveys in the secure area of the passenger terminal involves an array of logistical issues related to obtaining security clearance and identification badges for the survey field staff. Survey staff may be issued temporary badges, but they may then need to be escorted by a permanently badged airport employee. For surveys conducted over a long period of time and in multiple locations, the escorting approach may not be practicable or cost effective. Instead, the survey field staff should be issued regular identification badges to allow access.

The exact procedure for badging will vary from airport to airport, but a typical process is that all persons who require a badge will complete an application form that is submitted by their employer to the airport badging office for approval. Applicants will then make an appointment

The issues that will need to be carefully addressed in badging survey staff include the following:

- Every member of the team will need to be badged if the surveying is to be done post-security, and even for surveys conducted pre-security, many airports require the survey team to be badged.
- Some highly competent field staff from private contractors will not pass the required screening and thus will be ineligible to be badged. Airports are also unlikely to allow these people to work elsewhere on their premises. The requirements for badging are extremely stringent, and they need to be carefully explained to any outside vendors.
- If a team member quits, it will take time to replace that person if the replacement needs to be badged. It is also reasonable to assume that field interviewers will quit, with the number being more or less inversely proportion to the rigor with which they are screened. It is also important to remember that the challenges of interviewing at an airport—a lot of walking, lengthy periods of standing, crowds, and noise—will overwhelm even some people who are among the best interviewers in other situations.
- Over-hiring is essential—the only question is by how much. Unfortunately, there is no simple formula to predict this; recommendations range so widely that only experience is the best guide. Absent experience, it is wise to allow plenty of extra time in the schedule for a first venture. Information in Sections 4.6.1 and 4.6.5 on selection of field staff will help in reducing staff turn-over.
- The protocol for issuing badges and the time required varies from airport to airport. It is important to identify the procedures that will need to be followed and allow for this in survey planning. Where contract personnel are to be used, it is essential that potential contractors are informed of the procedures and time required before they submit bids.
- The staff time and costs involved in badging contract personnel need to be included in the survey budget.

to be fingerprinted and photographed at the badging office. The fingerprints are then sent to the Federal Bureau of Investigation for a criminal background check. This process can take several weeks. If there is no record of any offenses that would disqualify them from being issued a badge, they then return to the airport badging office to pick up their badge. When the survey is over, the employer is responsible for ensuring that the badges are returned.

To facilitate this process, the airport should designate an authorized staff member to coordinate with the survey contractor and approve the badge applications for survey field staff. This person should also coordinate with the Transportation Security Administration staff at the airport to ensure that they are aware that the survey is being conducted and address any concerns or local requirements that they may have.

2.9 Contracting External Resources

2.9.1 Reasons for Using External Resources

All or part of the work of a survey project may need to be contracted out for a number of reasons, including the following:

- The lack of specialized expertise in survey design or implementation within the airport or sponsoring agency.
- Internal personnel may not have enough time to design and implement a survey project.
- The need for objectivity and a fresh viewpoint that a contractor can provide.
- The lack of an in-house team of trained and experienced survey interviewers.

The following subsections present key issues specific to the contracting of external resources for airport user surveys. They are not intended to be a guide on the entire contracting process.

2.9.2 Preparing the Request for Proposals

A competitive procurement process is normally followed to select a contractor. Even if the airport or sponsoring agency has the authority to select a contractor without competitive bidding, it is important to document the requirements for the contractor. A potential contractor should not be expected to make assumptions about any significant factors. The RFP should include the following terms of reference:

- Background information leading to the need for the survey.
- Results of previous similar studies, if applicable.

- The purpose of the survey, definition of the population to be surveyed, and the specific information to be collected.
- The nature of the services to be provided (e.g., survey design only, survey design and implementation with contractor's interviewers and supervision, survey design and supervision of interviewers employed by the airport, data analysis, and report preparation).
- Any decisions that have been made regarding the survey methodology, survey frequency, desired accuracy, sampling strategy, and questionnaire content.
- Any assumptions that have been made.
- The nature and scope of the analysis and reports required.
- Materials and services to be provided by the sponsor and by the contractor, particularly during implementation of the survey, such as security clearances; trained interviewers, employees, or volunteers; and parking passes.
- Relationship to other information, such as ancillary data that the sponsor will be collecting or data obtained in previous surveys.
- Any requirements to be consistent with other surveys (to ensure that results are comparable over time or with surveys in other areas).
- Expected schedule for reviews, approvals and deliverables.
- Required qualifications of the contractor.
- The evaluation criteria.
- An indication of the available budget.

Not every item on this list will necessarily apply in every case, but any exclusion from the RFP should be the result of a conscious decision.

2.9.3 Proposal Evaluation and Contractor Selection

Criteria for evaluating the proposals should be prepared and included in the RFP. Suggested evaluation criteria include the following:

- Demonstrated understanding of the survey requirements and issues that should be addressed.
- A realistic approach that addresses the purpose of the survey and information to be collected and analyzed. This approach should be "creative" when the approach is not specified in the RFP or when the bidder feels strongly that the sponsor's approach is not suitable.
- Demonstration that the proposed sampling plan, if not specified by the sponsor, will be statistically valid.
- Qualifications of the firm and any subcontractors, as demonstrated by previous similar projects, including client references.
- Qualifications and experience of the proposed professionals who will actually work on the survey, as demonstrated by participation in previous similar projects, and assurances of their availability.
- For survey field staff—qualifications of staff, including background of interviewers and supervisors, experience of interviewers and supervisors in conducting airport surveys, language skills, previous security clearances, and experience with electronic data collection devices if applicable; general training and planned training specific to the survey in question; and strategies used to retain staff and to replace interviewers that leave.
- Realistic work plan, including adequate quality control and reporting to the sponsor.
- Type and amount of resources for each task or phase of the project.
- Price (as part of the proposal or negotiated) that represents value for the services being provided and the experience of the firm. (It is advisable to avoid automatically awarding the contract to the lowest-priced bid, unless this is a requirement of the contracting process.)

2.9.4 Contract Management

Selecting the right contractor is important but may only be half the battle; it will also be important for the survey project manager to effectively manage the contract and maintain open communications with the contractor to ensure that issues are identified and resolved before they have a major impact on the survey, that the contractor is adhering to the schedule, and that the quality of the work is acceptable. The survey project manager will need to ensure sufficient time for contract management.

2.10 Summary

This chapter has provided guidance on key factors in planning a survey. A well-defined plan must consider why the survey is being conducted and then determine how and where the survey will be conducted. Security restrictions must be considered. Budget considerations will likely have a major impact on the survey design, and financial approvals should be sought early in the planning process. The use of external agencies should be considered as a funding source and to avoid duplication of efforts between agencies. It may also be necessary to contract out all or part of the survey project if internal resources are not available or an independent view is required.

Chapter 3 explains the concepts of sampling and statistical accuracy, and Chapter 4 sets out the detailed design work of the survey planning team.

CHAPTER 3

Statistical Concepts

An understanding of the underlying concepts of sampling and statistical accuracy is fundamental to an understanding of such issues as the size of the sample to be used and the accuracy of the resulting findings. This chapter is primarily intended for readers who are not familiar with these concepts or those who are interested in a review of the basic statistical principles.

Overview of Basic Concepts

Distribution	In any set of data, each item in the dataset has a particular value. The **distribution** of the data in the dataset refers to the proportion of the items that take each of the possible values in the dataset. With **discrete** data (e.g., the number of people in a travel party), each possible value (1, 2, 3, etc.) will occur for some proportion of the total number of items in the dataset. For **continuous** data (e.g., the time taken to drive to the airport), there are effectively an unlimited (or at least very large) number of possible values. Therefore, the distribution is defined in terms of a functional relationship, typically plotted as a graph or expressed as an equation. The relationship can be used to determine the proportion of values within a given range.
Average	The **average** value of a set of data (also referred to as the **mean** of the distribution) is defined as the sum of the values of each item in the dataset divided by the number of items. This corresponds to the common usage of the term "average." Usual usage is to refer to the ***average*** of a set of data and the ***mean*** of a distribution, although the concepts are identical.
Variance	The **variance** of a dataset or a distribution measures the spread of the values about the average or mean value. It can be thought of as the average of the squared difference between each value and the mean of the distribution. The differences are squared so that larger differences have greater importance than smaller differences and negative and positive differences do not offset each other.
Standard Deviation	The standard deviation of a dataset or distribution is defined as the square root of the variance. This expresses the spread of the values around the average or mean of the dataset or distribution in the same units as the data.

More details can be found in textbooks on general statistics, such as those listed at the end of this guidebook.

3.1 Concepts of Census and Sample Surveys

In general, a survey will collect information from a sample of individuals from the target population (see Section 1.3 for a discussion of survey terminology). In some cases, it may be appropriate to survey the entire population, in which case the survey is termed a census survey.

A **census survey** is generally appropriate for collecting information on small populations when a very high level of accuracy is required and when there are no significant constraints due to budget, survey resources, or the time period when individuals are available to be surveyed. A census survey might be appropriate, for example, for a survey of tenants at the airport, but not for a survey of air passengers.

For a **sample survey,** a sample of respondents is selected from the target population in such a way that the characteristics of the population can be inferred from the corresponding characteristics of the sample. The way this is done and the implications for the accuracy of the resulting estimates of the characteristics of the population are discussed in more detail below.

3.2 Statistical Accuracy and Confidence Intervals

The characteristics of interest of the population being surveyed, such as the mode of travel to the airport, will vary across the members of the population. Aggregate measures of the population, such as the proportion of air passengers accessing the airport by taxi, can be estimated from the corresponding values for the sample.

However, when drawing a sample from a population, the distribution of the characteristics of interest across the members of the sample will generally be different from the corresponding distribution across the population, and thus measures of this distribution, such as the average value, will also be different. This difference between the sample average and population mean is referred to as the error of the estimate.

With very small samples relative to the size of the population, it is unlikely that the distribution of the characteristics across the sample will correspond exactly to the distribution across the population as a whole, since the opportunity for the sample to include the full range of values that exist in the population is limited by the small sample size. As the size of the sample increases, it becomes more likely that the distribution of any given characteristic will correspond to that of the population.

The degree to which the distribution of a given characteristic in a sample of a given size corresponds to the distribution of the characteristic in the population as a whole depends on how variable the characteristic is in the population. In statistical terminology, this variability is termed the **variance** of the characteristic. In the extreme case in which every member of the population has the same value for a given characteristic, a sample of only one respondent would provide a completely accurate estimate of that value. At the other extreme, if every member of the population has a different value for a given characteristic, a sample of the entire population (a 100% sample) would be required in order to include every possible value of the characteristic occurring in the population.

If a sample of a given size is drawn randomly from a population multiple times, a slightly different distribution would be expected of any given characteristic in each sample, except in the special case where every member of the population had the same value of the characteristic. The greater the variance of the characteristic in the population, the more variation there would be in the distribution of the characteristic across the different samples. Therefore, the average

value of a given characteristic in a sample of a given size, although it is a specific value for any particular sample, will vary across the different samples. This results in the following fundamental point:

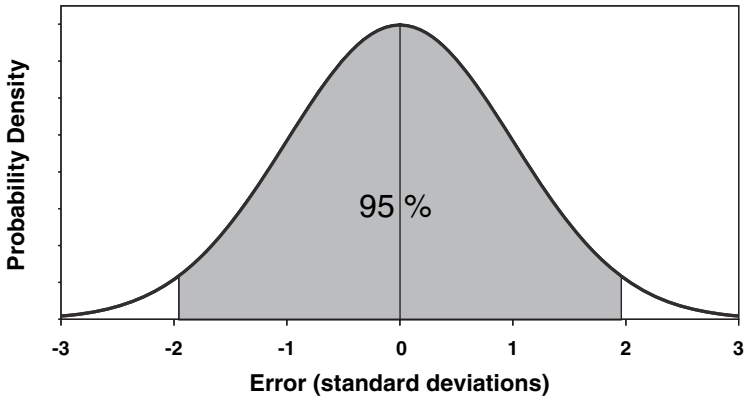
> The average value of any given characteristic in a sample drawn randomly from a given population has an expected variance that depends on the variance of the characteristic in the population, as well as the size of the sample relative to the size of the population.

Because of this variance, there will be an expected error between the average value of a particular characteristic given by a single sample and the true average (or mean) value of the characteristic in the population. Because the value of the population mean is not known (the survey is being performed to estimate this), the actual error is not known. However, the expected distribution of the error can be determined from statistical principles and an estimate made of the likely range of the error.[2]

The standard deviation of the estimated average value of any particular characteristic determined from a sample is termed the standard error of the estimate (SEE) and is a measure of the accuracy of an estimate.

For large enough samples, the error will approximate a Normal distribution with an expected (mean) error of zero, as illustrated in Figure 3-1.[3] This exhibit shows the probability of a sample giving an error of any particular size, measured in terms of the number of standard deviations from the mean value, with the area under the curve between any two values representing the probability of the actual value lying in that range of values. As the range gets larger, measured in terms of the number of standard deviations from the mean, so the probability of the actual value lying in the range approaches 100%. The greater that the variance of the sample estimate of the mean is (i.e., the larger the standard deviation of the sample estimate), the fewer standard deviations from the mean an error of any particular value will be.

Figure 3-1 also illustrates an important related aspect of sample error. As the standard deviation of the sample estimate of the mean increases, so the ***range of values*** covered by any given number of standard deviations also increases. Because an error of any particular absolute value



Note: Probability of error being between two values is given by the area under the probability density curve between those values.

Figure 3-1. Example of the probability distribution of the expected error.

[2] The theory underlying this statement can be found in any statistics textbook.

[3] Under the Central Limit Theorem, the probability distribution of the sample average will approach the Normal distribution as the sample size approaches infinity.

Expressing the Accuracy of Variables Expressed as a Percentage

For categorical variables, results are often expressed as a percentage of the sample, for example, the percentage of air passengers who use transit to access the airport. In such cases, expressing the accuracy of the estimate of the proportion of the sample in a given subgroup as a percentage can have two different meanings:

- A percentage of the sample size (e.g., ±5% of the sample), or
- A percentage of the subgroup mean (e.g., ±5% of the proportion in the subgroup).

The first meaning is often referred to as "percentage points" to distinguish it from the latter.

The two are very different. For example, if it is estimated that 10% of passengers take transit, then an accuracy of ±5 percentage points at the 95% confidence level corresponds to the interval from 5% to 15%. This range corresponds to plus or minus 50% of the proportion of transit passengers in the survey (i.e., 5/10 = 50%). However, an accuracy of ±5% of the estimated proportion of passengers taking transit corresponds to the interval from 9.5% to 10.5%, equivalent to an accuracy of ±0.5 percentage points.

To avoid confusion, care must be taken when expressing the accuracy of variables expressed as a percentage. When interpreting such values, care must be taken to be clear whether the accuracy is a percentage of the entire sample or of the subgroup in question. It may be helpful to make a distinction between percentage and percentage points in discussing accuracy. Failure to be clear in this distinction when reporting survey results can result in a situation where the reader cannot determine which way to interpret the stated accuracy.

(in the units of the variable) will be ***fewer*** standard deviations from the mean, this ***reduces*** the probability of getting an error ***no greater*** than that value, and hence ***increases*** the corresponding probability of getting an error ***greater*** than that particular value. Thus as the variance (and hence the standard deviation) of the sample estimate increases, so the probability of getting an error greater than any particular value also increases.

This leads to the second fundamental aspect of sampling accuracy:

> Although the actual error of a sample estimate of the mean value of any characteristic of the population is unknown, the probability of this error being less than any given value can be estimated.

This second aspect has the important implication that any estimate of the expected error has two attributes: the **magnitude** of the error being considered and the probability that the actual error is less than this value (referred to as the **confidence level**). Because the error distribution is symmetrical, as shown in Figure 3-1, it is common to express the expected error range, sometimes termed the margin of error, as plus or minus a specified amount (for a continuous variable) or number of percentage points[4] (for a categorical variable, where the value is one of a defined list of values). For example, the results of an opinion poll might be reported as being accurate to within plus or minus 3% with 95% confidence. In this case, the probability of the estimate being within a margin of error of plus or minus 3 percentage points is 0.95, or 95%, and the results could also be described as having a 95% confidence interval of plus or minus 3%, where the term **confidence interval** refers to the margin of error for a specified confidence level.

As shown in Figure 3-1, as the confidence level increases (i.e., there is a greater probability that the actual error lies within the interval being considered), the size of the associated error range also increases. For a given confidence level, the size of the corresponding error range depends only on the variance (and hence the standard deviation) of the expected error. As illustrated by Figure 3-1, a given confidence interval spans a fixed number of standard deviations either side of the mean. For a 95% confidence interval, this range is plus or minus about 2 (strictly 1.96) standard deviations. For a 90% confidence interval, this range is plus or minus about 1.65 (strictly 1.645) standard deviations. Thus if the variance of the estimated mean of some characteristic in a given sample is 0.0004 (i.e., the standard deviation is 0.02 or 2%), for a confidence interval of 95%, the margin of error would be plus or minus 4% (2 times the standard deviation). For a confidence interval of only 90%, the margin of error would be plus or minus 3.3% (1.65 times the standard deviation).

[4] The term "percentage points" is used to refer to the absolute change in a variable that is expressed as a percentage. For example, a range of 50% ± 5 percentage points is equivalent to the range 45% to 55%.

In practice, in addition to the sample size and variation in the attributes being estimated, the accuracy of the estimated population attributes also depends on the sampling method, the level of non-response, and the characteristics of the non-respondents. Unfortunately, the characteristics of the non-respondents are generally unknown and must be estimated in some way. In the absence of any information about the characteristics of the non-respondents (the usual case), they are generally assumed to be the same as the characteristics of the respondents.

The appropriate level of confidence to be used in expressing the margin of error in the results of a sample depends on the costs associated with making an error. The higher the costs of an error, the greater the confidence that is required that the true value is within the confidence interval. The width of the confidence interval can be reduced by increasing the sample size or, possibly, improving the sample design. Generally 95% confidence intervals are used for most purposes, but 99% confidence intervals may be used for some critical variables, while in other cases 90% confidence intervals may be adequate.

Accuracy is discussed further in Section 3.4. Information on the calculation of the SEE using the different sampling methods is provided in Appendix B.

3.3 Sampling Methods

For a **sample survey,** the sample of respondents should be selected from the population in such a way that the probability of any individual respondent being selected can be estimated. This method allows generalizations to be made about the entire population from the characteristics of the sample and estimates to be made of the likely accuracy of the estimated characteristics of the population based on the size of the sample. The most straightforward approach to obtaining a representative sample from a population is to select the members of the sample randomly from among the members of the population. However, in practice this is often difficult to achieve, particularly in an airport environment. Furthermore, it has the disadvantage that the sample will include relatively few members of particular subgroups of the population that compose only a small proportion of the total population. To address these concerns, other common sampling methods may be used. These methods are summarized in Table 3-1 and discussed in more detail in the following subsections.

The choice of the appropriate sampling method is partly a question of how best to achieve the desired accuracy of the survey results and partly a consequence of the practicalities of performing the survey. For example, it is common to perform air passenger surveys in departure lounges, because passengers are more willing to be interviewed or fill out a survey form when they are no longer anxious about whether they will make their flight and they are sitting down. However, this locale constrains the sample to those passengers on a set of flights, and does not provide a truly random sample of all passengers using the airport. On the other hand, a mail-back survey sent to the home address of airport employees can sample employees randomly from a list of all employees at the airport.

The sampling method selected will depend on the type of survey, data collection method, and characteristics of the population. Random and sequential sampling are the simplest methods to implement but require large sample sizes to obtain an adequate number of responses from small subgroups of the population, while stratified and cluster sampling can be used, with a limited budget, to improve the accuracy of survey results for different subgroups. Often multi-stage sampling is appropriate. For example, cluster sampling may be used with flights selected using stratified sampling, and passengers on those flights are selected using sequential sampling.

A *controlled sample* attempts to design the sampling approach so that the composition of the sample corresponds to the underlying distribution of the population characteristics. This

Table 3-1. Summary of sampling methods.

Type	Method	Comment
Random	Respondents are selected randomly from the target population.	Often difficult to do in airport environment. Need to use some randomizing technique (e.g., use of random number tables). Selection by interviewers can lead to biases if not well trained.
Sequential (Systematic)	Every *n*th individual is selected when potential respondents are arranged in some order. First respondent should be selected randomly from among the first *n* individuals.	Good practical technique for airport surveys. Sample characteristics will be equivalent to a random sample if the order of potential respondents is not related to the variables of interest.
Stratified	Respondents are grouped into homogeneous groups (e.g., different categories of employee). Sampling occurs within each group separately.	Used to obtain a more representative sample of different groups, particularly if the groups vary in size, or to obtain a specific accuracy in estimates for each group.
Cluster	Respondents are sampled from naturally occurring groups (e.g., flights). A sample of flights are selected, then all or a sample of passengers on those flights are selected.	Suitable for large surveys where a wide range of flights can be sampled. Can use stratified sampling of flights to obtain a more representative sample.
Non-probability	Respondents are selected on the basis of some criterion that does not allow the probability of sampling any given member of the population to be determined.	May be useful for gathering information on the range of possible responses, where the frequency with which those responses occur in a defined population is not required.

objective is generally satisfied with a truly random sample, provided the sample size is large enough. In practice achieving a truly random sample with airport user surveys is often difficult, as discussed in Section 3.3.1. In the case of other sampling methods, it is necessary to adjust the sampling rate or define the strata or clusters so that, where the characteristics of the population vary across different subgroups or time periods, those subgroups or time periods are represented in the sample in proportion to their occurrence in the population.

A controlled sample is thus an attribute of a particular sample design rather than a different type of sampling method. If the sample is not controlled so that its composition reflects the underlying distribution of the population characteristics, then the survey results need to be weighted to properly reflect the characteristics of the population. A cluster sample in which sampled flights are chosen to reflect the proportions of flights in markets that are believed to have different passenger characteristics (e.g., international, domestic short-haul, domestic long-haul, etc.) and passengers are sampled for each flight in proportion to the passengers on the flight would represent a controlled sample. Thus a self-completed air passenger survey in which flights are selected in proportion to the number of flights in broadly defined markets and survey forms are given to every adult passenger on those sampled flights would qualify as a controlled sample.

Because variation in the characteristics of the population over time or across different subgroups will not in general be known until the survey results are obtained, designing a controlled sample means making assumptions about subsets of the population with different characteristics and ensuring that each subset is sampled in proportion to its occurrence in the population. If it turns out that two subsets of the population that were expected to have different characteristics in fact have similar characteristics, the results for the two subsets can be combined. However, if two subsets that in fact have different characteristics are assumed to be similar and are not sampled in proportion to their occurrence in the population, the results will be biased. Weighting of the subgroups will be required to remove this bias.

Analysis of the results of previous surveys at the airport in question or of surveys conducted at other airports with similar traffic patterns can help identify subsets of the population that are likely to have different characteristics. The design of the controlled sample then attempts to ensure that those subsets are sampled in proportion to their occurrence in the population.

3.3.1 Random Sampling

With random sampling, each individual must have an equal (or at least known) chance of being selected. An example of random sampling would be a tenant survey where a list of all airport tenants is assembled and a table of random numbers is used to select individual tenants from the list. The sampling approach will generally ensure that no individual can be in the sample more than once. For air passenger surveys, the sample size is typically so small relative to the population and the methodology is such that there is very little likelihood of surveying the same person twice.[5] For most other airport user surveys, the methodology precludes sampling the same respondent twice.

Obtaining a truly random sample is often difficult, particularly for airport surveys. For example, identifying each member of the population to include in the sampling process, then applying a method for randomly selecting them can be difficult, if not impossible, in an airport departure lounge. There are also problems associated with having surveyors select passengers to survey; this introduces a human element and invariably leads to biases. To avoid this, random numbers or sequential sampling, discussed in the following subsection, should be used for selecting individuals to survey.

Interviews at groundside locations such as curb areas and parking lots, where the next available passenger is surveyed once an interview has been completed, are equivalent to random sample surveys as long as the ratio of interviews to passengers is fairly constant. However, such an approach will clearly change the sampling rate as the passenger flow changes. During periods of very low flow, every passenger might be interviewed, while during periods of high flow only a small proportion of passengers would be interviewed, and this should be taken into account in analyzing the results.

3.3.2 Sequential Sampling

Sequential sampling is generally a good form of sampling for use in airport surveys. With sequential sampling, also referred to as systematic sampling, the population is arranged in some logical order and every *n*th individual is selected, starting with a randomly selected individual from the first *n* individuals. An example of sequential sampling is to survey every fourth passenger in a check-in queue. Sequential sampling is usually easier to apply than random sampling and will yield a random sample if the order of individuals in the list is essentially random with respect to the characteristics being measured in the survey.[6] For example, there is no reason to think that the order in which people sit in a departure lounge has any systematic relationship to the characteristics being measured (such as their trip purpose or how they got to the airport), and therefore selecting every *n*th person is in effect a random sample. Of course, depending on the layout of the lounge, early arriving passengers or those with difficulty walking may sit closer to the boarding point, while later arriving passengers may have to use seats further away. However, as long as all passengers in the lounge are included in the sampling strategy, where they sit will not affect their chance of being sampled.

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[5] If an individual gets surveyed twice on two different trips, that is not the same thing as surveying the same traveler twice on the same trip. The former should be valid as the sample being drawn is really of passenger trips, not of passengers, and a single passenger may make more than one trip during the survey period.

[6] Serious biases can occur if a characteristic of interest occurs in a cyclic order in the population list and the length of each cycle corresponds to the sampling fraction, but this phenomenon would be rare in airport surveys.

Where the population list is ordered by a relevant characteristic, the use of sequential sampling will often result in a sample with a more representative range of characteristics than using random sampling. For example, in selecting flights to survey, if all flights during the survey period are listed in order of flight stage length, the resulting sample would likely better reflect passenger characteristics such as destination city or region than a random sample, as sequential sampling ensures a more even spread of flights by stage length and thus over destinations and regions. With random sampling, some subgroups of the population (flights with a particular stage length in the above example) may be missed completely and others may be over-sampled.

One common application of sequential sampling in air passenger surveys is to list flights by departure time (and destination to resolve flights with the same departure time) and select every *n*th flight to survey. A variation on this approach is to list the number of seats on each flight and calculate the cumulative total number of seats for each flight (the total number of seats on previous flights on the list plus the number on the current flight). Flights are then selected by identifying the flight that corresponds to every *m*th seat on the cumulative list. This ensures that the probability of a given flight being sampled is proportional to the size of the aircraft, which approximates a random sample of air passengers if the same number of passengers is interviewed for each flight.[7]

3.3.3 Stratified Sampling

In stratified sampling, the population is divided into mutually exclusive groups (strata) and individuals within each group are randomly sampled. Groups should be selected so that they are homogeneous with respect to the variables being studied (there is low variation within the groups), but so that the variation in the relevant variables is large between groups. For example, in a survey to determine passenger spending at airport concessions, passengers taking short-haul domestic flights are likely to spend much less than passengers taking long-haul international flights. The variation in spending among short-haul domestic passengers and among long-haul international passengers is likely to be less than the variation in spending between the two groups. If the criterion for stratification is highly correlated to the variable being studied, such as in this example, the gain in accuracy can be significant. Examples of stratified sampling include dividing flights into groups—such as international and domestic short and long haul, or by region—and dividing passengers to be sampled into groups based on day of the week, time period during the day, and airport terminal used.

The variable used for stratifying the population must be known for all individuals in the population. Once the survey population has been stratified into groups, simple random or sequential sampling is used to select individuals from each group.

With proportional stratified sampling, the proportions of individuals surveyed in each group are equal. This form of sampling is often used to assure a more representative sample than simple random or sequential sampling.

In non-proportional stratified sampling, different sampling fractions are used to improve the accuracy of estimates for a given overall sample size. Situations where non-proportional sampling is desirable include the following:

- Where the variation in the variables being studied differs greatly between groups. The non-homogeneous groups (with a high variation in the variables of interest) should have a larger sample than the homogeneous groups. For example, consider a survey conducted to determine the average number of check-in bags per passenger where a stratified sample is to be drawn with flights grouped into long- and short-haul domestic and international flights. If it is known that

[7] This method assumes that the load factor (the ratio of passengers to seats) does not vary significantly across flights. Where this is not the case, and some classes of flight have a higher average load factor than others, an adjustment to the number of passengers interviewed on each flight may be required to approximate a random sample.

the variation in the number of check-in bags is greater for passengers on long-haul international flights than short-haul domestic flights, the sampling fraction would be higher for the long-haul international flights.
- Where comparisons of distinct subgroups of the population are required, for example comparisons between domestic and international passengers.
- Where the cost of collecting the data differs greatly between groups. Here, overall accuracy for a given cost can be improved by having a lower sampling fraction for the groups with high data collection costs. However, while this may lead to a higher overall accuracy for the pooled data, when the characteristics of subgroups need to be considered, as is almost always the case in airport surveys, it can lead to very different accuracy for the various subgroups. Thus the approach of reducing the sampling fraction for groups with higher data collection costs is not generally recommended for airport surveys.

Expanding the sample results of non-proportional stratified sampling to determine estimates for the population is not as straightforward as with proportional stratified sampling, and is discussed in Appendix B. If non-proportional stratified sampling is appropriate, it is suggested that the planning team either become knowledgeable on the subject (refer to the Bibliography for appropriate guidance) or consider using external expertise.

3.3.4 Cluster Sampling

With cluster sampling, the population is distributed in a large number of naturally occurring groups, for example passengers on flights. The groups, or clusters, are sampled, thus not all clusters are included in the sample. This is the primary difference from stratified sampling where individuals are sampled from every group. In the simplest form, all individuals within a cluster are sampled. When clusters are homogeneous, it is more efficient to sample only a fraction of the individuals within a cluster, and to sample more clusters. Cluster sampling is used to make sampling easier and less costly by limiting the survey to well-defined groups, such as passengers on specific flights, and works well when the characteristics of interest have low variability between clusters and high variability within clusters. For example, although the household income of passengers on a given flight will span a wide range, the average household income of passengers on different flights will show much less variability.

The accuracy of estimates made using cluster sampling will almost always be lower than if a random sample is used with the same sample size, because the selected clusters may not be fully representative of the target population as a whole, and can be significantly lower if variability between clusters is high and/or a small number of clusters are selected. It is important that the consequences of the design of the cluster sample (often referred to as the design effect) are incorporated into the analysis when evaluating the accuracy of estimates and required sample sizes. Details of how to calculate sample sizes and confidence intervals for cluster samples are included in Appendix B.

A common example of cluster sampling in airport surveys is the use of individual flights as clusters, with the flights to be surveyed being selected using random, sequential or stratified sampling. Then either all passengers on each selected flight or a sample of passengers on those flights are surveyed.

3.3.5 Non-Probability Sampling

Non-probability (or uncontrolled) sampling is where the probability of an individual's selection cannot be determined. Examples of non-probability sampling include the following:

- Surveys of passengers who ask for help at an airport information booth, where no record is kept of the number of passengers seeking help at the booth.
- Voluntary Web-based surveys where all visitors to the site are invited to complete a survey.

With non-probability sampling, it is not possible to calculate the sample size required to achieve a given level of accuracy or to make generalizations about the population. These types of surveys are usually of limited value in ascertaining properties of the population but can be useful for obtaining ideas and user feedback.

3.4 Sample Size

A critical issue in planning any survey is determining the appropriate sample size, which is influenced by such considerations as the following:

- Survey purpose.
- Analysis of subgroups of interest.
- Required precision of the survey results.
- Credibility of results among decision makers and data users.
- Available resources (including budget, personnel, and equipment).

The survey purpose influences the required sample size in three ways: (1) by determining the key characteristics of the air travel party and the precision to which they need to be known, (2) by establishing the level of disaggregation to which the results need to be expressed, and (3) by identifying the value to be gained from improved precision. For any desired degree of precision in the survey results, the need to consider subgroups of interest—such as air passengers with ground origins in a particular area or visitors on business trips—will increase the required sample size of the overall survey in order to ensure a large enough number of respondents in the subgroup(s) of interest.

The required precision and the credibility of results influence the size of confidence interval and the acceptable margin of error. Larger samples are required to reduce the margin of error and/or increase the confidence level for a given margin of error.

Although the target sample size for a survey should ideally be determined by the purpose and objectives of the survey and the uses to which the results will be put, in reality the financial resources available to fund the survey often constrain the sample size, particularly where budgets have been established before the detailed planning of the survey has begun. Time constraints can also influence the sample size if information is required on short notice.

Other factors affecting the required sample size include the following:

- The proportion of the population with the attributes being measured. An airport seeking passengers' opinions of the retail concessions, for example, must design a survey that takes into account the fact that only a small proportion of passengers will have actually visited the retail concessions. The passengers visiting the retail concessions are a subgroup of all passengers, and so the required sample size is found in a similar way to that described previously for a subgroup.
- The variability of attributes being measured. If the variability is high, a larger sample size will be required.
- The sample design used. For example, a good stratified sample can permit a smaller sample size than a random sample for a given level of accuracy, while cluster sampling will usually necessitate a larger sample size (as discussed in Sections 3.3.3 and 3.3.4).

In the following discussion, sample size refers to the number of completed responses; the number of people approached to participate in the survey may be significantly higher depending on the rates of refusal and incomplete responses. These refusals and incomplete responses will generally take some time to survey and process, which could be significant in some surveys

(e.g., where follow-up phone calls are made) and should be allowed for in determining resource requirements. To estimate the total number of individuals to approach, divide the desired sample size of completed surveys by an estimate of the completed survey response rate, expressed as a proportion. For example, if a sample size of 1,000 is required and the response rate is 70%, then 1,429 [= 1,000/0.7] individuals would need to be approached.

3.4.1 Sample Size with Random Sampling

Calculation of the sample size required to obtain a specified accuracy differs depending on whether the required accuracy is for a question with categorical or numerical responses (question types are discussed in Section 4.3.2).[8] With a categorical response, the respondent must choose from a limited number of defined responses. For example, for a question on mode of travel to the airport, categories could be private vehicle, rented vehicle, taxi/limousine, train, bus, airplane, or walk/bicycle. Determination of the sample size for each type of question using random sampling is considered in the following paragraphs.

Categorical Response Questions

When using categorical response questions and random sampling, the sample size required to give a specified level of accuracy is a function of the population size and the proportion of the population in the category of interest (e.g., proportion using a private vehicle as their mode of travel to the airport). This proportion is unknown and should be estimated in the survey planning stage from experience, previous surveys, or values from other airports. The largest sample size required occurs when half of the population has the characteristic of interest. Table 3-2 provides approximate 95% confidence intervals for a range of population and sample sizes and two values of the proportion of the population in the category of interest (50% and 20%).[9] The largest sample size is required for a proportion of 50%. Thus, for surveys with many questions with a range of mean proportions, it is appropriate to use the sample size based on the 50% proportion as this will provide at least the required accuracy for all cases. Table 3-3 gives the required sample size using random sampling, based on the 50% proportion, for various confidence intervals and a range of population sizes. Alternatively, the sample size for an accuracy of $\pm a$ percentage points[10] can be calculated for a 95% confidence level using the following expression:[11]

$$n = \frac{1.96^2 p(1-p)}{(a/100)^2 + 1.96^2 p(1-p)/N}$$

where n is the sample size,
N is the population size,
a is the width of the confidence, and
p is the estimated proportion of the population in the category of interest.

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[8] With a categorical response, the variance can be expressed in terms of the proportion of the population in the category of interest. Thus an initial estimate of this proportion, rather than the variance, is required.

[9] For proportions (p) greater than 0.5, the required sample size is the same as for the proportion $1 - p$. For example, for a proportion $p = 0.75$, the required sample size is the same as for $p = 0.25$.

[10] If accuracy is expressed as a percentage of the mean, say b%, then the percentage points, $a = b \bullet$ mean. For example, a confidence interval width of ±25% of the mean with a mean of 40% corresponds to a confidence interval width of $a = 25 \bullet 0.4 =$ 10 percentage points.

[11] For other confidence levels, replace 1.96 with the appropriate value from the standard Normal distribution for the confidence level required.

Table 3-2. Approximate 95% confidence intervals for a categorical variable for a range of population and sample sizes.

Population Size	Sample Size	Proportion of Population in Category	95% Confidence Interval for Proportion of Population in Category		
			Range Mean ±*a* Percentage Points, where *a* =	Lower Limit	Upper Limit
100	80	50%	4.9 pts	45%	55%
		20%	3.9 pts	16%	24%
	60	50%	8.0 pts	42%	58%
		20%	6.4 pts	14%	26%
	40	50%	12.0 pts	38%	62%
		20%	9.6 pts	10%	30%
50,000 or higher	1,000	50%	3.1 pts	47%	53%
		20%	2.5 pts	18%	22%
	400	50%	4.9 pts	45%	55%
		20%	3.9 pts	16%	24%
	100	50%	9.8 pts	40%	60%
		20%	7.8 pts	12%	28%

Note: SEE estimated using binomial distribution and sampling without replacement, Normal approximation used to determine confidence intervals. For further information, refer to statistical textbooks listed at the end of this guidebook.

For large populations of over 50,000, the required sample size for a 95% confidence level is given approximately by:

$$n = \frac{40{,}000\,p\,(1-p)}{a^2}$$

Thus if the proportion of some characteristic of the population is 5% ($p = 0.05$), say, and the desired accuracy of the estimate of this proportion is ±1 percentage point at a 95% confidence level, the required sample size to achieve this accuracy is 1,900. It should be noted that an error of 1 percentage point on an estimated proportion of only 5% is an error of ±20% of the estimated proportion. If it is desired to reduce this error to only 5% of the estimated proportion (±0.25 percentage points), the required sample size would increase to about 30,000.

Table 3-3. Required sample size using random sampling for various sized confidence intervals and a range of population sizes.*

Population Size	Sample Size for 95% Confidence Interval: Sample Mean ±*a* Percentage Points, where *a* =									
	1 pt	2 pts	3 pts	4 pts	5 pts	6 pts	7 pts	8 pts	9 pts	10 pts
100	99	96	91	86	79	73	66	60	54	49
200	196	185	168	150	132	114	99	86	74	65
500	475	414	340	273	217	174	141	115	96	81
1,000	906	706	516	375	278	211	164	130	106	88
2,000	1,655	1,091	696	462	322	235	179	140	112	92
5,000	3,288	1,622	879	536	357	253	189	146	116	94
10,000	4,899	1,936	964	566	370	260	192	148	117	95
20,000	6,488	2,144	1,013	583	377	263	194	149	118	96
50,000	8,057	2,291	1,045	593	381	265	195	150	118	96
100,000	8,762	2,345	1,056	597	383	266	196	150	118	96
200,000	9,164	2,373	1,061	598	383	266	196	150	118	96
500,000	9,423	2,390	1,065	600	384	267	196	150	119	96

* Sample sizes where proportion of population in the category of interest is 50%.

If a subgroup composes S percent of the population and the estimate of the proportion of some characteristic of the subgroup is required to the same accuracy as the estimate of the proportion for the population as a whole, the sample will need to be larger by a factor of 100/S. Thus, to achieve the same accuracy for a subgroup that composes 20% of the population, the sample would need to be five times larger (100/20 = 5). If this level of accuracy is required for multiple subgroups, the required total sample size is given by the largest of the estimated total sample sizes calculated using the factor for each subgroup (100/S_i where S_i is the percentage of the population in subgroup i). For very small populations such as with airport tenant surveys, a high proportion of the population must be sampled to obtain estimates within 0.05 (i.e., 5 percentage points) of the proportion for the total population, but actual numbers of surveys required are small. For example, a sample size of 79 is required from a population of 100 to achieve an accuracy of 5 percentage points. For large populations, a sample size approaching 400 is required to achieve a similar level of accuracy using random sampling.

Numerical Response Questions

For questions with a numerical response, such as the number of travelers in a group, expenditures at the concessions, or time spent at the airport, the sample size required for a specified level of accuracy is dependent on the variability (as measured by the standard deviation) in the numerical response. With random sampling, the population mean and standard deviation are estimated by the average and standard deviation (weighted if appropriate) of the responses in the sample. The required sample size for an accuracy of $\pm w$ can be calculated for a 95% confidence level using the following expression:[12]

$$n = 1.96^2 s^2 / w^2$$

where s is the standard deviation of the responses in the sample.

The SEE can be found approximately by dividing the standard deviation of the sample values by the square root of the sample size of completed responses.[13] The standard deviation of the variable of interest is unknown during the survey planning stage and an initial estimate is required to calculate the required sample size. This initial estimate could be obtained from previous surveys at the airport or from other airports, or estimated from knowledge of the typical range in values.

Examples of the mean, standard deviation, SEE and accuracy of estimate (95% confidence interval), and required sample sizes for accuracy to within 10% of the mean for selected air passenger characteristics from some airport surveys are given in Table 3-4.

As can be seen by these examples, the accuracy and required sample sizes vary greatly depending on the variable of interest. Expenditures at the airport vary greatly as many people do not spend any money and some spend a lot. Thus large sample sizes are required to produce estimates to within 10% of their expected value. In contrast, variability in the time passengers spend at the airport is much less, and small samples would give a similar accuracy (in percentage terms).

3.4.2 Sample Sizes with Stratified and Cluster Sampling

The methods for determining the sample sizes with stratified and cluster sampling are more complex and are outlined in the following paragraphs with details provided in Appendix B.

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[12] For other confidence levels, replace 1.96 with the appropriate z-value from the standard Normal distribution for the confidence level required. For small population sizes, use the expression: $n = 1.96^2 s^2/[w^2 + 1.96^2 s^2/N]$ where N is the population size.

[13] A more accurate estimate is given by dividing by the square root of the sample size less one. This can become important for small samples.

Table 3-4. Examples of 95% confidence intervals and sample sizes for selected air passenger characteristics from some recent airport surveys.

Variable	Mean	With Sample Size = 400		Sample Size for Confidence Interval ±10% of Mean
		Standard Deviation	95% Confidence Interval*	
Number in travel group	1.4	1.6	±0.16 or ±11%	503
Expenditure at all concessions				
Airport 1	$6.20	$8.53	±$0.84 or ±14%	728
Airport 2	$8.00	$19.00	±$1.86 or ±23%	2,168
Time at airport (min)				
Large intern'l	160	60	±6 min or ±4%	55
Domestic	106	43	±4 min or ±4%	64

* Confidence interval expressed as difference from sample mean, also given as a percentage of the sample mean.

Note: Sample mean will be approximately normally distributed for large sample sizes according to the Central Limit Theorem, even for variables such as expenditure at concessions that are not normally distributed.

Source: Airport surveys conducted by Jacobs Consultancy in the United States and Canada.

Stratified Sampling

The objective of stratified sampling is to reduce the size of the required sample to achieve a desired level of accuracy in situations where it is possible to define population strata within which the variance of the population characteristic of interest differs between the strata. For example, if the characteristic of interest is the duration of air passenger air trips (because trip duration affects the likely use of parking at the airport), the duration values are likely to differ considerably between international trips, long-haul domestic trips, and short-haul domestic trips. Because the variance of the air trip duration within each of these three strata will be much smaller than the variance for the population as a whole, it may be possible to estimate the average trip duration for all air passengers to the desired level of accuracy with fewer total responses divided between the three strata than by randomly sampling the entire population.

To achieve a similar level of accuracy in the results for each stratum, it will be necessary to use non-proportional stratified sampling, with the sample size in each stratum inversely proportional to the variance of the characteristic within that stratum. Because the actual variance in the characteristic for each stratum will not be known until the survey has been performed, it will be necessary to make an initial assumption of the differences in the variance across the strata in order to determine the proportion of the survey responses to assign to each stratum. These assumptions can be based on the results of prior surveys or of surveys performed at similar airports.

If σ_{Xi} is the standard deviation of characteristic X in stratum i, then for a confidence interval for the sample mean of X across the population of $2w$ (i.e., $\pm w$) at a 95% confidence level, w is given by:

$$w = 1.96\sqrt{\sum_i \left[W_i^2 \sigma_{Xi}^2 \left(1 - n_i / N_i\right) / n_i \right]}$$

where W_i is the proportion of the total population in stratum i
N_i is the population in stratum i
n_i is the sample size in stratum i

A given confidence interval can be obtained for varying combinations of n_i. However, if n_i is selected to be inversely proportional to the variance of X within each stratum, i.e., $n_i = k / \sigma_{Xi}^2$, then n_i can be replaced by k / σ_{Xi}^2 in the above equation, which can then be solved for k and hence

n_i calculated for each stratum. The expression for calculating the value of k and the sample sizes for each stratum is provided in Appendix B.

The total sample size is obtained by summing n_i across all the strata.

Cluster Sampling

Calculating an appropriate sample size with cluster sampling in considerably more complicated than with random or stratified sampling, because the composition and size of the clusters affect the variance of the resulting estimates of the population characteristics.

The accuracy of a cluster sample depends on both the variance of the characteristic of interest within each cluster and the variance between clusters. If the variation in the sample mean between clusters is fairly small (i.e., the clusters are fairly homogeneous and have similar means) but the variance of the characteristic within each cluster is fairly large, then the cluster sample will give a similar accuracy to a random sample of the same overall sample size. One can think of this situation as a series of small random samples of the population as a whole. Conversely, if the variance between clusters is fairly high, then the overall variance of the population sample mean of the characteristic will be larger than for a random sample and in consequence a cluster sample will require a larger overall sample size to achieve the same level of accuracy.

3.4.3 Comparison of Sampling Methods

An example of sample size calculations for different sampling methods is given in Appendix B. The example provides some insight into the efficiencies of each sampling method and is summarized in this section. In the example, a survey of passengers is to be undertaken to obtain information on airport access trips. A critical question to be answered may be: *What is the percentage of departing passengers dropped off at the terminal curb?* Random and stratified sampling of passengers—with stratification by flight sector (e.g., short-haul domestic, long-haul domestic, international) and day of the week—and one- and two-stage cluster sampling—with both random and stratified sampling of flights by sector—are examined. The flight schedule for the survey period includes 610 flights per week, and the number of originating passengers per week is estimated at 48,300. Some 42% of passengers are on short-haul domestic flights, 34% on long-haul domestic flights, and 24% on international flights. From past experience, initial estimates of the percentages of passengers dropped off at the curb are 40% of short-haul domestic passengers, 60% of long-haul domestic passengers, and 90% of international passengers. In the example, the percentage of passengers to be dropped off at the curb is quite strongly related to the flight sector, but fairly weakly related to the day of the week.

Table 3-5 summarizes the required sample sizes for an accuracy of ±2, 3, and 4 percentage points for a 95% confidence level using various sampling strategies. The following observations were made from this example:

- Using random sampling, the required sample size approximately doubles as the accuracy improves from ±4 to ±3 and doubles again from ±3 to ±2 percentage points.
- Stratified sampling by flights (which has a strong relationship with the variable of interest) reduces the sample size required by 15%, but stratified sampling by day of the week (which has a weak relationship with the variable of interest) has a negligible effect on the required sample size.
- Cluster sampling with random sampling of flights and surveying of all passengers on those flights was found to be very inefficient, increasing the sample size required by a factor of 9 or more compared to random sampling.
- Cluster sampling with stratified sampling of flights by sector greatly improves the efficiency of cluster sampling.
  - With all of the passengers on the selected flights surveyed, the sample size required is reduced to approximately 3 times that of random sampling.

Table 3-5. Sample sizes in example survey for an accuracy of ±2, 3 and 4 percentage points for a 95% confidence level using various sampling strategies.

Method		Unit Sampled	Mean ±*a* Percentage Points, *a* =			Comment
			2 pts	3 pts	4 pts	
Random		Passengers	2,218	1,012	574	Random sampling of passengers (pax)
Stratified		Passengers	1,879	853	484	Stratified by sector of flight
		Passengers	2,215	1,011	574	Stratified by day of the week
Cluster	1.	Flights	252	146	92	Random sampling of flights with all pax on each flight sampled
		Passengers	19,953	11,560	7,285	
	2.	Flights	83	41	24	Stratified sampling of flights by sector with all pax on each flight sampled
		Passengers	6,560	3,280	1,910	
	3.	Flights	117	47	26	Stratified sampling of flights by sector with 50% pax on each flight sampled
		Passengers	4,615	1,860	1,040	

- With a random sample of 50% of passengers on each flight surveyed, the sample size required is reduced by 30% to 2.1 times that required using random sampling. However, with only 50% of passengers surveyed on each flight, the number of flights surveyed increases.
- Several other percentages of passengers to survey on each flight were examined, and both the 30% and 75% levels resulted in larger passenger sample sizes. The optimal balance between the number of flights and the proportion of passengers on those flights to survey depends on the variation in responses between and within flights, and on the relative costs of surveying passengers and flights, which vary from survey to survey.

The results of this example reflect the assumptions regarding variation used in the example and will vary in other situations. Refer to Appendix B for more information on the example and the calculation of the sample sizes.

In comparing the required sample sizes for different sampling methods, it should be borne in mind that true random sampling of air passengers is almost impossible to achieve, as discussed in Chapter 5.

3.4.4 Determining Desired Accuracy

While the mathematics of calculating required sample size is generally fairly straightforward, deciding on the appropriate desired level of accuracy is anything but, because it depends on the consequences of being wrong. Although it is common in statistical analysis to use a target accuracy of ±5% at a 95% confidence level, this is an entirely arbitrary choice and is typically not achievable or not accurate enough for many issues addressed by air passenger surveys.

Consider the case where the characteristic of interest accounts for only a small proportion of respondents, say air passengers using transit to access the airport, which from past surveys is estimated to be approximately 5%. The proportion using transit is to be estimated for a subgroup that composes 20% of the population (e.g., air passengers from a particular part of the region). If the required accuracy for the estimated proportion of this subgroup is ±5% of the estimated proportion (i.e., ±0.25 percentage points) at a 95% confidence level, a random sample survey would require a sample size of 150,000 responses, a level of effort that is totally impractical. Even accepting an accuracy of ±20% of the estimated proportion (i.e., ±1 percentage point) at the same confidence level, the required sample size would still be 9,500—potentially achievable, but significantly larger than most air passenger surveys.

Therefore, determination of the required sample size should proceed by asking the following questions:

- What are the critical characteristics of the target survey population that will drive decision making?
- For what subgroups of the target survey population will these characteristics be required for decision making, and what proportion of the survey population do these subgroups compose?
- What is the expected proportion of respondents with the critical characteristics in each of the subgroups?
- For a range of different possible sample sizes, what is the expected accuracy of the estimated proportion of respondents with the critical characteristics in each of the subgroups?
- What are the potential consequences if decisions are made on the basis of the estimated proportions of respondents with the critical characteristics and these estimates turn out to be wrong by the magnitude of the expected accuracy for each of the different possible sample sizes?

The final decision on sample size will involve a tradeoff between establishing a reasonable sample size (and associated budget) for the survey and the resulting accuracy that is achievable for the various critical characteristics for each of the subgroups of interest. This tradeoff may involve accepting a significant reduction in the level of accuracy that will be achieved for many of the characteristics and subgroups, particularly those accounting for a small proportion of the target survey population.

3.5 Weighting

Most survey designs attempt to select a representative sample of individuals from the target population. However, in practice the resulting sample rarely corresponds exactly to the composition of the population. Some groups are over-sampled and some are under-sampled, because of the sampling approach adopted or the inevitable variability in executing the planned sampling approach. The objective of assigning weights to the individual survey responses is to correct for these differences and improve the accuracy of the results.

For random, sequential, and proportional stratified sampling, the number of sampled individuals with a particular characteristic can be expanded to an estimate for the population by simply dividing by the sampling fraction. Thus, if 1% of passengers are surveyed, population estimates can be obtained by multiplying the sample number by 100. Each response is therefore given a weight of 100 and it is these weighted values that are used in the analysis and preparation of results.

For non-proportional stratified sampling, sampled numbers within each stratum must be expanded separately by dividing the sampling fraction for that stratum, and then summed to obtain estimates for the population. Similarly, for cluster sampling, the sample numbers in each cluster must be expanded separately, dividing by the sampling fraction for that cluster (if not all individuals in the cluster were sampled), then the sample cluster numbers expanded to population estimates. If the clusters were selected using random, sequential, or proportional stratified sampling, the sampled numbers in each cluster are summed and divided by the fraction of clusters sampled.

Weighting can also be used in surveys where the sampling proportion varies over the time of day. For example, if the same number of interviewers is used over the day, the proportion of passengers surveyed in the busy periods will be much less than during the quiet periods, and peak period passengers will be under-represented in the sample. This issue can be addressed by applying higher weighting to surveys collected in the peak period. The method for determining the

weights will vary depending on the survey type. For example, for surveys of passengers exiting the security checkpoint, weights for surveys collected in a particular hour could be set equal to the total numbers of passengers going through security in that hour divided by the numbers of surveys collected in that hour. The numbers of passengers exiting the security in each hour of the survey could possibly be obtained from the security authority or counted manually.

Rather than applying equal weights to all passengers, or to all passengers within a group, weights can be applied so that the sample is more representative of the population. For example, weights could be set so that the distribution of surveyed passengers by airline matched the actual distribution of passengers by airline during the survey period. If the actual numbers are not available from the airlines, they could be estimated based on the seat capacity of departing flights and average load factors for each airline during that month.

In some cases, different sets of weights may be required for analyzing different characteristics of the population. For example, in a survey of passengers, questions relating to their travel to the airport and air trip are relevant to the respondent's companion or companions, as well as the respondent, but personal questions such as gender and age apply only to the respondent. By including questions on the number of travelers in the group and number of questionnaires completed by others in the group, it is possible to define two sets of weights, one for the airport access and trip characteristics and the other for personal traveler characteristics.

Although the air travel party and those traveling together to the airport are generally the same, this is not always the case, as discussed in Section 5.2. People who have been attending an event such as a business meeting or conference may travel together to the airport but then take different flights, while others may travel separately to the airport and meet there to travel together on the same flight. The latter situation is particularly common with large air travel parties such as school groups or sports teams. Therefore, it is desirable for passenger surveys to ask how many people are traveling together on the same flight as well as how many people traveled to the airport together with the respondent. This specificity will allow separate weights to be calculated for the air travel party characteristics and the ground access travel characteristics.

3.6 Summary

The goal of this chapter has been to provide the non-statistician with an understanding of the basic statistical principles behind sample design, the terminology involved, and the importance of considering how the sampling approach and the sample size interact to determine the statistical accuracy of the resulting data. Although it is not unusual to present the results of airport user surveys without any real discussion of the likely accuracy of those results, it is not good practice. If the results are to be used for decision making, it is the responsibility of those managing the survey process to decide how accurate the results need to be, design the survey accordingly, and ensure that decision makers using the survey results are aware of the likely accuracy of the results.

One of the most fundamental questions in planning a survey is deciding how large a sample size is required, because this has a major influence on the cost of conducting the survey. As discussed in this chapter, the decision on sample size is in turn influenced by the sampling approach adopted, which also affects the cost of conducting the survey. An appreciation of the statistical basis for assessing the likely accuracy of the results of a particular survey approach and the sample size required to achieve a desired level of accuracy is therefore critical to effective survey planning.

CHAPTER 4

Survey Design

This chapter describes the process of designing a survey after the initial steps and planning decisions that were discussed in Chapter 2 have been completed. Each part of the design process needs to be given careful consideration, because the way in which each is addressed will affect the quality of the results as well as the costs of performing the survey. Considerations that are specific to particular types of airport-user surveys are discussed in more detail in subsequent chapters, which should therefore be read in conjunction with this chapter in planning a survey of a particular type.

4.1 Survey Population

The results of a survey represent a sample drawn from the larger population, although in some cases the sample may consist of the entire population (often referred to as a 100% sample or a census survey). This section addresses the need to clearly define the population of interest, including the characteristics of the population required for survey planning and where this information can be obtained.

4.1.1 Defining the Population of Interest

The first step in any survey design is to define the target population for which information is to be collected. For example, the target population could be origin/destination passengers at the airport, in which case connecting passengers would be excluded, or all airline or airport-based employees using the airport terminal, in which case flight crews not based at the airport would be included. While the target population may seem self-evident at first, the exact definition will influence the survey methodology and sampling strategy and requires careful thought.

The population available to be surveyed may differ from the desired target population, depending on the survey period and method used to conduct the survey. For example, the survey sponsor may wish to obtain information on all air passengers using the airport throughout the year. Performing a survey over a relatively short period limits the available population to travelers during that period, whose characteristics may differ from those at other times of the year. Similarly, performing an Internet survey of airport employees limits the available population to those with Internet access.

The limitations imposed when a survey is performed must be fully understood when interpreting the results. When the characteristics of the target population change throughout the year, as they generally do for air passengers, there is no way to know whether a survey performed over a fairly short period will provide a reasonable representation of average annual conditions. If information on average annual conditions is desired, it will be necessary to perform the survey over a number of different periods throughout the year to account for seasonal variations.

In some cases, the individual members of the target population can be identified prior to the survey. For example, it will generally be possible to obtain a list of all airport tenants and it may be possible to obtain a list of all airport-based employees. However, it will not be possible to identify every air passenger using the airport during a specific period. In the case of area residents or businesses, while it may be possible to define the entire population, in practice it will usually not be feasible to assemble a comprehensive list.

In cases where it is not possible to identify individual members of the population prior to the survey, it is often possible to obtain some information about the relevant characteristics of the population, although this information will not necessarily be organized in a readily usable format and may require some additional research. Some of this information may be prospective, such as flight arrival and departure times and the aircraft types assigned to each flight that can be obtained from the Official Airline Guide or other sources of flight schedule information. Other information may be historical and require extrapolation to the period of the survey. For example, fairly detailed information on air passenger trips in the United States by airline and market is available from the Bureau of Transportation Statistics of the U.S. Department of Transportation, and there are generally similar sources of information in other countries.

Design of an appropriate survey sampling plan (discussed in Section 4.2) requires a well-defined target population, as well as information on the size of the target population. The types of data that can be used to determine the size of the target population include the following:

- Enplaned/deplaned air passengers for the period of the survey.
- Aircraft movements by time of day and seat capacity, typically available from airport flight information systems, gate assignment systems or tower records.
- Vehicle counts on airport roadways, typically collected using automatic traffic counters.
- Parking exit counts and duration data from parking systems.
- Curb activity counts.

The above list is not exhaustive. The exact data required to determine the size of the target population for a survey will be a function of the goal of the survey, the target population, and the type of survey being conducted. Additional details on defining survey populations are included in the chapters devoted to each survey type.

4.1.2 Identifying Sources of Information

In addition to information on the overall size of the survey population, assembly of information on the composition and characteristics of the population will generally be desirable. This information will enable development of a more detailed sampling plan, as well as provide an indication of the extent to which the survey results correspond to the distribution of characteristics within the population. This in turn will allow appropriate weights to be assigned to the individual survey responses so that the survey results can be extrapolated to the population as a whole.

In some cases, detailed data on the size or characteristics of the population may not be readily available. For example, an airport authority may not have traffic counts on the terminal roadways or may have no information on the number of air parties arriving at the airport by shared-ride van or using off-airport parking. It is increasingly common for airports to use automated vehicle identification (AVI) systems to track the number of trips made by different classes of commercial vehicles, such as shared-ride vans or hotel shuttles. However, even in these cases information on the occupancy of those vehicles is generally not available. Smaller airports may have no idea how many such trips are made. Similarly, where airport employers provide parking for their employees, the airport operator may have no information on the number of parking permits that have been issued, much less the number of vehicles parked at the airport by those

employees on a given day. While an airport operator will generally know how many parking permits it has issued to its own employees, it may not know how often they are used.

Therefore, in planning a survey, one of the first steps is to decide what characteristics of the population are desirable to know in order to develop appropriate weighting factors and what data on these characteristics are already available. Where information on desired characteristics is not readily available, what would be involved in obtaining it? Answering this question may require some consultation with operational staff or external agencies. As it becomes clearer how much work would be required, a decision can be made whether the benefits of improving the survey weighting process justify the effort involved.

4.1.3 Determining Population Characteristics

Although the total number of air passengers per month is generally known from airline reports and the total number of airport employees is known from employment records, the more relevant information is how the flow of passengers or employees varies by time of day or day of the week. Because the number of surveyed passengers in any hour or the work-shift patterns of surveyed employees may not correspond to the overall distribution of activity, it is desirable to know how passenger flows or employee shifts vary over the day and week.

Some airports require airlines to report air passenger statistics for each flight. In this case it is fairly straightforward to assemble data on passenger flows by time of day, although adjustments will need to be made for connecting passengers, unless these are reported separately. In the more common situation, where airlines do not report passenger traffic at this level of detail, one approach is to analyze the distribution of seats on departing and arriving flights and make assumptions about load factors. Where passenger data at the level of individual flights are not routinely reported, it may be possible to obtain this level of information for the period of the survey from the airline departure desk or by counting boarding passengers. Data may also be available from the Transportation Security Administration on the hourly variation in the flow of people through the security screening checkpoints, which can be used to refine assumptions about the variation in airline load factors at different times during the week. Similarly, it may be possible to obtain information from airport employers on the number of their employees who will start their shift at different times throughout the week for the period of the survey.

In the case of airport ground access modes used by air passengers and airport employees, it would be helpful to know how the use of the different modes varies over the week. In principle, detailed information on the number of parking exits by time, together with how long those vehicles have been parked, should be available from the parking revenue control system. However, at many airports this information is not readily extracted from the database, and some manual analysis of printouts or even a sample of parking tickets may be necessary. Information on the use of other modes, particularly drop-off and pick-up by private vehicle, is more difficult to obtain. Counts of vehicle trips may be available from AVI systems or trip fees paid by the operators, but these counts will not necessarily correspond to air passenger use, because of variation in air party size, more than one air party in a vehicle, and vehicles traveling to or from the airport without passengers (deadheading). It may be necessary to perform an occupancy survey to determine appropriate assumptions for the variation in vehicle occupancy over the week. These counts can be supplemented by installing traffic counters at strategic locations on the airport roadway during the period of the survey.

In some cases, the survey sponsor may not even know the overall size of the target population. For example, if the target population is local area businesses, the total number may not be known to the airport operator. Some research may be necessary to obtain data from external sources, such as city and county business license records.

While the effort required to assemble statistical information on the size and characteristics of the airport user population can be considerable, the information has other uses apart from survey design. Combining information on airport user characteristics with the survey data will produce a more integrated profile of airport activity.

4.2 Sampling Strategy and Plan

4.2.1 Determining Strategy

After identifying the population to be surveyed and determining whether this population can be counted, the next step in the survey design is to determine whether a census or sample survey should be used. Depending on the type of survey the following strategies and plans must be determined:

- If a census survey is to be used, determine how each individual in the population will be contacted.
- If a sample survey is to be used, determine:
  - The sampling method (i.e., random, clustering, stratification, etc.), taking into account the overall budget and the feasibility and efficiency of collecting data using each method.
  - The sampling plan (i.e., multi-stage sampling, choice of strata or clusters, methods of sampling within clusters). The sampling plan to be used is very dependent on the type of survey being conducted (see Chapters 5 through 10).
  - The sample size for the level of accuracy required.

Whether a census or sample survey is used, steps for minimizing non-responses should be identified. Consideration should also be given to whether further analysis of individuals not responding is required and overall estimates adjusted.

The sampling plan to be used is very dependent on the survey type being conducted and is covered in the chapter for each survey type (for example, see Section 5.3 for surveys of air passengers).

4.2.2 Minimizing Bias

The two main sources of bias in airport user surveys and measures to reduce their occurrence follow:

- Use of non-random sampling procedures. Bias can be reduced by the following measures:
  - Selecting an appropriate sampling method for the type of survey population, location, and time constraints.
  - Training interviewers in sampling techniques.
  - Supervising the interviewers.
  - Developing backup plans for unexpected events affecting the sampling process, such as delayed or cancelled flights.
- Non-response of sampled individuals, as non-respondents can have significantly different characteristics from those responding. Response rates (also discussed in Section 4.8) can be improved by the following measures:
  - Choosing the survey location and time so that respondents have time available to respond.
  - Keeping the questionnaire short, as well as easy to understand and complete.
  - Using well-trained, experienced, and friendly staff to conduct interviews.
  - Using multilingual interviewer staff and questionnaires if appropriate.
  - Providing incentives, such as pens or coupons for free coffee. Incentives are generally not required for airport user surveys but can help if respondents are significantly inconvenienced.

Sampling of air passengers to survey can be particularly problematic because of their transience. Passengers arriving late at the gate are typically under-represented and have a high non-response rate, while connecting passengers are often over-represented. Appropriate sampling methods are discussed in Sections 5.2 and 5.3.

4.3 Questionnaire Design and Structure

The design and structure of the survey questionnaire, including the wording of individual questions, is crucial to the success of a survey. Issues to be considered include what information to request, the order in which the questions are asked, how much detail to try to obtain, and the amount of time that respondents can be expected to spend completing the survey.

4.3.1 Length

As the amount of information to be obtained by a survey or the level of detail desired for the responses increases, so does the length of the questionnaire. Once the decision is made to incur the cost of performing a survey, there is often a strong desire to increase the amount of information it provides. However, increasing the length of the survey may increase the refusal rate and the number of incomplete responses, and also reduce the number of surveys that the field staff can perform in a given time period, thereby increasing the cost of the survey to obtain the same number of responses.

There are a number of practical limitations on survey length. The most obvious is the time that respondents are willing to spend answering the questions. This length of time will depend in part on the circumstances. Someone completing a survey questionnaire in the comfort of their office or home will generally be willing to answer more questions, and in greater detail, than someone who is standing in a busy airport terminal and is anxious to catch a flight.

The survey methodology may also impose limitations on survey length. If the survey questionnaire is a printed form that is completed by hand, it should take up no more than two sides of a single sheet of paper. The text has to be large enough for respondents to read and the form has to provide enough space to write in the answers.

4.3.2 Response Options

Survey questions fall into three broad types, based on the response options:

- Numerical, in which respondents provide a numerical value, which could include dates and times.
- Categorical, in which respondents choose among predefined alternatives.
- Open-ended, in which respondents can answer in their own words.

The results of open-ended questions are much more difficult to analyze, but they may provide richer information because the respondents are not forced to select from a limited number of categories. For many applications it is common to use a hybrid form, in which respondents are presented with a set of categorical responses, one of which is "Other" with an option for an open-ended response. This option allows common responses that were not covered by the categorical options to be assigned their own category code after the fact. Also "Other" responses that really should have been one of the defined categories can be recoded.

However, adding a category after the survey based on the "Other" responses can result in an under-reporting of that category, because some respondents who would have selected that option if it had been presented chose a defined category instead. This occurrence is less of a

problem with an interview survey, where the respondents cannot see the defined categories when they answer the question, than with a self-completed survey.

In addition to being easier to analyze, categorical questions have the advantage that they are generally quicker to answer, because they typically involve just checking a box. Also, because they present the respondent with a predefined set of possible responses, they encourage the use of standardized terminology, yet may also trigger a response that would not otherwise have been mentioned. While this is true for self-completed questionnaires, there is a potential disconnect with interview surveys, where the respondent does not see all the options and the interviewer assigns the response provided to one of the defined categories. Different interviewers may handle a similar response in different ways. This phenomenon is called inter-rater reliability, and it can be a particular problem when asking about ground transportation modes, because different respondents may refer to the same mode in many different ways. One solution is to provide interviewers with printed cards that list the defined options, which can be shown to respondents to help them provide an appropriate response.

Categorical questions and the responses obtained from them may include the following types of problems:

- The respondent checks multiple boxes when asked to check only one. The wording should make it clear whether one or multiple boxes should be checked. This wording should not be part of the question and should stand out. Web-based surveys and those using electronic data collection devices (discussed in Section 4.9) eliminate this error.
- A categorical response for "Not applicable" or "No opinion" is not provided where some such form of non-response is appropriate.

When using a rating scale for opinions such as 1–5 or 1–7, be careful to word all the questions in a consistent way so that the highest number corresponds to the most positive opinion and 1 corresponds to the most negative opinion.

Consideration should be given to including a comment box after each group of questions to allow respondents to note any clarifications or other relevant information.

4.3.3 Question Wording

The wording of questions is critical to the success of a survey. Respondents who misunderstand a question are not going to provide the desired information. Worse, it may not even be clear that they have given an answer to a different question from the one intended. Similarly, interviewers who misunderstand a question may miscode the response. Therefore, considerable effort should be devoted to developing clear and unambiguous questions.

Consider the question "How far do you live from the nearest airport?" The question is asking how far in terms of what: miles? blocks? travel time? travel time by car or by transit? And what kind of airport is meant: the local general aviation airport? the nearest airport with scheduled passenger service?

Getting from the general and vague to the specific is both necessary and difficult. Airports with years of experience conducting user surveys are still investigating possible refinements to their questions. Unfortunately, the easiest way to discover that a question is problematic is to look at the resulting data. Preventing this after-the-fact problem requires a serious commitment of time and effort to planning, thoughtful consideration of possible answers, and thorough testing of questions before the survey is deployed.

There are two broad categories of questions:

- Factual questions.
- Opinion questions.

Factual questions ask for factual information that the respondent should be able to provide (such as how many bags they checked or how they got to the airport), while opinion questions seek the respondents' views on an issue. Opinion questions present respondents with a range of options so they can select the one that best describes their opinion. This type of question may take the form of a statement, with the respondents being asked how strongly they agree or disagree. Satisfaction questions that explore the respondents' satisfaction with particular facilities or services are a subcategory of opinion questions.

Wording concerns with factual questions largely revolve around ensuring that the intent of the question is clear to the respondents and that the descriptions used for categorical questions are unambiguous. For example, difficulties can arise over local terminology that may not be familiar to visiting air passengers, such as the names of different ground transportation services (discussed further in Section 5.4). Question clarity is particularly important with self-completed questionnaires, where there is limited opportunity for respondents to clarify the intent of a question or ask how their response should be classified in terms of the response categories provided.

The challenge with opinion questions is to ask the question in a way that allows for a meaningful answer. Such careful wording is particularly important with questions that ask respondents to indicate how likely they would be to use some proposed facility or service, or their satisfaction with some existing facility or service. Because the likelihood of using a facility or service depends on the circumstances affecting the decision, such questions have to be framed in terms of a specific situation, such as the trip that an air passenger is currently taking. Similarly, because satisfaction with a given facility or service is influenced by both expectations and the respondent's experience with the use of the facility or service, customer satisfaction questions need to be worded in a way that allows these influences to be identified.

4.3.4 Question Order and Interview Flow

At least four considerations affect the order in which the different questions are asked:

- The most obvious consideration is where the answer to one question affects subsequent questions. For example, it is important to determine whether an air passenger is starting a trip or connecting between flights before asking questions about the ground access trip to the airport.
- A more subtle but equally important consideration is to introduce requests for information in a logical sequence. Asking survey respondents the type of place from which they began their trip to the airport gets them thinking about where they started their trip and leads naturally to questions about the location of that trip origin, such as the city or zip code. Earlier questions can also help clarify the intent of subsequent questions. Asking how many people are traveling together clarifies subsequent references to the travel party, such as how many bags the travel party checked.
- A third consideration is to obtain as much key information as possible if there is a likelihood that the respondent will be unable to complete the survey. Asking those questions earlier in the survey makes it more likely that they will be answered.
- The fourth consideration is that most surveys involve some branching that depends on the responses to earlier questions. These branches or skip patterns can request more detailed information for certain responses or omit questions that do not apply. In the case of printed questionnaires, these skip patterns should not be too complex, or respondents or interviewers will have difficulty deciding where to go next in the questionnaire and may miss key

questions or attempt to answer questions that do not apply to them. The order of the questions is one way to simplify the skip patterns. Branching is less of a concern with programmable hand-held electronic data collection devices, because the software handles the skips based on the responses to earlier questions. However, complexity can significantly increase the cost of the required programming.

Another less technical suggestion is that the questionnaire should start with a question that is easy to answer and non-threatening, such as: "Did you travel to this airport by ground transportation to take this flight or are you connecting between flights?" This will help in getting the respondent's cooperation for the survey.

4.3.5 Translations

In the case of surveys where respondents may have limited facility with English (or with the primary language of the area where the survey is being performed, if this is not English), consideration should be given to providing the questionnaire in other languages. This situation arises at airports serving bilingual or multilingual areas or at international airports, as discussed further in Section 4.8.3. It is preferable to have the translation performed by a native speaker of the language in question, because there may be subtle issues of usage that could affect how the questions are interpreted. It is also desirable to have the resulting translation reviewed by an aviation specialist with knowledge of the language to make sure that the translator has understood the intent of the questions.

The decision as to whether translations are necessary or worth providing will depend on the proportion of the target population who may have difficulty completing a survey in English. If this falls within the anticipated confidence interval for the survey as a whole, as discussed in Section 3.2, it may not be worth incurring the cost of the translations in order to include these users in the survey. However, even in this situation there may be other reasons for including non-English-speaking airport users in the survey, such as gathering information about foreign tourists.

There are usually practical limits to the number of different languages that the questionnaire can be translated into, and the choice of languages will depend on the composition of the target market. Because the field staff may not be fluent enough in any of these languages to explain the nature of the survey, ask the questions, or understand the responses, the translated versions will most likely have to be self-completed. If so, a brief addition to the questionnaire may be necessary to explain its purpose, which in turn may change the layout of the questionnaire. It may be helpful to use colored paper to help the field staff distinguish between the different versions of the questionnaire.

4.4 Expected Data Collection Rate

Factors affecting the rate at which interviewers can collect responses include the following:

- Questionnaire design—length, format, and types of questions.
- Types of information collected—opinions usually take longer than current factual information.
- Surveying method—intercept interview or self-completed.
- Competency of interviewers—good interviewers can complete significantly more surveys.
- Airport layout—time needed to move between gates or between terminals, considering likely congestion and the availability of moving walkways and inter-terminal transportation.
- Refusal rates—affect the number of potential respondents who must be approached to obtain a completed response.

Collection rates differ significantly depending on these factors, but a rough guide to the expected average response rate per hour per interviewer is as follows:

- Intercept interviews:
  - 6-10 per hour for a 3-4 page survey with about 25 questions.
  - 10-15 per hour for a short questionnaire (10-15 questions).
  - 15-20 per hour for a very short questionnaire (5-10 questions) and introduction.
- Self-completed: 25-40 per hour.

These rates are applicable to situations where there are passengers available to interview, and they include an allowance for typical gaps between interviews but exclude breaks and inactive periods, such as between flights.

Where all passengers on a flight are surveyed, experience indicates that responses are typically received from 40% to 60% of passengers. The non-responding passengers are mostly those who

- Arrive at the gate after the first boarding call. They either cannot be interviewed in the short time available or decline to participate as they are getting ready to board the flight.
- Decline to participate because they are engaged in activities such as working, reading, or talking with others.

For groundside surveys, refusal rates generally range from 5% to more than 30%, depending on the survey type and method, and the time of day.

4.5 Survey Logistics

4.5.1 The Importance of Logistics

Both the survey quality and the physical well-being and mental attitude of the survey team will be directly affected, positively or negatively, by the amount of thought given to logistics. One of the principal challenges with air passenger surveys is that they are conducted in the physical environment of the airport terminal. Careful attention to survey logistics is therefore critical to a successful passenger survey.

4.5.2 Survey Implementation Team

Of first importance is the survey team. In addition to the strong project manager recommended earlier, the survey implementation team needs a technical expert, a field manager, field supervisors, and interviewers. This structure applies whether the survey is conducted in person or by handing out questionnaires.

- The technical expert is charged with addressing any deviations from the survey design and making the most scientifically appropriate choices when challenges arise.
- The field manager oversees operations and serves as a liaison to the project manager.
- The supervisors oversee the daily operations.
- The interviewers either ask questions and record answers or hand out forms, answer questions, and collect completed questionnaires.

Ideally, members of the survey team will be quick on their feet and effective problem-solvers. These characteristics will be helpful when things go wrong, which is likely to happen every day.

Flights are cancelled or delayed. Interviewers do not show up or are late. Interviewers show up in inappropriate attire. Lines are too long for interviewers to get where they need to be when they

need to be there. Gate personnel refuse access to survey staff. Passengers get annoyed or complain. Security breaches or weather shut down the entire operation. Labor disruptions hinder airport operations. The variety of things that can go wrong is essentially endless, and every problem requires a solution as quickly as possible.

It is therefore critical that the survey team develop contingency plans for everything from a late-arriving interviewer through weather problems to special events that either cause havoc at the airport or skew the passenger profile. Survey teams that do not do this in advance are likely to find themselves scrambling madly on a daily basis.

Table 4-1 lists some common problems and possible plans for dealing with them. These guidelines are general and would have to be tailored to the specific situation.

4.5.3 Other Logistical Considerations

Field Office Space

Survey teams that do not plan for adequate, appropriately equipped, and accessible field office space are likely to see the quality of their work and results suffer as a result. The first consideration is where the space should be located: before or after security screening. This decision should be driven by what type of access will be most convenient to field staff and least disruptive to the airport. The space should also

- Provide enough room for the field manager, field supervisors and interviewers to check in, check out, and meet (perhaps for announcements or some refresher training). It need not accommodate the entire team, although a space for training the entire team will need to be identified and reserved.
- Have the necessary technology and equipment, including Internet access, electrical outlets if electronics will need to be charged, a photocopier and fax machine if needed by the team, and storage space for supplies and equipment.
- Be private (not shared with others) and locked, both to prevent conflicts and for security reasons.

Table 4-1. Representative problems and contingency plans.

Potential Problem	Possible Contingency Plan
Target flight is delayed	Prepare a list of alternate flights to survey in case selected flights cannot be surveyed as planned. If departure delay is greater than 30 minutes, survey alternate flight. If departure delay is less than 30 minutes, continue interviews until team is scheduled to move to next flight and leave one interviewer behind to continue until boarding starts then rejoin team at next flight.
Target flight is cancelled	Survey designated alternate flight
Severe weather disrupts flight schedules	Shift interview schedule by a designated amount of time to allow as many flights as possible to be surveyed in the planned sequence.
Interviewers fail to show up or arrive late	Reallocate available interviewers among teams to ensure that each team has the required minimum number of interviewers.
Interviewer runs out of survey forms	Record responses on an already used form in a different color.
Airline suspends operation due to strike	Survey designated alternate flights

Communications

The best and easiest way for survey staff to communicate with one another (interviewer to supervisor, for example) is by cell phone or walkie-talkie. This eliminates the cumbersome use of courtesy phones (assuming there is a telephone in the field office that can be called from a courtesy phone) or the wasted time of walking around trying to find someone. Provisions need to be made for sufficient devices and for charging them as needed.

Parking

As airports are well aware, parking is expensive. Arrangements for parking for members of the survey team who are not on the airport's staff need to be made well in advance so they are in place when the survey starts. Provisions also must be made for parking tags, vouchers, or validations for those working early or late shifts when airport managers are not available. If arrangements are made for off-site parking, the team will need to consider the extra time staff will need to get to the airport, both in terms of scheduling and in terms of wages.

Weather Conditions

If the survey is being conducted outdoors (such as a survey of meeters and greeters or one of drivers), plans should be made in case of inclement weather. In hot weather, it is important to provide water. In the cold or rain, provision needs to be made for shelter and possibly for extra breaks to "thaw out."

Material and Equipment

Appendix C provides a checklist of supplies and equipment that will be required for the typical air passenger survey. This list can be adjusted to meet each survey's needs and circumstances.

Scheduling of Interviewers

At least two shifts per day will usually be necessary because of the long hours that airports operate. The staffing schedule should avoid staff being assigned to a late-night shift followed by an early-morning shift. The schedule should also allow enough time for staff to move between the different survey locations.

4.6 Selection and Training of Field Staff

4.6.1 Quality of Field Staff

When hiring temporary staff, it is important to remember that generally "you get what you pay for." The more the airport is willing to pay for interviewers, the higher the level of competence of the interviewers who will respond and, with careful selection of candidates, the higher the quality of data that will be collected. The length of the temporary commitment is also important. Trying to get competent and experienced interviewers for one or two weeks of work will be considerably more difficult than getting and keeping the same interviewers for two months.

Dealing with a contractor for temporary staff can introduce a different dynamic. Some contractors will have a pool of experienced, quality interviewers, but others will have just as much difficulty finding and keeping interviewers as the survey sponsor would. However, there will be a mark-up associated with the contract. The competence of the interviewers is a function of the final rate of pay, not how much is paid for their services to the contractor. It may seem that a high labor rate should attract good interviewers, but it is the final wage being paid to the interviewer that will attract quality interviewers, not the rate listed by the contractor.

Given the difficulty of attracting well-qualified interviewers, particularly for a fairly short duration, the best approach may be to retain a market research firm to provide the survey staff, preferably a firm with extensive airport survey experience. Such firms will generally be able to call on interviewers that they have used for other projects or that they employ on an ongoing basis. They can be made responsible for scheduling the field staff and providing field supervision. They may also have interviewers working on other projects who can be assigned to the survey as needed to handle peak periods or replace absent interviewers. Interviewers who have a long-term working relationship with a particular firm are also much less likely to quit unexpectedly.

Qualities to look for when selecting interviewers include the following:

- Professional and educational background.
- Experience in conducting airport surveys. (Experience in conducting surveys at other transportation facilities can be a substitute.)
- Presentable dress and appearance.
- Motivated, driven to perform, and willing to take up a challenge.
- Strong interpersonal skills, friendly and outgoing, and willing to approach people.
- Able to understand what data are being collected, and why.
- Willing to pay attention to detail to ensure good data are collected.
- Able to cope with long periods standing and lots of walking.
- Comfortable using electronic devices, if such devices are to be used.
- Fluent in the desired language(s).
- Able to obtain a security clearance.

4.6.2 Interviewer Training

If interviewers are to be used to conduct the survey, they will need to be trained. Training considerations will probably apply primarily to intercept surveys; telephone surveys are likely to be conducted by a call center already staffed with trained interviewers. This section therefore focuses on training intercept interviewers.

Training is not an area in which the survey team should be looking for cost savings. Although many factors contribute to the success or failure of an intercept survey, skilled interviewers are mission critical. In addition, there are so many unique aspects to airport surveys that the training session should be mandatory, even when interviewers have already been trained by an outside vendor.

The technical expert and field manager are likely to be the persons providing the training, and all field supervisors should also attend. It is a good idea for the project manager to attend as well, because sometimes that person can answer questions no other team member can. In addition, the project manager can identify any areas where the training is insufficient and point these out to the trainer before it is too late.

Training should always take place at the airport. This location will not only facilitate the airport tour (discussed in the following subsection), but will also expose interviewers to the conditions in which they will be working. It is better for interviewers who are taken aback by the distances involved in getting from gate to gate, or who are surprised by the prices of the food in the airport concessions, to find out sooner rather than later.

4.6.3 Content of the Training Session

A sample agenda for a training session is provided in Appendix D. This outline can be expanded, shortened, or modified to meet a survey's particular needs.

After introductions of the survey team and the interviewers, the training should begin with a discussion of the purpose, goals, and objectives for the survey. Ideally, this should be considered in the context of actions to be taken and decisions to be made; enthusiasm for the project on the part of the project manager is also beneficial at this point. If people understand why they are doing what they are doing and how important it is, they are more likely to be motivated to do a good job.

Having spent some time on "what's in it for the survey sponsor," the next part of the training should be devoted to "what's in it for the interviewers." People are always eager to learn about such basics as work hours and days, shifts, pay rates, and the like. Once they know what they are going to get out of participating in the survey, they will be more likely to pay close attention to what follows.

The next part of the training should deal with expectations, including everything from productivity and quality to behavior, attire, and grooming. People need to know what the rules are, so they can put what they are supposed to do into the appropriate context.

The next part of the training is typically devoted to basic interviewing skills. (The Bibliography lists some useful interviewer training manuals developed by the Council for Marketing and Opinion Research and Marketing Research Association.) Even if the project is being staffed with previously trained and experienced interviewers, it is wise to include this topic in the training by labeling it as a review. The quality of interviewer training varies considerably from firm to firm, and it is possible that the survey team will have higher standards than the firm from which the interviewers are drawn.

After the interviewers understand the requirements of the job, it is time to go over the specifics. In this part of the training session, the questionnaire should be reviewed question by question. Any questions that could prove challenging for interviewers to ask or for respondents to answer should receive special attention. After the questionnaire has been reviewed, the use of devices that will be utilized in the survey (such as electronic data collection devices or laptops) should be taught.

A tour of any airport facilities or services that are referenced in the survey, whether passenger amenities or ground transportation services, should also be included. This tour will also orient staff to the layout of the airport and the ways to get from one place to another.

By the end of this part of the training, interviewers should know exactly how to conduct the survey. The final step is to have them practice, first by interviewing one another and then by conducting practice interviews with passengers or other target respondents. The results from the latter should be reviewed by supervisors to ensure that they are accurate and complete before the interviewers are released to conduct actual interviews.

4.6.4 Duration of Training

If the interviewing team is focused, it is possible to conduct an acceptable training session in a day, and a one-day training session appears to be the general practice. There is, however, a large amount of material to master, even for experienced interviewers, and fatigue can be a problem. In an ideal world, training would probably be spread over two days, with perhaps six hours of instruction and practice per day. While two days may seem costly, the expense could well be offset by increased efficiency and accuracy of the interviewers during the actual survey, particularly during the first few days. Having interviewers familiarize themselves with the questions and survey procedures during the actual survey not only reduces the survey completion rate (increasing the cost per completed survey) but also runs the risk of generating poor quality data until the interviewers gain experience.

4.6.5 Coaching and Retraining

Even the best training session is not foolproof, and even a highly competent interviewer can fail to grasp an important point. It is therefore extremely important that everyone's work be checked on a daily basis, particularly during the first few days of the project. Later work can often be spot-checked, but early work should be reviewed constantly.

It may then be necessary to take corrective action, either by coaching an interviewer who missed something during training or by retraining the entire group if the trainer failed to convey a point well enough. The survey planning team would be wise to budget for both of these occurrences, particularly if the questionnaires or procedures are complicated or difficult.

It is also important either to train backup interviewers, who may or may not be deployed, or to provide for a second training session for new hires if people need to be replaced. As it is difficult to find people who are willing to be trained without any assurance that they will have the opportunity to participate in the survey, the latter approach is more typical. However, a second training session can present scheduling difficulties because attrition of the trained interviewers can occur throughout the survey. Another problem arises with recruiting and training additional interviewers at short notice if they have to be issued with security badges, because this process can be quite time-consuming. Therefore, it may be better to recruit and train enough interviewers at the start of the survey to allow for some attrition, and adjust the length of the survey period and the hours worked by each interviewer to manage the attrition that actually occurs.

Finally, it is important to note that when mistakes happen, the decision about whether to retain and tabulate work that is imperfect is both a research and a policy decision. The research decision has to do with the necessity of having enough interviews to achieve the desired statistical precision and power; the policy decision has to do with the importance of a given piece of information. It is also important to consider just how imperfect less than "perfect" work really is.

4.7 Pre-Tests and Pilot Tests

Pre-tests of questionnaires and pilot tests of survey procedures provide an opportunity to identify any problems with question wording or other aspects of the questionnaire as well as the planned arrangements for performing the survey. Such tests allow corrections or adjustments to be made before the main data collection effort.

4.7.1 Pre-Test of Questionnaires

The goal of a pre-test of the questionnaire is to make sure the survey questions can be asked easily by the interviewers, are clear to the respondents, and produce the desired information. Pre-tests also provide an opportunity to identify unanticipated responses or situations and to adjust the question response categories or the survey script as necessary.

An initial pre-test may be performed on a convenient group of people who were not involved in developing the instrument, such as staff of the survey sponsor. However, while this may help improve the question wording and identify unanticipated responses that require changes to the question response categories, it is not a truly representative test of the questionnaire. It should be followed by a pre-test involving a sample of the intended respondents of the survey, performed in the same way as planned for the survey itself. This pre-test will increase the chances of identifying unanticipated responses or situations. The questionnaire designers should be involved in conducting the pre-test, because they will be able to identify unanticipated responses or any misunderstanding of the intent of a question better than someone who was not involved in the development of the questions.

The results of the pre-test should be subject to careful analysis to identify any apparent difficulties with the question wording or survey flow, such as missing or incomplete answers, illogical responses, or incorrect skips. In particular, responses of "Other" to categorical questions, where the respondent has provided an explanation, should be examined to identify any misunderstanding of the categories or commonly occurring responses that should be added to the designated categories.

If electronic data collection devices are to be used in the survey, the programming needs to be thoroughly tested and debugged before the pre-test, or the validity of the pre-test may be compromised by errors in the programming. A rigorous testing plan for the software should be included in the project schedule. This program testing, done by people other than the programmers, will attempt to ensure that all possible response options and question branches are tested. This can be quite time-consuming and can be facilitated by preparing a set of response scripts that test all possible branches from each question. These test scripts ensure that certain response options are not overlooked, and can also be used to check that changes made to fix any problems have not affected other parts of the program. The survey schedule should allow enough time to adequately test the programming and make any needed revisions before the first pre-test.

4.7.2 Pilot Test of Survey Procedures

The primary purpose of a pilot test of survey procedures is to identify any problems with the planned approach to conducting the survey and to refine the estimates of the number of field staff required. Because a pilot test typically involves performing the survey on a representative sample of potential respondents, it presents an opportunity to conduct a pre-test of the survey questionnaire, and the two tests are often combined.

Other objectives of a survey pilot test include the following:

- Testing the survey sampling strategy.
- Validating the sampling plan.
- Identifying problems with survey logistics.
- Checking the data quality.

Feedback from the pilot test should include both field observations by supervisory staff and issues reported by field staff in debriefing sessions, supplemented by an analysis of the survey responses collected. In the case of interview surveys, noting the start and end time on each response will enable this analysis to examine the average time to perform a survey as well as the interval between ending one interview and starting the next. This will provide information on the amount of time spent waiting for subjects to become available to be interviewed as well as the time required to move between locations. Field staff should also note refusals to participate and record the reason where given or apparent, such as a language barrier or cell phone conversation.

The pilot test results should be compared to the expected number of responses from the sampling plan. This comparison may require collecting data on the potential number of respondents, such as the number of passengers on flights surveyed in airline gate lounges. The results should be examined for data quality, including missing or incomplete information, apparently illogical or inconsistent responses, or difficulty interpreting free-text write-in answers. Where addresses or other location data are collected, these should be examined to ensure that the location can be identified.

While this analysis addresses many of the same issues as the survey pre-test, it focuses on the conduct of the survey rather than the design of the questionnaire. Results of the pilot test analysis can be used to identify issues requiring particular attention in training field staff for the data collection phase.

4.7.3 Scheduling of Pre-Tests and Pilot Tests

Pre-tests and pilot tests should be performed far enough in advance of survey data collection that there is time to adequately analyze the results and resolve any issues, as well as perform any additional testing required. This process is likely to require several weeks to do well. Any changes to the questionnaire have to be finalized before the forms are printed for the data collection phase

and may involve reprogramming electronic data collection devices, if these are used, which will also take time. Therefore, it is prudent to schedule the pre-test and pilot test at least a month before the main data collection. The exact amount of lead time must be carefully considered in the light of the time required for the intermediate steps, which will vary from survey to survey.

4.7.4 Quantity of Pre-Tests and Pilot Tests

In general, one questionnaire pre-test and one pilot test of survey procedures will be sufficient. However, if the tests reveal problems that require significant changes to the questionnaire or procedures, it may be desirable to perform a second pilot test to verify that the changes have successfully resolved the problems. When a second pilot test is not performed, the experience and results of the first day or two of the main data collection period should be closely scrutinized to ensure that any changes have produced the intended effects.

4.8 Maximizing Response Rates

The willingness of potential survey respondents to participate in an airport user survey varies with the survey method and type of survey. Air passengers are generally cooperative, if they have the time. The response rates for other types of surveys, such as surveys of airport employees or tenants, can be improved by the way the initial contact is undertaken and the justification given for requesting the information.

4.8.1 Techniques that Improve Response Rates

Intercept Interview Surveys

Response rates to intercept interview surveys can be improved by the way the initial request is communicated. The quality, experience, and training of interviewers can significantly influence response rates. Survey personnel should be clearly identified as performing an officially approved function by wearing identification badges (these will be necessary anyway if the survey is being performed in the secure part of the airport terminal) and professional attire. It is helpful if survey personnel wear distinctive clothing that identifies them as performing a survey, such as vests or aprons marked "Airport Survey" or similar wording and the name of the survey organization. Clear identification will

- Assure potential respondents that this is an officially sanctioned activity.
- Help prevent airport, airline, or security staff from becoming suspicious about why the survey staff are approaching people.
- Simplify the initial explanation when the potential respondent is approached.

High-visibility safety vests add to the safety of interviewers in groundside locations where vehicles and pedestrians mix. Vests and aprons can also be designed with large pockets to make it easy to carry forms, pens and so on.

Survey staff should be trained to follow a standard introductory script that explains the purpose of the survey, which organization or organizations it is being performed for, and how the information will be used. If the survey involves sensitive or identifying information, such as the respondent's address or income, assurances should be given that this information will only be used for statistical analysis and will not be divulged outside the survey team. As interviewers gain experience, they can adjust their introduction to respond to varying situations and the mood of the respondents. However, field supervisors should make sure that the introductions retain the important points and do not become too casual.

Passengers arriving at the gate after the first boarding announcement who are reluctant to complete an interview survey could be provided a mail-back questionnaire, discussed below. While response rates are typically low, they do provide some responses from this passenger segment. The questionnaire should include a serial number, or other information identifying the day and flight number, and this information should be recorded so that the numbers of mail-back surveys handed out and returned can be tracked and appropriate weights can be assigned.

Telephone Surveys

Telephone surveys are in many ways more difficult than intercept interview surveys. Because neither the interviewer nor the respondent can see each other, it is more difficult for the interviewers to tell whether they have reached an appropriate respondent. Also many people are so tired of telephone solicitations masquerading as surveys that they are likely to be quite suspicious, if not hostile. Therefore the initial introductory script is all the more critical. It may be helpful to send an advance letter, when possible, explaining the purpose of the survey and indicating that a follow-up call will be made.

Other fairly standard practices that can help improve response rates include stating the expected length of the survey, if this is fairly short, and identifying a specific time to call back if the current call is inconvenient or the desired respondent is not available.

Mail-Back Surveys

Mail-back surveys do not face the problem of contacting potential respondents as long as the mailing addresses are correct. However, response rates from mail-back surveys are generally much lower than for telephone surveys, because there is no direct personal contact. The survey should be accompanied by a cover letter explaining the purpose of the survey, preferably signed by an appropriate official of the sponsoring organization, such as the airport director. In the case of airport employee surveys, it may be preferable to have the cover letter issued on the letterhead of the employer and signed by an appropriate official, at least for large employers.

A response date should be set to allow a reasonable time for completion of the survey and for follow-up reminders to be sent if a response is not received by that date. There is a rapidly diminishing response rate to follow-up reminders, so it will generally not be worth sending more than two reminders. In cases where there is a relatively small target sample, such as airport employees, it may be worth making follow-up telephone calls and performing the survey by telephone if the recipient is available, rather than sending follow-up letters.

Mail-back surveys that are handed out to potential respondents, such as to air passengers in an airport departure lounge, do not generally permit any follow-up unless contact information has been obtained in the course of distributing the survey. In this case, response rates may be improved by offering some inducement to participate in the survey. One technique that might be considered is providing a pen with the survey form that is marked with the name of the survey. This inducement will not only facilitate completion of the survey, but also serve as a reminder to do so. Asking potential respondents whether they would be willing to complete a mail-back survey before handing them the form may also help improve response rates by creating an implied commitment on the part of the respondent.

With all mail-back surveys, providing a pre-paid return envelope—or designing the form so that it folds to show the return address and pre-paid postage—is essential to increasing response rates. Consideration may need to be given to providing forms to be returned from international destinations, such as using International Business Reply Service envelopes. Although they are more expensive than regular mail, costs are incurred only for those returned.

Internet Surveys

Respondents to Web-based surveys are generally contacted by email to request their participation. Follow-up reminder emails can be sent at regular intervals to those who have not yet responded, although this produces the same diminishing returns as reminders to mail-back surveys. With a limited and well-defined target sample, it may be more effective to follow up by telephone, or even to call before sending the first request by email. Such a call will help ensure that the correct respondent has been identified and prepare the respondent for receiving the survey request. A telephone call will also avoid sending unnecessary reminders in cases where the respondent does not wish to participate in the survey.

The survey software should give the respondent the opportunity to save partly completed responses and return to complete the survey later, particularly for longer or more complex surveys.

4.8.2 Refusals and Incomplete Surveys

It will generally be useful during the course of a survey to record refusals and monitor incomplete surveys. Monitoring incomplete surveys should distinguish between the following:

- Those where the respondent terminated the survey before the end, possibly due to the need to board a flight or undertake some other activity, but the survey was complete up to that point.
- Those where the survey was ostensibly completed but some questions that should have been answered were not.

Comparison of refusal rates and incomplete surveys across interviewers may identify field staff who have a higher refusal or incomplete rate than average and could benefit from closer supervision or additional training.

Incomplete surveys may still provide useful information for those questions that were answered, and the data analysis phase of the survey should consider how best to make use of this information. For example, responses for completed questions in an incomplete survey can be included in frequency tabulations of those questions, although it will not be possible to include them in cross-tabulations with questions that were not answered. Where the contract for a survey requires the contractor to meet a certain target number of completed surveys, a decision should be taken on which questions must be answered before a survey is considered complete.

4.8.3 Other Languages

The two language issues to be considered regarding survey populations that do not speak English are the local languages of the area and the language of the target airport users to be interviewed.

If the airport is serving a bilingual or even multilingual area, the interviewers will need to speak those languages, particularly if the area is officially bilingual.[14] If the survey results are to be truly representative of the population, the multilingual nature of the area must be reflected in the survey process. As well as multilingual interviewers, this process calls for multilingual questionnaires and other handouts. Translations must be of excellent quality to maintain the meaning of each question and response option.

Where only a small proportion of the local population cannot communicate effectively in English, the need for multilingual interviewers becomes less clear. In the case of a flight-based survey, at least one multilingual interviewer should be available, if possible, for each flight surveyed.

[14] Note that a requirement for bilingual or multilingual interviewers will increase the wage rate.

The second language issue concerns international passengers. As the number of people flying internationally continues to grow, more and more languages are being spoken at airports, particularly at major gateway international airports. This prevalence of multiple languages is a real problem for surveys and one for which there is no ready solution. The survey planning team must determine if this will be an issue and attempt to arrive at a workable solution. Where international passengers are primarily from a small number of countries, bilingual or multilingual interviewers could be scheduled to survey the appropriate flights. It will not usually be feasible to translate questionnaires into many languages, but if most passengers who cannot speak English speak a common language, a translation in this language could be developed.

If the survey team is conducting a strict sampling process, the language barrier may interfere with this process and lead to some bias in the results. A related issue is that travelers whose first language is not English may appear to understand the questions, but in fact do not fully understand them and give incorrect answers. It is important that interviewers be trained to identify such situations and that they devote time to ensuring that the respondents understand the questions and they understand the responses.

A benefit of using a multilingual questionnaire is that it will allow the survey team to examine whether the characteristics of non-English-speaking respondents are significantly different from those of English-speaking respondents, and thus how important it is to make special arrangements to include these respondents in future surveys.

4.9 Use of Electronic Data Collection Devices

There is a growing interest in using hand-held electronic data collection devices (EDCDs) for performing interview and observation surveys. These devices have a number of distinct advantages over printed forms, as discussed in the following subsection, but also raise several issues that need to be carefully considered.

4.9.1 Advantages and Disadvantages

One of the most obvious advantages of using EDCDs is the elimination of the data entry task and the associated potential for errors to be introduced in the data. EDCDs store the recorded data directly in a database that can typically be downloaded and combined with the corresponding data from other devices. Questions are displayed and responses are entered using a program running on the device. While the capabilities of commercial software for data capture vary, most, if not all, programs provide the capability of exporting the data in a format that can be read by or imported into commercial statistical analysis software packages and spreadsheet software. This capability can represent a significant cost and time savings, as well as eliminate a potential source of error.

Some survey sponsors have raised the concern that the absence of a paper form means that there is no opportunity to go back and check the validity of the data in the data file. This is true, but no different from the use of paper forms. There is no way with paper forms to check whether the response that was recorded on the form is in fact what the respondent said or intended. The use of paper forms does allow the data entry task to be checked for errors, but this is an irrelevant consideration with EDCDs because the task is eliminated. The electronic data files should of course be backed up regularly so that they can be restored if they become corrupted.

There is also the possibility that failure or loss of an EDCD could result in the loss of the data stored on the device. This possibility is no different from the possibility of loss or accidental destruction of paper forms before the data have been extracted from them. Modern EDCDs are quite robust and preserve their data if they lose power. Survey procedures should provide for

periodic downloading of the data on EDCDs. Some devices can do this while in use through a cell phone or Wi-Fi capability. In the final analysis, if a survey sponsor wants a paper backup to the electronic data file, one can always be printed out.

One caveat is that with paper forms, well-trained interviewers sometimes make notes on the forms to clarify responses or suggest cautions in interpreting the response. Depending on the software, programming EDCDs to provide the same capability may be possible, but entering these comments typically takes longer on an EDCD than on a paper form.

A difficulty with using EDCDs is that they cannot be used to survey passengers who are hurrying to catch a flight, because (unlike printed forms) they cannot be handed out to respondents to take with them. Inability to survey such passengers can result in biased information if these passengers have different characteristics from those interviewed. This issue can be addressed by providing interviewers with mail-back forms to hand to passengers in this situation. Because the response rate from mail-back forms is typically quite low, the number of such forms handed out should be recorded on the EDCD (including the serial number of the form and where distributed) so that appropriate weights will be assigned to those forms that are returned.

Use of EDCDs introduces additional costs for purchasing or renting the devices and the software and programming the devices. There will also be logistical issues regarding availability and recharging of devices. The requirement to be able to use EDCDs efficiently can limit the applicants when selecting interviewer staff, to some extent, and can introduce the need for additional training. These issues are discussed in the following subsections.

Survey Design and Data Quality

An important advantage of EDCDs is that they allow more complex branching based on responses to prior questions and can tailor subsequent questions to information already provided. While branching can also be done with paper forms, it can quickly become unwieldy and confusing if there are more than a few such branches. There is no such limitation with an EDCD program and the resulting logic is transparent to the user. Thus survey questions can be tailored to individual situations and the questionnaire can include questions that apply to only a few respondents without affecting the questions asked of others.

The ability to tailor questions on the basis of prior answers can also shorten the length of time required to conduct the survey by skipping questions that are not applicable to particular respondents. Also, with paper forms the questionnaire may appear very long to the respondent and adversely affect the response rate, but the length of the survey is not evident to the respondent when using EDCDs. However, for this reason it is generally advisable to inform respondents of the likely time required to complete the survey.

Another advantage is the ability to do real-time data checking and ask follow-up questions to clarify apparently inconsistent responses. This ability allows the interviewer to correct misunderstandings or mistakes while the respondent is still available. In other cases it may provide an explanation for what appears to be inconsistent information but is in fact an unusual or unanticipated combination of circumstances. This is a powerful feature. As more detailed information becomes available about air passenger travel patterns, for example, it has become clear that the range of traveler behavior is much wider than is commonly assumed. Therefore, trying to fit the full range of behavior into only a few simplistic categories can lead to a misunderstanding of the situation.

Cost and Technical Support Considerations

Although EDCDs provide powerful capabilities, the units themselves can be fairly expensive and a large number may be required for a given survey. Survey firms and airports conducting frequent surveys will generally acquire their own equipment and allocate the cost over many different surveys. It may be cost effective for infrequent survey sponsors to rent units. In this situation,

it would be desirable for the survey planning team to purchase a few units for questionnaire development and post-survey use, but rent additional units for the period of the survey. There is also the cost of the data entry software to be considered. Depending on the software used, license fees can cost as much as the units themselves. However, the cost of the equipment and software has to be balanced against the saving in data entry costs, both for the current survey and for future surveys that will use the equipment.

While the technology involved in using EDCDs will be familiar to anyone with a personal digital assistant (PDA), some technical support will be necessary, particularly for programming the units and downloading the data. Survey firms with experience using EDCDs should be able to provide this level of technical support, either with their own staff or though a subcontract with a technical specialist who has appropriate programming experience.

4.9.2 Choice of Equipment

The choice of equipment for EDCDs involves tradeoffs between cost, capability, and ease of use. With increasing capabilities in terms of memory, screen size, and battery life, standard PDAs are becoming widely used for survey data collection. Custom devices that have been designed specifically for use in survey data collection are also available. These generally have larger screens and keyboards but are typically bulkier and heavier, and thus harder to use. The ability to hold the unit in one hand while entering data with the other is an attractive feature of PDAs. Consideration should also be given to the need for staff to hold the units for extended periods of time while standing; therefore, compactness and light weight are distinct advantages. On the other hand, a small screen limits the font size and the number of response options that can be displayed on one screen, while a compact keypad is more awkward to use and more likely to lead to mistyping. The principal factors to consider in selecting equipment are

- Screen size and clarity.
- Data storage capacity.
- Software that can be used.
- Use of keypad versus stylus.
- Key size and keypad layout.
- Battery charge life and recharge time.
- Weight and handling.
- Data export capability.
- Wi-Fi or cell phone capability.
- Cost.

Laptop and tablet computers have been used for some survey applications where complex, graphically intensive screen displays need to be shown to respondents. However, these are awkward to hold for extended periods and would require either that respondents and interviewers be seated during the interview or that interviewers be provided with a mobile cart to support the unit.

4.9.3 Programming Considerations

Selection of software to program EDCDs involves the choice between purchasing commercial software and developing a custom program using a suitable programming language. Commercial software is available that has been designed for programming surveys on EDCDs, particularly PDAs. The more advanced software generally includes the capability to present the usual types of questions and response formats, including categorical check-box questions and free text input, as well as to program skips to different questions based on the responses to prior questions. However, this software often has limited ability to display sophisticated graphics or custom screen layouts. Thus for applications that require this capability, it may be necessary to

develop a custom program. In this situation most survey sponsors will retain a survey firm that already has this capability.

Selecting an appropriate commercial software package involves deciding which program features and capabilities are required and which packages support the EDCDs being considered. The choice of EDCD and software should be approached as an integrated decision, because such issues as screen size and keypad design interact with how the software displays the questions and allows the responses to be entered.

As with any other software and hardware, capabilities are continually evolving and hardware costs are dropping, so the survey planning team or contractor will need to assess the currently available technology before making a purchase. Some questions to consider when reviewing commercial software follow:

- What question formats are supported?
- Can the software combine different types of question format (e.g., both check-box responses and free-text answers) in the same screen display?
- How does the software handle questions that have more response options than will fit on a single screen?
- What are the limits to the number of response options a given question can have?
- Can the user customize the code that is used for each categorical response for a given question?
- Can the user customize the order that categorical responses appear on the screen?
- What are the limits to the number of questions?
- Can the software use an existing data file to control what response options for a question are displayed based on prior responses (e.g., listing hotels in a given city)?
- Can the software display response options based on the first few characters entered (e.g., suggesting city names based on the first two or three letters)? Do the options get refined as more letters are entered?
- Can the user restrict the format used for numerical entries (e.g., require that a zip code have five digits and no decimal point)?
- Can the user specify a template for numerical entries (e.g., telephone numbers as xxx-xxx-xxxx)?
- Can the user specify range and consistency checks to be made on numerical responses?
- Does the software provide specific capabilities to enter dates and times?
- Does the software support touch-screen responses?
- Can the software display a keyboard on screen for entering free text?
- Can the software display graphical features?
- Can the software allow the user to select a location on a graphical feature (e.g., a location on a map)?
- Does the software allow logic branches, and how easy is it to program logic branches?
- How much memory or disk space does the program occupy?
- How much memory or disk space is required to store each survey response, and how does this vary with the number of questions?
- What data download formats does the software support?

4.9.4 Survey Logistics

Other considerations also need to be taken into account in using EDCDs. There will need to be a secure room where the equipment can be left when not in use and where the data can be downloaded. It will usually be necessary to have spare batteries that can be charged while the units are in use or to have spare EDCDs to use while others are being recharged. Downloading the data from the units will typically require a desktop or laptop computer. Access to a telephone line or Wi-Fi link will allow the downloaded data to be transferred to a central database on a regular basis. Because the units themselves are fairly expensive (several hundred dollars each), appropriate steps

should be taken to ensure their security while in use. Units should be checked in and out to survey staff at the start and end of each shift, and staff should be trained not to let them out of their possession while they are in use. It may be prudent to provide each unit with a short tether that can be clipped to the interviewer's apron or vest to help prevent loss and damage.

4.9.5 Staffing Considerations

Use of EDCDs will generally require staff training. Some older interviewers may have less experience handling small electronic devices, may have difficulty using the small keypads or seeing the screen display fonts, and may require additional practice to become comfortable using the devices.

The other staffing consideration relates to programming and technical support. The programming can be subcontracted if nobody on the survey planning team has the necessary skill and experience, but this will incur additional cost and administrative effort. The team will need to coordinate closely with the programmer to ensure that the finished program performs satisfactorily. Although technical support in the field does not require the same level of specialized skill as programming, and will generally be within the capabilities of survey supervisory staff, some training may be required beforehand if the field supervisors have not performed this function previously.

4.9.6 Summary

Although EDCDs offer a number of distinct advantages, experience in their use for airport user surveys has been mixed. Problems can arise if their use has not been carefully planned and thought through. As with any evolving technology, some of the difficulties that arose with the early hardware and software have been overcome. Even so, the effective use of EDCDs requires some technical skills and experience. Survey sponsors should consider on a case-by-case basis whether the advantages justify the effort involved. In general, hand-held EDCDs are only practical to use with interview surveys. Printed forms will typically be required for self-completed surveys.

Surveys with the following characteristics tend to favor the use of EDCDs:

- A long or complex set of questions with multiple branches.
- The need to tailor questions to the respondent's answers to earlier questions.
- Questions with a large number of categorical response options.
- A large sample size (resulting in high data entry costs).
- The desire to include data consistency checks during the survey interviews.
- Availability of survey staff with experience in the use of EDCDs.
- The survey is likely to be repeated frequently (spreading the cost of programming over several surveys).

On the other hand, surveys with the following characteristics may be more appropriately performed using printed forms:

- A fairly simple questionnaire with limited branching.
- A relatively small sample size.
- Straightforward questions that do not require data consistency checks.
- Respondents with limited time to answer questions, who may need to be given the survey form to complete and mail back later.
- Respondents need to enter information or complete the questionnaire themselves.
- Lack of staff with appropriate experience in the use of EDCDs.
- No plans to repeat the survey in the near future.

4.10 Data Entry and Quality Control

4.10.1 Data Coding, Data Entry, Verification, and Editing

Data coding refers to the assignment of numeric codes to the various response options. Typically, this is done at the time the questionnaire is developed and the codes are shown on the printed survey form to assist in data entry or embedded in the EDCD program. In some cases, responses in free-text fields are assigned numeric codes in a separate field, particularly where the same response recurs frequently in the data, such as hotel names. Although response codes can be omitted from printed survey forms and provided to the data entry staff as a separate document, this procedure may require them to refer to two different documents during data entry (depending on the data entry software) and may slow down the data entry and/or introduce data entry errors. It will of course be necessary to define any response codes for commonly occurring free-text responses after the survey has been performed.

Data entry involves transferring the survey response data from the survey forms to a computer file using the numeric codes shown on the survey form or developed later and defined in a survey codebook. Two methods may be considered:

- Manual data entry, using survey staff (or others) retained after the survey data collection for this purpose. This method is labor intensive and subject to data entry errors.
- Mass-scanning techniques, using high-speed scanning hardware and software that is capable of automatically coding responses into a database. Further information on this method, including pros and cons, is provided in Appendix E.

There are two aspects to data verification:

- Checking that the data entry was done correctly. Ideally this involves repeating the data entry task with different staff and comparing the two files. Data entry software typically provides a verification function that compares the second data entry to the original file and flags any differences. Any discrepancies are then resolved with reference to the survey forms. However, this technique doubles the data entry cost. A less expensive but less reliable approach involves verifying a random sample of survey forms. This technique will establish whether the required accuracy for data entry has been achieved, but of course cannot identify and correct any errors on the survey forms that are not included in the verification.
- Analyzing the data to identify any obvious errors, inconsistencies, or apparently illogical responses. This can address such issues as whether a trip origin zip (postal) code is in the reported city, and whether the street name of a reported address exists in the city indicated. A common problem is misspelling of free-text data, such as city or street names, or switching digits in zip and postal codes. Checks can be run to make sure that respondents reporting the use of ground transportation services reported trip origins in locations where use of the service would be plausible. Numerical responses can be checked to ensure that they are within a reasonable range. Free-text responses in the "Other" category of categorical questions should be reviewed to determine whether the response should have been given as one of the defined categories. In some cases, an error will be fairly clear, such as misspelled names or transposed digits in a zip or postal code. In other cases, it may be less obvious what the correct answer should have been, or even whether there is an error at all.

Data verification can be very time-consuming if done thoroughly, but the overall quality of the survey data is greatly improved by devoting adequate resources to this task. The majority of the required effort lies not so much in identifying apparent errors in the data, which is fairly straightforward, but in the research necessary to determine what the correct response should have been. For example, it may be fairly easy to determine that a zip code is not in the reported city, but figuring out what the error is in the zip code, or even whether the zip code is correct but

the city name wrong, is much more time-consuming. The more redundant information that is obtained in the survey, such as asking for both the zip code and state (or province) of a respondent's home, the easier it is to identify and correct any errors. "Self-completed Surveys" in Section 5.2.2 includes a discussion on the verification of air party size that may be helpful in understanding what can be involved in the data verification and cleaning process.

Data editing is the final step in the process and involves making the necessary changes to the data file to correct any known errors. It is good practice to preserve the originally reported data in one set of data file variables (these may be referred to as fields or columns) and copy the data to a different set of variables before editing it. This procedure allows the data that have been changed to be identified later. Then changes can be revised—or even reversed—if subsequent information comes to light.

4.10.2 Benefits of Using Interviewers for Data Entry

Where the survey takes place over a relatively long period, such as several weeks, it is highly desirable to start on the data entry and verification process while the survey is still in progress. This can help identify any problems with the survey questions or procedures while there is still some opportunity to correct them during the remainder of the survey.

When the survey schedule permits, it may be advantageous to have contract staff hired as interviewers spend some time assisting with the data entry task. Exposing them to the difficulties involved in transcribing the information from the survey forms might lead them to take more care with the way they record responses during the remainder of the survey. Also, because extra interviewers are usually required as backup, using them for data entry helps keep them productively employed when they are not required for interviewing.

In general, however, temporary staff hired as interviewers will not have the data entry skills to efficiently perform the majority of this work. In addition, they will generally not have enough local knowledge about the airport and ground transportation system to perform effective verification and error correction. Therefore verification and error correction will require the active involvement of the survey planning team and possibly the assistance of other operations or planning staff with the necessary local knowledge.

4.11 Analysis and Reporting of Survey Results

At this stage of the project the survey data collection is complete, the data have been entered into appropriate databases, and the data have been checked for the internal integrity of each response and cleaned accordingly. It is now time to undertake the analysis, as determined by the goals of the survey project.

4.11.1 Considerations for Doing the Analysis In-House

When the analysis will be completed by in-house staff, the resources necessary may not need to be included as part of the survey project budget.

It is appropriate to use in-house resources if the following considerations make it feasible:

- There is sufficient expertise in-house to complete the tasks listed in this section, and this expertise is available in a timely fashion after the data collection period.
- The appropriate software and hardware exists to complete the analysis. Modern spreadsheet applications have many data analysis capabilities. The requirements may extend beyond these capabilities, in which case the survey sponsor should consider using the more powerful statistical features of applications such as SAS® or SPSS®.

4.11.2 Weighting and Expansion

Once the data have been cleaned and made available to the analyst, one of the first priorities is the assignment of one or more weighting factors to each interview response. In the case of sample surveys that have been conducted according to a strict sampling plan, the response weights will be determined as part of this plan, as discussed in Sections 3.5 and 5.5. These weights can be added to each interview record.

In the case of groundside surveys, discussed in Section 5.9, there will be one weight assigned to the interview record based on the vehicle count at the facility and a second weight assigned based on the passenger volumes. The analysis may utilize either of these weight factors depending on the focus of the results, passenger versus vehicle.

Depending on the available data, these census counts might include the following:

- Air passenger counts, possibly by hour or by day.
- Parking ticket counts.
- Automated vehicle identification system counts for modes other than private vehicles.
- Roadway traffic counts.
- Control count observation surveys—such as at the curb area, security clearance area, or other suitable location—for determining the effective sampling rate and weighting of responses to be used in the analysis.

4.11.3 Tabulation and Interpretation

Tabulation and interpretation are the core of the analytical process. Typically, this process begins with basic frequency counts of the key variables and cross-tabulations. This step can often reveal unexpected relationships as well as unexpected problems in the data. It is recommended to do basic frequency counts on all variables to get an initial look at the numbers of valid responses for each question.

The process of data analysis is determined by the goals of the survey and is often a personally defined process, unique to the analyst. Invariably the analysis will reveal many interesting results that appear to warrant further analytical effort. However, further analysis should only be pursued as time and resources permit. It is in these secondary analyses that the additional value of the data will be exploited.

4.11.4 Survey Accuracy and Limitations

An important, but sometimes overlooked, purpose of the data analyst is to identify the accuracy of the results as well as the limitations within the survey data. Where results are provided for subgroups of the population, the accuracy of the estimates for these subgroups should also be identified. In some cases

- The sample size may not be sufficient, and consequently it may not be feasible to drill down to increasing levels of detail.
- The conduct of the survey or response rates will produce limitations in how the data can be analyzed or the level of detail that can be achieved in the analysis. Avoiding these limitations is a key reason to include the expertise of a data analyst from the outset of the survey project.
- The limitations may be a function of the questions, how they are coded, and what responses were obtained. These limitations may not be revealed using data analysis techniques alone.

4.11.5 Report Preparation and Presentations

The primary reports and presentations must be directed towards the goals and purpose of the survey. A formal report is generally required and will be a substantive document that fulfills the

requirements of the survey project. A presentation on the results of the survey, which addresses the purpose of the survey and explains what was obtained for the funds approved, will close the loop with senior management.

4.11.6 Publications

The entire survey project, while unique to the agency and airport involved, may include aspects that are of potential use to a wider audience. In this regard, consideration should be given to publicizing the survey results to parties beyond the original survey planning team. The decision to publicize the results is the responsibility of the survey sponsor.

There are many forums where such publications would be welcome. Because there are many airports conducting surveys at any time across the country and around the world, other planners may just be beginning the process and would benefit from the knowledge gained from this survey. Perhaps the single most effective way to distribute information about airport user surveys is for survey sponsors to post the survey reports on their websites.

4.12 Post-Survey Analysis: Lessons Learned

The periods immediately following the survey and after the analysis are important times to sit back and reflect on the survey. Chances are that there are a number of things that went really well. It is also likely that some things did not go as well as planned. Documenting this information at this point will prove worthwhile when it is time to do another survey in the future.

For both the things that went right and the things that went wrong, it is important to document why this is the case, and what the thinking was underlying the various decisions.

Especially important is documenting what went wrong, why it went wrong, and how it should be done if it had to be done again. At this closing stage of the project there are probably some ideas and thoughts that can be included in this document that will help in the future.

During the survey, the project team probably received many comments—from supervisors, interviewers, and even the airport users who were interviewed—about things that could have been done better. Documenting all these comments will ensure they are considered before the next survey, when improvements can be made at the design stage.

4.13 Documenting the Survey

It is important to record as much as possible about the survey. The importance of recording what went right and what went wrong has already been emphasized. Throughout the survey project, a number of other documents will have been created for various purposes. All this documentation should be preserved for possible re-use in later surveys.

Documents that are likely to have been created and that should be maintained for future use include the following:

- Survey design reports (including sampling procedure, survey plan, logistics documentation, etc.).
- Requests for Proposals for any contractors.
- Training materials.
- Survey questionnaire.
- Data entry or transfer software.
- Survey analysis reports and presentations.

- Lessons learned.
- The data.

Of all the components of the survey, the data are the most valuable. This information, after all, is what the money was spent to collect. Even after the analysis is completed, these data will be invaluable in the future.

4.14 Summary

This chapter has covered the general aspects of planning an airport user survey and outlined issues common to all surveys. Planning tasks specific to the particular type of survey to be conducted are described in the following chapters.

It is clear that planning an effective airport user survey requires careful consideration of a large number of different factors. It follows that adequate resources and time need to be allocated to the planning stage. The appropriate level of resources and lead time will vary with the circumstances of each survey—in particular, whether the survey is being performed for the first time or is repeating a former survey. For an air passenger survey with several thousand respondents being performed for the first time, the planning stage could require as much as 20% of the overall budget and should commence at least six months before the planned data collection. The time required is considerable, but the quality of the resulting information will depend on the effort devoted to sound planning.

CHAPTER 5

Air Passenger Surveys

A survey of air passengers involves a number of difficult challenges because of the wide range of information that may be required and the limited opportunity to perform the survey, given that the subjects are anxious to catch their flight. Thus air passenger surveys require careful attention to survey methodology and development of an effective sampling plan and questionnaire. Related aspects that are also addressed in this chapter include gathering information on greeters and well-wishers and on the use of ground vehicles for planning airport groundside facilities.

5.1 Purpose of the Survey

Much of the information about air passengers that is needed for planning or operational decisions cannot be directly observed or is not readily available from statistics that are collected routinely; it can only be obtained by asking the passengers themselves. Surveys of air passengers are the most common type of airport user survey and are performed for a variety of reasons, including data collection on the following:

- Air party characteristics for airport terminal planning.
- Air passenger use of ground transportation for airport groundside[15] planning and regional transportation planning.
- Air travelers' choice of airport in a multi-airport region.
- Air passenger satisfaction with airport facilities or services.

An air passenger survey may be initiated to gather information on a very specific issue, such as the use of different ground transportation modes in order to perform an air quality emissions analysis for environmental impact documentation of an airport project. However, given the cost and effort involved in performing a survey, consideration should be given to whether there are other information needs that can be met at the same time by expanding the scope of the planned survey. Such scope expansion will require a careful tradeoff between the need for the additional information and the potential impact on the cost and complexity of the survey.

The information obtained from air passenger surveys is so important to airport planning and management that many airports perform such surveys on a regular basis, such as every year. These surveys often contain the same core set of questions in order to provide a consistent time

[15] Also often referred to as landside planning. However, the term landside can also refer to airport terminal facilities, as distinct from airside facilities that handle aircraft. The terms landside and airside are also sometimes used to refer to the areas of the passenger terminal before and after security screening. For these reasons, the term groundside is less ambiguous and is used throughout this guidebook to refer to those areas of the airport used by ground access and egress vehicles, including the terminal curbfront, airport roadways, and vehicle parking facilities.

series of information, but questions may be added to a specific survey to address particular issues of interest at the time.

One important role of air passenger surveys is to provide information on air traveler characteristics and decisions in order to develop models for air travel demand forecasting, airport ground access mode choice, and airport choice. These models play an important technical role in airport planning, regional transportation planning, and airport system planning studies and generally require very detailed data on a large sample of individual air travel parties.

Table 5-1 illustrates the range of information obtained in a representative sample of air passenger surveys undertaken prior to the drop in traffic following the events of September 11, 2001. Although the travel environment has changed since 2001, the types of information shown in the table remain valid.

The purpose for which the survey is being undertaken influences a wide range of survey planning decisions, including how and where the survey will be performed, the questions that will be asked, the sample size required, and the sample strategy adopted. Therefore, the purpose needs careful thought at the start of the survey planning process.

5.2 Survey Methodology

The circumstances under which air passengers spend time at an airport have an important influence on the choice of survey methodology. Passengers are available to be surveyed for only a relatively short time and may have activities they need or wish to undertake during this time. Departing passengers are concerned that they not miss their flight, while arriving passengers may have people waiting to meet them or be anxious to claim checked bags and be on their way. These constraints determine how passenger surveys can be performed.

The three principal decisions on survey methodology are as follows:

- Whether to interview passengers or use self-completed survey forms.
- Where to perform the survey.
- When to perform the survey.

There are a number of issues specific to air passenger surveys that need to be considered in planning the survey and designing the questionnaire, including how to account for air passengers traveling together and the variation in air travel characteristics by time of the day and day of the week.

5.2.1 Issues Specific to Air Passenger Surveys

The first issue to consider is that air passengers often travel in groups, referred to as air travel parties, so it is important for surveys to collect information on the composition of the air travel party. Whether it is best to collect data on the basis of the air travel party or from air passengers as individuals is really a function of the survey methodology. Self-completed surveys are typically given to every adult passenger, because it may not be obvious who is in the same party when the questionnaires are distributed. Handing out questionnaires to every passenger is fairly low cost and helps improve the response rate, because some passengers may not complete the survey. If the survey involves survey staff interviewing respondents, typically only one representative from each party is interviewed. It makes no sense to ask the same questions of other members of the same party, although there are a couple of caveats to this.

The first caveat is that with large air travel parties, such as tour groups, an interview survey may get multiple responses from the same party, because the members of the party may not be

Table 5-1. Information obtained in a sample of air passenger surveys.

Question	DIA 1999	MWCOG 2000	LAWA 2001	MTC 2001
Airline/flight			●	●
Flight destination			●	
Originating/connecting		●	●	Originating only
Arriving/departing/connecting	●			
Final destination of air trip		●	●	●
Purpose of trip	●	●	●	●
Number of people in air travel party	●	●	●	●
Number of well-wishers	●	●	●	●
Departure time from trip origin			●	●
Arrival time at airport	Before flight		●	●
Type of ground access trip origin		●	●	●
Ground access trip origin address		●	●	●
Mode of transportation to airport	●	●	●	●
Use of parking/terminal curb	●	●	●	●
Parking facility used	●	●	●	●
Duration vehicle parked				●
How accessed bus or train				●
Reason for choosing access mode			●	●
Number of checked bags	●	●	●	●
Number of carry-on bags			●	●
Where checked bags	●		●	
Use of airport in past year	●	●	●	●
Use of other airports in area		●	●	●
State of residence	●	●	Country	●
City/zip code of residence		●	●	●
Nights away on trip/nights in area		●	●	●
Time of arrival/return flight				●
Airport used for arrival/return			●	●
Egress mode on arrival/return			●	●
Number of people in household		●		●
Total annual household income		●	●	●
Vehicles available at household		●		
Age of respondent		●	●	
Gender of respondent	●		●	●
Satisfaction with facilities/services	●			
Amount spent while visiting area		●	●	
Amount spent at airport			●	
Reason for choosing airport		●	●	
Preferred airport		●	●	

Note: Table does not show all questions asked in each survey.

Sources:
- DIA 1999 — Denver International Airport, *1999 DIA Intercept Survey*, Denver, Colorado, September 1999.
- MWCOG 2000 — Metropolitan Washington Council of Governments, *2000 Washington–Baltimore Regional Air Passenger Survey*, Washington, D.C., June 2002.
- LAWA 2001 — Los Angeles World Airports, *2001 Air Passenger Survey*, Los Angeles, California, April 2004.
- MTC 2001 — Metropolitan Transportation Commission, *2001 Airline Passenger Survey*, Oakland, California, September 2003.

standing or sitting together and it may not be obvious who is in the party. Indeed, it may be desirable to get multiple responses from the same party because their characteristics may be different (e.g., they may have traveled to the airport separately). This situation leads to the second caveat. There may be a difference between the air travel party (often shortened to air party) and the ground access party (e.g., two colleagues going on a business trip together who travel to the airport independently from their homes). These issues have to be addressed in the questionnaire wording (see Figure 5-1).

Including yourself, how many people are in your air travel party today? By air travel party, I mean all of the people who are **traveling together** with you **on the same flight**.

If more than one person in air travel party, ask:

And how many of these are children under the age of 18?

If air travel party is more than six people, ask:

Are you traveling as part of an organized group, such as a tour group, school party, sports team, etc.? Yes/No *If Yes:* What is the name of this group? _____

(Ask following questions after asking about airport access mode used)

If more than one person in air travel party, ask:

Including yourself, how many of the people **in your air travel party** came to the airport together in the same vehicle as you?

For shared-ride modes only (shared-ride van, courtesy shuttles, scheduled airport bus, charter bus or van), ask:

How many **other** passengers (**not including your air travel party or the driver**) were in the vehicle when it arrived at the airport?

Figure 5-1. Sample question wording to address travel party characteristics.

A related issue is the extension from air party travel patterns to vehicle trips, which are typically required for groundside and ground access planning. In some cases (e.g., use of rental cars or private vehicles parked at the airport for the duration of the air trip), there is usually a one-to-one correspondence between the air party trip and the associated vehicle trip. In other cases (e.g., passengers dropped off at the airport by private vehicles), there will be two one-way vehicle trips for each one-way air party trip. In the case of taxis or hired limousines, there may be additional vehicle trips, depending on whether the operator is able to obtain a fare in the other direction. In the case of shared-ride modes, the number of air parties in each vehicle trip can vary widely, depending on the ability of the operator to combine parties into a single trip. Therefore, for some modes it is useful to determine how many of the air party were in the vehicle that the survey respondent traveled in to the airport and how many other passengers (not from the air party) were also in the vehicle. Figure 5-1 shows some possible question wording to address this issue.

The differences in air and ground access party composition and characteristics raise the question of whether to present survey results in terms of air parties, ground access parties, or air passengers. Depending on how the results are going to be used, it may be desirable to present the results more than one way. From the perspective of ground access planning, it may be best to present results in terms of ground access party or air parties, because, generally, each air party represents a single ground access decision (with the caveats noted above). However, for shared-ride modes one may want to know what percentage of air passengers use the mode, because, generally, ridership on such modes is counted as people rather than parties. The bottom line is that to interpret the survey results properly, it is important to understand the distinction and be clear what is being shown. Knowing the average air party size for each mode, the data can always be re-expressed on whatever basis makes the most sense for a given issue.

Another issue that has to be addressed in planning an air passenger survey is the variation in passenger characteristics over the time of the day and days of the week. Typically a higher

proportion of business travel occurs at the start and end of the day and on weekdays rather than weekends, although a significant amount of originating business travel may occur on Sundays. The pattern of travel is also different for residents of the area and visitors: residents tend to leave earlier in the day, while visitors are more likely to travel later in the day.

Example of Variation Over Day of Week and Time of Day

To illustrate these effects, Figures 5-2 and 5-3 show the variation in the composition of air parties for two airports in the San Francisco Bay Area: Oakland International Airport (OAK) and San Francisco International Airport (SFO). The composition varies both by day of the week (Figure 5-2) and time of day (Figure 5-3), although the variation is greatest by day of the week. There are also clear differences in traffic composition between the two airports.

At OAK [Figure 5-2(*a*)], business travel accounts for the greatest proportion of the traffic on Wednesdays. The split between business travel by residents and visitors is quite different, with the highest proportion of resident business trips early in the week and the highest proportion of visitor business trips from the middle to the end of the week. Notably, business travel on Saturdays is not significantly different from Fridays. Personal travel shows the reverse pattern, with resident personal trips increasing toward the end of the week, with the highest proportion on Fridays. Visitor personal trips are at their highest proportion on Sundays and decline steadily during the week, reaching their lowest proportion on Thursdays and Fridays.

The variation of traffic composition by day of the week at SFO [Figure 5-2(*b*)] shows a similar pattern, although business travel remains strong through the end of the week, with the highest proportion of visitor business trips on Fridays. The highest proportion of resident personal trips occurs on Thursdays rather than Fridays.

The traffic composition by hour of the day at OAK [Figure 5-3(*a*)] appears fairly consistent until late afternoon, with the proportion of visitor personal trips increasing from about 4 p.m. (i.e., 16 on the 24-hour clock), reaching its highest level between 8 p.m. and 9 p.m. (20 and 21). The traffic composition at SFO [Figure 5-3(*b*)] shows somewhat greater variation by hour of the day, with a higher proportion of business trips in the early morning and from the middle of the afternoon until about 8 p.m. (20).

The survey results for both airports appear to show an increase in the proportion of business trips between 11 p.m. and midnight (i.e., 23 and 24), although the small sample sizes at this hour make these proportions statistically unreliable. Unlike the situation at OAK, where the proportion of business trips made by residents is fairly consistent throughout the day, the proportion of business trips made by residents at SFO is highest in the early morning and declines progressively through the day.

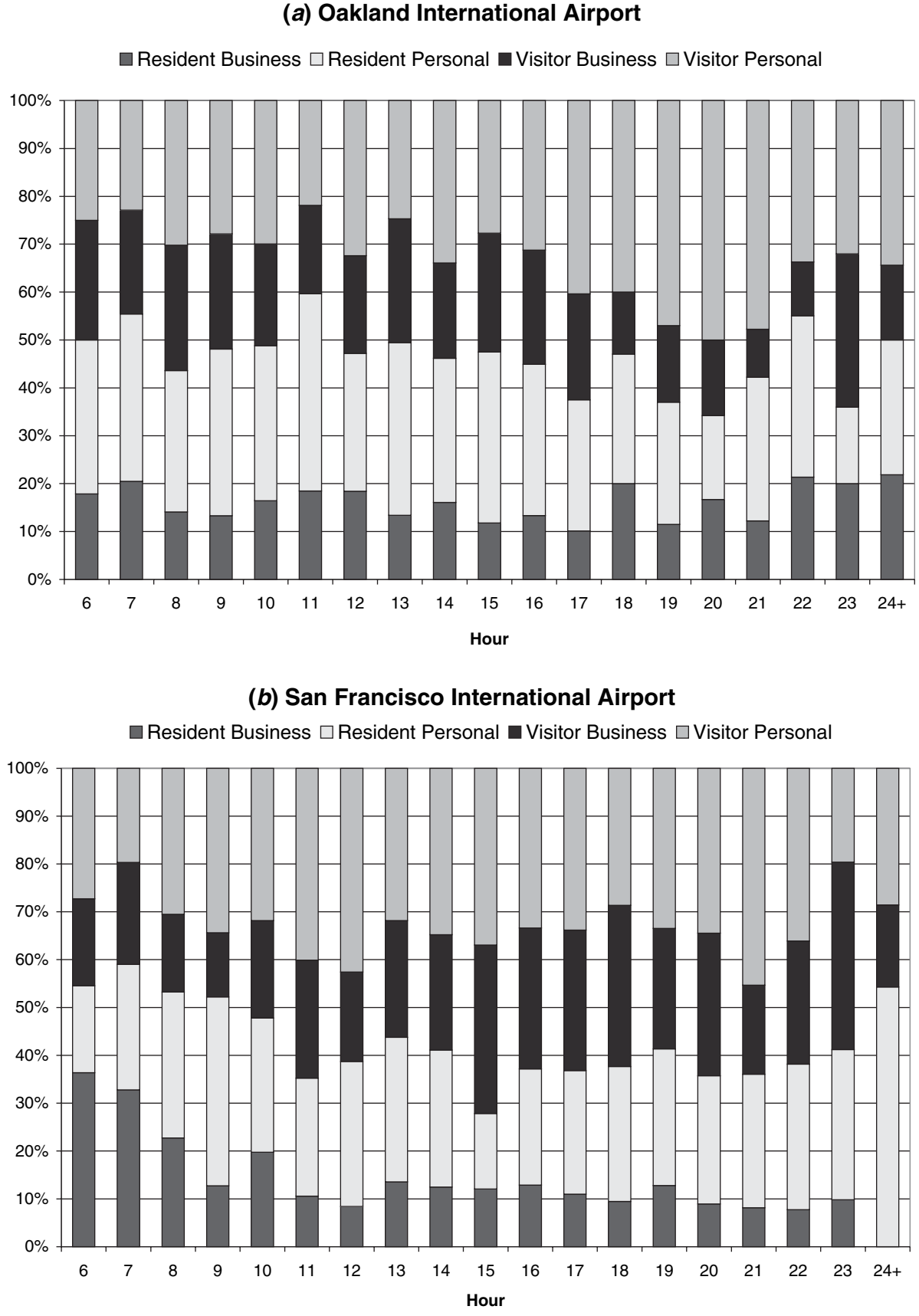
The traffic patterns at OAK and SFO illustrate the importance of ensuring adequate survey coverage for each day of the week and hour of the day. Performing a survey on only some days or during only some hours would bias the results.

5.2.2 Approaches to Surveying Air Passengers

There are two very different approaches to performing air passenger surveys in airport terminals: *intercept interview surveys,* in which survey staff select potential respondents and record their answers to the survey questions, and *self-completed surveys,* in which questionnaires are distributed to potential recipients to complete and return. The advantages and disadvantages of each, together with some practical considerations, are discussed in the following paragraphs.

Source: Metropolitan Transportation Commission, *2006 Airline Passenger Survey* (Project team analysis of survey response data).

Figure 5-2. Variation in air party composition by day of week—departing passengers.



Source: Metropolitan Transportation Commission, *2006 Airline Passenger Survey* (Project team analysis of survey response data).

Figure 5-3. Variation in air party composition by hour of the day—departing air passengers.

Intercept Interview Surveys

Intercept interview surveys are generally more costly to perform than self-completed surveys, because of the staff time required to perform the interviews. However, it is generally believed that the resulting data are of better quality, because the interviewers can ensure that questions are not skipped, clarify questions for the respondents, resolve ambiguous or unclear responses, and attempt to obtain responses to open-ended questions—such as the trip origin address—in the level of detail required. Interview surveys can also include more complex branching and follow-up questions, because the respondent does not generally see the questionnaire.

The two principal planning issues with intercept interview surveys are as follows:

- The protocol for selecting the potential respondents to approach and ask to participate in the survey.
- Whether to use printed questionnaire forms or EDCDs.

In the case of interviews in airline gate lounges, it is generally not feasible to interview every air party in the lounge, because of time and staffing constraints. Interviews can only take place over a limited period, typically 30 to 40 minutes, after enough passengers are in the lounge to provide a representative sample of air parties and before boarding commences. If the interview takes an average of five minutes, each interviewer would be able to complete six to eight interviews. A typical domestic flight with a narrow-body aircraft might have 70 or more air parties (105 passengers) depending on the size of the aircraft and the load factor. At least 10 interviewers would therefore be needed to survey every air party. Quite apart from the logistical difficulty of trying to conduct that many interviews simultaneously, passengers do not arrive in the gate lounge uniformly, so it would be necessary to interview a larger proportion of air parties closer to boarding time, further increasing the number of interviewers required.

As a result, intercept interview surveys usually attempt to survey only a sample of air parties. In the foregoing example, a team of three interviewers might be able to survey every fourth air party.

Interview surveys should define a sampling protocol that the survey staff will follow in order to avoid respondent selection bias. The following protocols are examples:

- For an airline gate lounge interview with two interviewers, one interviewer should start with the right-most passenger (as viewed by the interviewer) seated in the row of seats furthest from the airline podium, then select every fifth passenger, counting to the left and proceeding around the rows of seats, from the outermost seats toward the center of the lounge. The second interviewer should start with the right-most passenger seated in the row of seats closest to the podium, then select every fifth passenger, also counting to the left and proceeding outward from the seats closest to the podium in a general counter-clockwise direction.
- For a survey of passengers exiting security screening, the interviewer selects the next passenger to exit the screening area after completing each interview.

The logic behind sampling every fifth passenger in the first example (when two interviewers might expect to survey about one-seventh of the passengers on the flight) is to allow for passengers who arrive after the surveying has started and sit in areas of the lounge that have already been surveyed, as well as those passengers that choose not to sit in the lounge at all.

Because the layout of seating in airline gate lounges varies widely, sampling rules should be flexible enough to accommodate the different layouts that the interviewers are likely to encounter. Interpreting the sampling rules in different situations should be part of interviewer training. Examples of respondent sampling sequences in two different gate lounge layouts are shown in Figure 5-4.

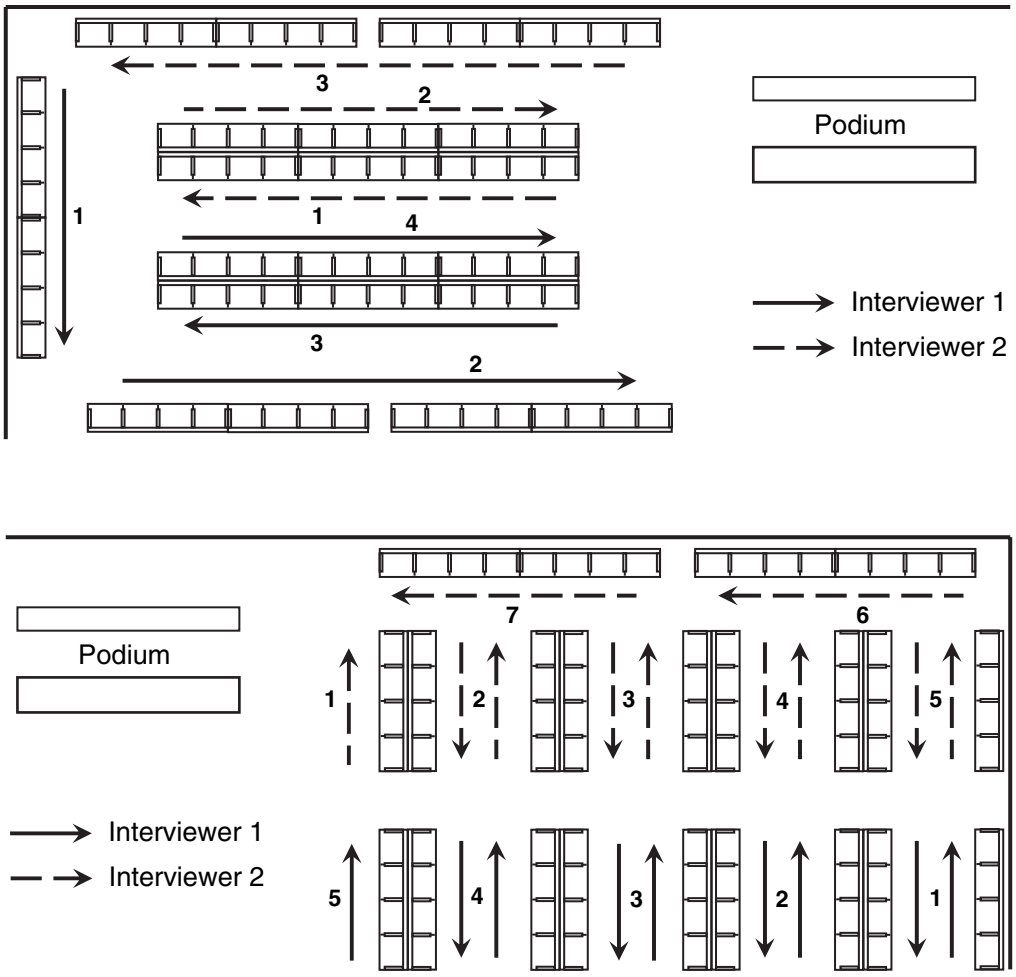


Figure 5-4. Typical respondent sampling sequences in airline gate lounges.

Two issues arise in sampling passengers in an airline gate lounge. The first is that passengers will arrive in the lounge as the interviews are in progress. Some of these passengers will sit in areas of the lounge that have already been surveyed and therefore will be missed in the sampling process. Thus passengers who arrive in the lounge well before boarding commences will have a higher probability of being sampled than those arriving closer to boarding time. This occurrence needs to be considered in weighting the survey results.

The second issue is that as the seating in the lounge fills up, some passengers may choose to stand. Members of large air parties, in particular, may not sit down, or some members of the group may stand while others sit. Passengers arriving in the lounge shortly before boarding is scheduled to commence may choose not to sit down, even if there are empty seats. Therefore, the sampling protocol needs to include standing passengers as well as those seated.

Some passengers may also change seats or stand in a different part of the lounge as the interviews are in progress. In particular, many passengers will get up and stand closer to the boarding point as the time to board approaches. (One airline has formalized this process at some airports by installing numbered markers in the queuing area corresponding to a sequence number on the boarding pass.) In principle, when passengers leave an area that has not yet been surveyed and move to an area that has been surveyed, or joins the queue waiting to board the flight, it is the same as if they arrived in the lounge at the time they changed positions.

Obviously, there is a small chance that passengers who change position in the lounge could be sampled twice. However, interviewers will usually recognize people they have just interviewed, and passengers will generally indicate that they have already been surveyed if they were interviewed by another interviewer.

The tradeoffs between the use of printed forms and EDCDs have been discussed in Section 4.9. For use in air passenger surveys, EDCDs have a number of attractive features. They can be programmed to probe for detailed information on specific issues from certain respondents in a way that is transparent to the respondents and the interviewers. They can also be programmed to perform consistency checks on the response data and generate clarifying questions to resolve apparently inconsistent or implausible responses. Certain information, such as the time the survey was performed, can be entered automatically. Information that repeats from one interview to the next, such as the location where the survey is being performed, can be entered once and then automatically recorded for subsequent interviews until the interviewer indicates that this has changed.

Figure 5-5 provides examples of consistency checks that could be programmed into EDCDs, and Table 5-2 provides detailed follow-up questions that could be asked to resolve unclear responses or provide additional information.

Another useful feature of EDCDs is the ability to vary the questions asked of different respondents. For example, a question that asks whether air passengers might have changed their ground access mode if a proposed new service had been available could vary the price or other attributes of the service in the wording of the question in order to explore how these factors affect the responses.

The following consistency checks assume that EDCD programs can access relevant ground access service and other information.

- Check that reported airline and flight number is reasonable for start time of interview and reported final destination of trip.
- Check that reported parking facility and duration is reasonable for reported air trip duration and city of residence.
- For reported use of ground transportation services with limited geographical availability (e.g., a shared-ride van operator serving only part of the region), check that reported trip origin is within service area.
- For reported use of fixed-route ground transportation service from a given stop, check that the stop is a reasonable choice from reported trip origin.
- For reported use of hotel/motel courtesy shuttle, check that reported trip origin hotel/motel offers courtesy shuttle service.
- Check that number of air travel party members reported coming to airport in same ground access vehicle is not greater than reported size of air travel party.
- Check that reported number of air travel party members coming to airport in same ground access vehicle is reasonable for reported vehicle.
- Check that reported arrival time at airport is earlier than start time of interview by a reasonable amount.
- Check that reported ground access time from trip origin to airport is reasonable for reported trip origin and ground access mode.
- Check that reported number of checked bags is reasonable for reported size of air travel party.

Figure 5-5. Sample consistency checks.

Table 5-2. Representative follow-up questions.

Purpose	Follow-up Questions
Resolve Inconsistencies	Just to confirm that I have this correct, you stated that you began your trip in (city) and boarded the (airport bus) at (stop). Did I record that correctly? *Yes/No* *If Yes:* Did you travel directly from your trip origin to the stop, or did you stop somewhere along the way for some other purpose? *(Record location of intermediate stop, if applicable, using trip origin questions.)* *If No: Return to relevant question and revise response.* Just to confirm that I have this correct, you stated that (number) of your air travel party came to the airport in the same vehicle. Did I record that correctly? *Yes/No* *If No: Revise relevant response.* Just to confirm that I have this correct, you stated that you began your trip in (city) at (time) and arrived at the airport at (time). Did I record that correctly? *Yes/No* *If Yes:* Did you travel directly from your trip origin to the airport, or did you stop somewhere along the way for some other purpose? *(Record location of intermediate stop, if applicable, using trip origin questions.)* *If No: Return to relevant question and revise response.* Just to confirm that I have this correct, you stated that you arrived at the airport (number) hours ago at (time). Did I record that correctly? *Yes/No* *If No: Revise relevant response.* Just to confirm that I have this correct, you stated that the (number) members of your air travel party checked a total of (number) bags. Did I record that correctly? *Yes/No* *If No: Revise relevant response.*
Obtain Additional Information for Specific Access Modes	
Rental car	Were any passengers dropped off at the curb in front of the terminal before returning the rental car? *Yes/No.*
Scheduled airport bus	At what stop did you begin your trip on the (airport bus)? *(Check response option or write in.)* How did you get to that (airport bus) stop? *(Check response option or write in.)*
Rail system	At what station did you begin your trip on (the train)? *(Check response option or write in.)* How did you get to that (train) station? *(Check response option or write in.)*
Hotel/motel courtesy shuttle	Did you stay overnight at that hotel, or did you visit the hotel only for the purpose of getting to the airport? *(Check response option.)* Did you park at that hotel, or did you get to the hotel some other way? (*Check response option or write in.)*

Because the number of interviews that each interviewer can perform in a given period is fairly constant, there will be a higher sampling rate during periods when the flow of passengers is reduced or when the flights have fewer passengers. Therefore, staffing levels may need to be increased during busy periods or when surveying flights that use larger aircraft in order to achieve a fairly consistent sampling rate.

Self-Completed Surveys

Self-completed surveys should be conducted in a location where respondents are able to fill out the form, which limits the use of this approach to the airline gate lounge or similar location where passengers are seated and have time to do it. The advantage of self-completed surveys is

that a large number of survey forms can be distributed and collected by one or two survey personnel. A common procedure is to distribute the forms to passengers as they enter the gate lounge area and collect them as the passengers board the aircraft, although some passengers may hand the completed forms back before boarding commences.

An important consideration is whether to attempt to survey passengers who arrive at the gate after boarding has begun. Excluding these passengers may bias the sample if those arriving close to flight departure time have different characteristics from those arriving earlier. In general, passengers arriving at the gate once boarding has started will not have time to complete the form before boarding, and therefore if survey forms are to be distributed to these passengers they will need to be designed so that they can be completed later (e.g., on the flight) and returned by mail. In this case, it will be desirable to have a second staff member collect the forms as passengers board the aircraft, so that the person distributing the forms can continue to do so.

The designers of the survey form need to consider that respondents may not have a flat surface to write on. Printing the forms on thin card with a three-part fold produces a form that is convenient to handle and sufficiently rigid to write on while holding in one hand. Survey staff should have an adequate supply of pencils or pens to give to respondents who do not have one.

A number of issues arise with self-completed surveys that need to be carefully considered in the wording of the survey questions, design of the form, and analysis of the results:

- It will not always be possible to determine which passengers are in the same air party when distributing the forms, so it is common practice to distribute forms to every adult passenger. In some air parties more than one passenger will provide responses, while other passengers may decide not to complete the form if they see someone else in their air party doing so or complete it together. It will therefore be necessary to ask about the size of the air party and identify multiple responses from the same party before analyzing the results, so that these responses are not double-counted. Some surveys ask how many respondents from the air party have responded to the survey. However, experience has shown that these answers are often unreliable, possibly due to respondents misunderstanding the term "air party" or other members of their party starting to fill out the form but not finishing. Therefore, it may be safer to identify multiple responses on the basis of the information provided, as discussed further below, or use this question on multiple responses in conjunction with other information provided.
- Respondents may not be familiar with local terminology, particularly for ground transportation services. It is important to describe response options in terms that can be generally understood, rather than use the names of particular local services or facilities. Having respondents provide the name of the transportation provider, service or facility they used, where appropriate, can help resolve misunderstandings over terminology such as "airport bus" or "off-airport parking."
- Skip or branch patterns, when used, should be clearly shown on the survey form, with bold arrows directing the respondent to the next relevant question. Where questions only apply to some respondents (e.g., which parking lot was used), it is better to explicitly direct those respondents to the question with a branch from a previous question rather than ask the question in a way that requires each respondent to decide whether to answer it or not.
- Check boxes for response options should not be too small or too close together. If the check boxes are too close together, it may be difficult to determine which one respondents intended to check.

- Fonts used on the survey form for text that the respondent is expected to read should be no smaller than 10 point. Many respondents may have poor eyesight, particularly in the prevailing lighting conditions in a gate lounge area.

To identify responses from the same air party in self-completed surveys, the analyst can make use of such information as the following:

- Trip origin address (or other location information).
- Final destination for air trip.
- Home zip or postal code.
- Air party size.
- Air trip duration or duration of visit.
- Departure time from trip origin.
- Ground access mode used.

While this process can be partly automated, there will be questionable cases where the analyst will not be able to resolve whether two responses are from the same air party, and inspection of the detailed response data will be necessary to make a decision. This process adds to the data-cleaning workload and constitutes one of the tradeoffs with the lower cost of self-completed surveys.

One issue that arises with self-completed surveys is what to do if members of what is obviously the same party (e.g., they started from the same address and are on the same flight to the same destination) give conflicting information to other questions. This happens more often than might be expected. It may be naive to assume that every survey respondent understands the questions and gives the correct answer. There is also the possibility that apparently conflicting answers are in fact correct—for example, different members of the same party may have different trip purposes or may be returning at different times—or that the apparent inconsistency is a coding error or the result of an unclear response.

In cases where conflicting responses are unlikely to both be correct (e.g., passengers traveling on the same ground access vehicle giving different departure times from the same trip origin), it will be necessary to define a rule for which response to accept. In some cases, examining the responses to other questions may resolve the issue. For example, one departure time may be physically impossible, given the arrival time at the airport, or be an obvious error, such as recording the time as a.m. rather than p.m.

It should also be borne in mind that for some questions (such as the time of departure from the trip origin) respondents will be giving their answer to the best of their recollection. Minor differences in answers from members of the same air party are to be expected.

Hand-out/Mail-Back Surveys

Because of the very low response rate that is typically experienced with mail-back surveys, this approach should only be used in situations when there is not enough time for the respondent to complete the survey and it is not practical to collect the completed survey forms later. Mail-back questionnaires should include a pre-paid return envelope.

5.2.3 Survey Locations

The choice of location to perform an air passenger survey has significant implications for the logistics involved as well as the ability to obtain a representative sample of the target population. The principal options and the associated logistical constraints have been discussed in general terms in Section 2.8. This section discusses the advantages and disadvantages of the different options in meeting the objectives of an air passenger survey.

Non-Secure Locations

Inside the Terminal Building. Within the terminal building there are typically two possible non-secure areas for conducting interviews: one area for surveys of arriving passengers and one for departing passengers.

The non-secure arrivals area of the terminal can be either open or enclosed; the former is typical of smaller domestic operations and the latter is more usual at larger domestic or international operations. The domestic arrivals hall usually provides an opportunity to interview arriving air passengers with any greeters (if present) while waiting for baggage. (Note that passengers without checked baggage would not be included in such a survey process.) For international arrivals the greeters will typically be waiting—en masse—in front of the exit from the customs and immigration hall. While it may be possible to interview the greeters as they wait, it is not advisable to wait for the passengers to join them.

The most suitable non-secure departures area is the lobby in front of the ticket and check-in counters. This area may or may not include other services, such as food concessions or convenience stores. Well-wishers could still be with the air passengers in this area, and members of the entire group can be interviewed. While the lobby is a possible survey location, it is not recommended for surveying air passengers and should only be considered as a way to obtain information from well-wishers.

Although it is possible to perform an intercept survey of air passengers before they join the security screening line, passengers are usually anxious to complete the check-in and security screening process and may be reluctant to take the time. Passengers may spend some time waiting in line, either for check-in or security screening, but this environment is not particularly good for interviews. The passengers need to move with the line, which interrupts their attention to the interview, and they are usually near other passengers, which may make them reluctant to answer some types of questions. During less busy periods, the line may be too short to complete the survey before the passengers reach the check-in counter or screening location. Also, interviewing passengers in the check-in lobby will miss any passengers who already have a boarding pass, which is becoming more common now with Internet and cell phone check-in, and are not checking bags.

The best location to survey passengers before security is as they join the line for security screening, because this line will include all passengers. If the line is fairly short, passengers may not mind being asked to step aside to complete the survey. It is advisable to determine their flight departure time to ensure that there is enough time for them to complete the survey without missing their flight. If the line is long, their willingness to participate may be increased if they can be offered the opportunity to go to the head of the line afterwards. This of course will require the agreement of the local Transportation Security Administration (TSA) staff, but it is fairly common when the security line is long to give passengers who may miss their flight priority in the line.

The problem of potential bias from not surveying late-arriving passengers is no different from any other survey location, although it may involve a higher proportion of passengers, and can be addressed by having mail-back survey forms to distribute to such passengers.

Groundside Locations. Intercept surveys of air passengers can also be performed in non-secure locations on the airport groundside, such as the terminal curb front, parking lots or payment machines, transit stations or boarding areas, rental car facilities, and inter-terminal shuttle bus stops or people-mover stations. (Section 5.9 discusses groundside surveys in more detail.)

With the exception of the terminal curb front, these locations will only allow a subset of air passengers to be surveyed. However, they may allow a larger sample of this subset to be obtained to supplement a more general sample of air passengers obtained at other locations. For example, the proportion of air passengers using transit is typically fairly small. Thus a survey in air-

line gate lounges will obtain relatively few responses from passengers who used transit to access the airport. If the survey sponsor is particularly interested in collecting data on transit use, it would be helpful to obtain a larger sample of transit users by surveying passengers at transit stops or stations.

If the survey sponsor wishes to obtain information on air passengers' airport egress travel rather than their access travel, surveys could be conducted in the baggage claim areas, at the terminal curb front, or as passengers exit the secure area of the terminal. Such surveys need to be fairly short, because respondents will generally want to quickly complete their journey or may be anxious to meet some scheduled or pre-arranged ground transportation. A survey of passengers exiting the secure area of the terminal will intercept a sample of all arriving passengers, but some may not have made ground transportation arrangements and will be anxious to do so. Also, this is the point at which arriving passengers are often met by greeters, which is not an ideal situation in which to perform a survey.

As with many aspects of conducting air passenger surveys, there is no ideal solution. The choice of location to survey arriving air passengers involves a tradeoff between the ability to sample all arriving passengers, their willingness to be surveyed, and the extent to which respondents know how they will reach their final destination, as well as such considerations as whether there is adequate space to perform the survey without obstructing the flow of other passengers and how many locations can be staffed at a given time.

Experience with airport user surveys shows that people are generally cooperative and may go out of their way to assist with the survey. This cooperativeness is no different in the non-secure area from the secure area, although the time that respondents may be willing to spend being interviewed will often be much less.

Other Considerations. ***Interview Time.*** Intercepting airport users in the non-secure area is subject to a significant time constraint. Departing passengers may still have many steps to complete before boarding, including check-in, baggage drop, security screening, and perhaps shopping or obtaining a meal. It is therefore imperative that the survey be short.

A good guideline is one single-sided form. If all the questions cannot fit into this space, the form is likely too long. It is possible to conduct a meaningful interview—obtaining many key characteristics of the air passengers, greeters, and well-wishers traveling in a group—in under one minute, although this is highly dependent on the skill of the interviewer.

A maximum interview time of two minutes is recommended. For longer surveys, alternative locations on the secure side of the terminal—or different methods, such as mail-back forms—should be considered.

Security Clearance. In the current security-conscious environment, an airport is viewed as a relatively vulnerable location and personnel with access to the secure side of the terminal must undergo security clearance and be issued identification badges. Conducting a survey on the non-secure side may remove some of this constraint, depending on the particular requirements of the airport. Even so, it may be worthwhile to issue survey field staff with identification badges and authorization letters in case they are challenged on their right to conduct the survey and to reassure potential respondents that this activity is officially sanctioned.

After Security Screening

An alternative approach is to intercept passengers as they exit security screening. This approach has the advantage that air parties are generally still together and the survey will intercept all passengers clearing security, whether they go directly to their gate or not. Passengers who do not go to their gate until the flight boarding time have an equal chance of being included in

the sample as those that spend the time before the flight waiting in the gate lounge. Intercepting passengers as they exit security screening also samples passengers on all flights departing from the gates served by the security screening channels, not just those on flights from selected gates.

However, surveying passengers as they exit security screening is only suitable where information is not being collected on connecting passengers. Most connecting passengers do not pass through security unless they are changing terminals, and the characteristics of the small number of connecting passengers that do go through security will likely be very different from those of other connecting passengers.

There are two other potential disadvantages with this location:

- Passengers with limited time before their flight is due to depart may be anxious to reach their gate. The airlines may also be concerned that the survey will delay passengers.
- There is often no seating in this area, so the interview may have to be conducted with the passengers standing.

The first issue can be addressed by asking the passengers what time they were told to be at the gate for boarding and the gate number (for large terminals). This information is usually printed on their boarding pass. Asking to see their boarding pass in this context is a non-intrusive way of verifying their flight number. If there is insufficient time to conduct the survey, the interviewers can ask if they can accompany the passengers to the gate and perform the interview there. Generally there will be enough time to complete the survey in the gate area while other passengers are boarding.

If passengers appear elderly or uncomfortable standing for the interview, the interviewers can ask if they would like to go to a nearby gate area to be interviewed, so that they can sit down. Alternatively, it may be possible for the airport to provide some temporary seating in the area where the survey is being performed.

Because surveying passengers as they exit security screening will obtain a sample of all originating passengers departing on flights from the gates served by that security checkpoint, it will be necessary to weight the results to reflect the total number of originating passengers on those flights. Passengers should be asked if they are connecting between flights so that they can be excluded from the weighting of responses in the analysis. Because the sampling rate will vary with the flow through the security checkpoint, and because the interview rate will be relatively constant for a given staffing level, it will be necessary for the weight assigned to a given response to reflect this varying sampling rate. If possible, passenger throughput counts should be obtained from the TSA in 10- or 15-minute intervals to allow for short-term fluctuation.

Where these counts are not available, it will be necessary to assign a survey staff member to count passengers exiting security or estimate the flow from the flight schedule and the estimated passenger load on each flight. The distribution of the time before scheduled flight departure that passengers on a particular flight clear security can be estimated from the survey results and then applied to the estimated passenger loads to estimate the flow rate through security, with appropriate adjustments for passengers on connecting and through flights.

Airline Gate Lounges

One of the most common locations for an air passenger survey is the airline gate lounges. Passengers in the lounges are generally seated and are usually willing to participate in a survey. They tend to remain in the same seats and the seats are typically grouped in rows, which in the case of an interview survey facilitates a consistent approach to selecting passengers to survey.

However, there are a number of disadvantages to performing a survey in this location and some aspects that need careful planning. The most obvious consideration is that passengers in a

given gate lounge are generally waiting for the next flight to depart from that gate, and thus are all traveling to the same destination airport, although this may not be their final destination if it is an airline hub or international gateway. There must therefore be careful selection of flights to survey in order to obtain a representative sample of air passengers in all markets.

Some passengers in the lounge may be waiting for a later flight or for a flight from a nearby gate. Should such passengers be included in the sample? On the one hand, including these passengers in the survey may result in obtaining fewer responses from the other passengers than anticipated in the flight sampling plan. On the other hand, including them may provide survey responses from a broader sample of flights than those included in the flight sampling plan, which could be regarded as a good thing.

In cases where the survey is attempting to obtain responses from every adult passenger on a flight, including a few responses from passengers on other flights may unduly complicate the response weighting process or lead to biased results. It may be preferable to ask passengers which flight they are taking when handing out the survey forms and only survey those on the sampled flight (or only code those responses from passengers on the sampled flight).

However, with interview surveys, responses will be obtained from a relatively small sample of passengers on the sampled flight anyway, because of time and staffing constraints. Use of weighting factors which expand the responses to reflect the passenger traffic in fairly broad groups of markets, by time of day and day of the week, will generally be preferred to factoring up the few responses from a flight to the estimated passenger load for that flight. This approach avoids potential bias from over-weighting survey responses from flights for which a smaller proportion of air parties were interviewed.

A major disadvantage of performing an interview survey in airline gate lounges is the small opportunity that interviewers will have to survey passengers who arrive at the gate just before or after boarding begins. If those arriving at the gate close to flight departure time have different characteristics from those arriving much earlier, as is quite likely, the survey will give biased results for those characteristics. This bias can partly be addressed by providing such passengers with a mail-back survey and through the process of weighting survey responses, discussed in Section 5.5.

Another practical difficulty with airline gate lounge surveys arises from the limited time window for any given flight during which passengers can be surveyed. If interviews are started too soon, there will be nobody in the lounge to survey. Once boarding has commenced, it will generally be difficult to get passengers to agree to participate. This time window will generally begin about an hour before the scheduled flight departure time and end when boarding starts, which is typically 20 to 30 minutes before flight departure. In the case of flights using wide-body aircraft, passengers will often begin arriving in the gate area somewhat earlier, and there will usually be enough passengers in the lounge to begin interviewing an hour and a half before the scheduled flight departure time. However, boarding often begins as much as 40 minutes before flight departure. Some international flights start boarding as much as 60 minutes before flight departure and there may be enough passengers in the gate lounge two hours before departure to allow interviews to begin.

Once a survey team has finished surveying a particular flight, it will need to move to the next flight to be surveyed, unless the team is scheduled to take a break. The next flight should therefore have a scheduled departure time at least an hour later (an hour and a half in the case of a wide-body aircraft and two hours for international wide-body flights). This requirement limits the flight sampling plan, because there may be few flights departing around that time. If those that are departing around that time are leaving from gates some distance away, additional time will be required for the survey team to travel between gates, particularly if this travel involves going through security screening again. As discussed in more detail in Section 5.3, developing

a flight sampling plan that provides reasonable coverage of different flight destinations and airlines—while utilizing survey teams efficiently and allowing staff to take required breaks at appropriate intervals—is a major challenge.

5.3 Sample Size, Survey Coverage, and Timing

Once the details of the survey methodology have been determined, the next steps are to decide on the required sample size, develop a sampling plan to provide adequate coverage of the variation in air passenger characteristics over time, and decide when to perform the survey.

5.3.1 Sample Size

The details of calculating sample sizes for different sampling methods are discussed in Section 3.4.

In air passenger surveys, the most common type of sampling method uses cluster sampling to select a random sample of flights as clusters and then attempts to survey either all the passengers on each selected flight (with a self-completed survey) or a sequential sample of passengers on each flight (with an interview survey). The accuracy of a cluster sample depends on both the variance of the characteristic of interest within each cluster and the variance between clusters. Where each cluster is a flight, whether the mean of a given characteristic varies significantly between flights will depend on the characteristic. However, many characteristics—such as airfares, ground access mode use, air trip duration, and air travel party size—are likely to vary significantly by destination and hence their sample mean will vary between different flights. Of course, these characteristics vary widely within a given flight as well. Therefore, it will generally be necessary to use a significantly larger sample size with flight-based cluster sampling than with random or sequential sampling of the air passenger population in order to achieve a similar level of accuracy.

As a practical matter, the only way to perform random or sequential sampling of the air passenger population without resorting to a flight-based cluster sample is to interview passengers at a location where all passengers can be intercepted, such as the exit from security screening.

The extent to which a flight-based cluster sample should increase the sample size to provide an equivalent level of accuracy to that calculated for a random sample is dependent on the specific traffic composition at each airport, the characteristics of interest, and how these vary between passengers on particular flights and on average between flights. This issue is not at all well understood and is deserving of further research. In the absence of more specific analysis, it would be prudent to increase the sample size by a factor of two for well-designed interview surveys of air parties, with appropriate stratification of flights[16] and approximately 20 air passengers interviewed on average per flight. This factor increases as the number of passengers interviewed per flight increases. In the above case, a factor of 1.5 would be more appropriate where an average of 10 passengers per flight is interviewed, but a factor of 6 would be more appropriate where an average of 90 passengers per flight is interviewed. Sample size with cluster sampling is discussed in more detail in Appendix B.

5.3.2 Estimating the Population of Airport Users on a Given Day

To develop a sampling plan for a given day, it is desirable to have an estimate of the number of air passengers (and possibly the associated greeters and well-wishers) using the airport on that day. If the sampling plan is being developed a fairly short time before the survey, it may be pos-

[16] Assuming an intra-class correlation coefficient of 0.05.

sible to obtain expected passenger loads on each flight from the airlines. If the sampling plan is being prepared well before the start of data collection or the airlines are not willing to provide this information, the population of these categories of airport users per day can be estimated as follows:

- Passengers—Obtain a schedule of departing flights (and arriving flights if interviewing arriving passengers) for the survey period from the airport operator or sources such as the Official Airline Guide (OAG). The schedule should indicate the flight departure (or arrival) time, airline, flight destination (or origin), terminal, aircraft type and seats, and whether it is a through flight or originating (or terminating) at the airport. This information can be determined from the full flight itinerary or routing. For each flight, estimate the load factor using past data for the airline and city pair.[17] This estimate could be further refined, if necessary, to allow for variation in load factor by month, day of week, and time of day where data for this level of detail is available.[18] For through flights, estimate the proportion of passengers who will continue on the flight and not leave the aircraft.[19] The proportion will vary by routing, airline, and airport and may need to be estimated based on limited qualitative inputs (e.g., comments by gate staff or other knowledgeable people). Multiply the seats, load factor, and proportion of passengers not continuing on the flight to estimate the enplaning (or deplaning) passengers. The daily or hourly passengers are then found by summing the estimated passengers over the flights in that time period. Connecting passengers do not make use of the groundside facilities or transportation system and can be excluded, where necessary, by multiplying by the ratio of origin/destination (O/D) passengers to enplaned/deplaned passengers for that airport. This approach can be extended to estimate the proportion of the passenger population in different market segments (e.g., domestic versus international passengers, or passengers using a specific terminal), based on the flight destination (or origin in the case of arriving flights).
- Greeters and well-wishers—Numbers vary greatly with airport size, types of service available, proportions of business and visiting (non-local) passengers, and public transportation services to the airport, among other factors. The numbers of well-wishers and greeters that come into the terminal can be estimated based on the numbers of O/D passengers. While these vary significantly by airport, month, day of week, and time of day, a rough guide to the average number of well-wishers per originating passenger based on recent airport surveys is shown in Table 5-3.

The number of well-wishers can be estimated by multiplying the number of originating passengers by an appropriate factor based on the data in Table 5-3. Note that many of these well-wishers will be in groups and may be seeing off several passengers. Numbers of greeters are typically similar to the numbers of well-wishers.

5.3.3 Sampling Strategy

The design of the sampling strategy is key to obtaining reliable results in an air passenger survey. A poorly designed sampling strategy can exclude certain subgroups from the sample entirely and lead to biased results. As discussed in Section 3.3, a controlled sample attempts to design the sampling strategy so that the composition of the sample reflects the underlying distribution of the population characteristics fairly accurately. In the case of air passenger surveys, this means

[17] Monthly data on passenger loads by airline and flight segment are available from the U.S. Department of Transportation Bureau of Transportation Statistics T-100 database.
[18] Some airports require airlines to report passenger loads by flight.
[19] The difference between arriving/departing and enplaned/deplaned passengers.

Table 5-3. Representative ratios of well-wishers to originating passengers.

Airport Size	Terminal Type	Airport	Year	Well-wishers per Originating Passenger
Large hub	International	New York JFK Terminal 4	2003	0.29
	International	San Francisco, California	2006	0.17
	Domestic	San Francisco, California	2006	0.14
Medium hub	Domestic	San Jose, California	2003	0.16
	Domestic	Oakland, California	2006	0.18
	Domestic	Winnipeg, Manitoba	2007	0.25
Small hub	Domestic	Birmingham, Alabama	2005	0.09
	Domestic	Quebec City, Quebec	2006	0.19
	Domestic	Victoria, British Columbia	2006	0.35

Source: Airport surveys conducted by Jacobs Consultancy

that the sample has the same (or very similar) proportions as the population for such characteristics as the following:

- Airline.
- Flight departure time.
- Day of the week.
- Destination.
- Originating versus connecting traffic.
- Domestic versus international trips.

In practice this is very difficult to achieve. Each of these characteristics varies independently of the others, resulting in a huge number of potential combinations of characteristics, and the logistics of performing the survey limit the ability to vary the sampling rate to match the underlying distribution of characteristics. In particular, intercept interview surveys tend to under-sample during busy periods and over-sample during less busy periods, because it is difficult to schedule the number of interviewers to match the changes in passenger flow.

When the sample is not controlled to ensure that the composition of the sample corresponds to that of the population, the results of the survey can be weighted so that the reported results reflect the composition of the population rather than that of the sample. The process for determining the weights to be used is discussed in Section 3.5.

Sampling Passengers

The first consideration in sampling air passengers is to decide whether to sample individual passengers or air travel parties. As discussed earlier in this chapter, this decision is largely a function of the survey method adopted. Self-completed survey forms are typically distributed to every adult passenger in the group of interest, while intercept interview surveys are usually designed to collect information on air parties. There is obviously no difference in the case of one-person parties.

The objective in defining a sampling strategy to survey air passengers is to obtain a random sample of respondents. Where the flow of passengers or the sequence of passengers in a queue is already random with respect to the characteristics of interest, selecting every *n*th passenger will generate a random sample of respondents. When a respondent is in an air travel party of more than one person, the count to determine the next *n*th passenger in a sequential sampling strategy should start again if the next *n*th passenger is a member of the air party that has just been interviewed. This method will avoid interviewing multiple passengers from the same air party. Members of the same air party will typically be standing or seated together, and it will usually be

obvious who is in the party. Where it is not obvious, it may be necessary for the interviewer to ask the respondent who has just been interviewed to indicate the members of the air party. In the case of large air parties, such as tour groups, members of the party may not remain together in the terminal, and thus the sampling strategy may happen to interview several members of the same party. Large air parties call for particular consideration in analyzing survey results, as discussed in Section 5.2.1, to account for the possibility that the survey may interview several members of the same party or that different members of the party may have traveled to the airport separately. With large air parties (more than about six people), it may be helpful to record the name of the group organizing the trip in order to identify other respondents from the same group when analyzing the results.

Where passengers are moving, such as at an exit from security screening or an entrance to the terminal building, the duration of each interview will generally be sufficiently long that by the time the interview is completed, the next passenger in the stream will be effectively chosen at random. Also the variation in the duration of each interview will help ensure the randomness of the sample.

Where passengers are grouped by some characteristic, such as passengers in a check-in queue at an airline counter, the sampling strategy should attempt to distribute the interviews across the different groups in proportion to the passengers in each group, such as the number checking in on each airline. However, this is difficult to achieve in practice, particularly because those passengers in short queues may not be in the queue long enough to complete an interview. For these reasons, queues are generally not a good location to perform intercept interview surveys.

In locations where passengers are not in an ordered sequence, such as in airline gate lounges or baggage claim areas, it will be necessary to define a starting point for the sequence of passengers in the sample and a rule for the direction to move to determine the next passenger to interview. One such rule for airline gate lounges was suggested in Section 5.2.2. A similar rule for baggage claim areas might be: Start with the person standing closest to the airline baggage office door, then select every sixth person, proceeding clockwise around the baggage claim device.

The exact starting point is not particularly important, and interviewers can use their judgment as to which person is closest to a defined point in ambiguous cases. The point is to ensure that the interviewers follow a defined rule to select the passengers to interview rather than selecting them on the basis of whether they appear likely to be cooperative or some other criterion that might bias the sample. Similarly, the interval between sampled passengers is not particularly critical. The objective is to ensure that interviews take place throughout the area in question and so should be chosen in the light of the number of interviews anticipated to be performed and the number of passengers expected to be present in the area. In the case of baggage claim areas, allowance should be made for greeters waiting with the passengers.

When there is more than one interviewer performing interviews in a given area, the sampling rule will need to ensure that they each start at a different location and the sequences of selected passengers do not overlap. Because the number of interviews that can be performed while the passengers are present in an airline gate lounge or baggage claim area is fairly limited, overlap is not usually a problem. For example, if each interview takes an average of four minutes and the passengers in a gate lounge are surveyed over a 40-minute period, each interviewer will only be able to complete 10 interviews.

One issue that arises with airline gate lounge surveys is that the seats may all be taken before boarding of the flight begins and thus passengers arriving after this point will either stand in the gate area or find a seat in nearby lounges. A sampling protocol that includes only passengers seated in the gate lounge will systematically exclude passengers arriving close to flight departure

time. It may therefore be desirable to modify the sampling rule to include standing passengers when most of the seats are taken.

In practice, where passengers sit (or stand) in a gate lounge or stand in a baggage claim area may be influenced by characteristics such as the time they reach the gate lounge or the order in which they arrive at the baggage claim device (which is influenced by the order in which they deplane and their walking speed through the terminal). However, as long as the sampling protocol includes all occupants of the gate lounge or claim area and samples people in proportion to the number occupying each part of the area, these differences will be reflected in the resulting sample.

Sampling Flights

In the case of airline gate lounge surveys, whether interview or self-completed, it is necessary to select a sample of flights to survey. This selection is a particularly challenging problem, because of the need to ensure appropriate coverage of airlines, destinations, and times of day, while utilizing the survey personnel efficiently. Flights depart at irregular intervals throughout the day. There will be periods when a large number of flights will depart around the same time and periods with relatively few (or even no) flight departures. To complicate matters further, different airlines serving the same market will often have their flights depart around the same time, partly for competitive reasons and partly due to time zone differences.

Although the characteristics of passengers on different airlines in the same market may not necessarily be significantly different, this is not always the case. Factors that can cause passenger characteristics to vary by airline include the following:

- Nationality of airline (flag of carrier) in international markets.
- Type of carrier: low-fare versus network.
- Market share and flight frequency.
- If the destination is a hub for one of the airlines.
- Flight departure times.

Business travelers will tend to favor airlines that provide flight departures that better match the business day and those that offer higher frequency in case their travel plans change, while leisure travelers may be more willing to use flights at less convenient times and with fewer alternative departure times in order to obtain a lower fare. Passengers who are residents of cities that are airline hubs are more likely to be in the frequent flier program of the hub airline, while residents of spoke cities are more likely to be in the frequent flier program of another airline, particularly if that airline has a stronger presence in the spoke city.

Therefore, a fully stratified sampling plan would group flights by the following:

- Airline.
- Destination (possibly grouped by region).
- Time of day.

In practice, at many airports this approach would generate a very large number of separate groups, and it would be impossible to develop a viable sampling plan by selecting a sample of flights from each combination of these factors. Instead, the usual approach is to define a sampling strategy that ensures that the selected flights provide a reasonable sample of each of these three factors.

One such approach is to list flights throughout the period of the survey in order of scheduled flight departure time and calculate the cumulative number of departing seats for each flight. If information on average load factor by market and time of day is known at the level of individual flights, then the cumulative number of expected passengers can be calculated in place of seats.

Flights are then selected by finding every *m*th seat in the cumulative seat count, where *m* is the ratio of the total number of seats to the number of flights to be sampled, considering the expected number of completed interviews per sampled flight. This process ensures that larger aircraft have a higher chance of being selected than smaller aircraft, which offsets the smaller likelihood of a passenger on a large aircraft being interviewed if approximately the same number of interviews is performed for each sampled flight.

If more interviews are performed for flights using larger aircraft, as could occur if more interviewers are assigned to those flights or more time is available for the interviews, or if all adult passengers are sampled using self-completed survey forms, then either the flight sampling process needs to be modified or the results weighted accordingly. Where all or a constant proportion of passengers are sampled, the procedure is simpler. After arranging all flights in order of scheduled departure time, select every *m*th flight where *m* is the ratio of total flights to the number of flights to be surveyed. The latter is calculated by the total number of passengers to be surveyed divided by the average passengers per flight times the proportion of passengers on each flight to be sampled.

If the survey will only be conducted for certain periods each day, the cumulative list of seats is only determined for flights scheduled to depart during the times when the survey will be performed. After identifying an initial list of flights to sample, the characteristics of those flights in terms of the above criteria can be compared to the corresponding proportions across all flights, and any necessary adjustments made to the sample by dropping some of the flights with characteristics that are over-sampled and replacing each of them with the next flight in the list of flights with the characteristics that are under-sampled. Further adjustments may be necessary to ensure that the survey field teams have a fairly steady workload throughout their shift. A flight that has a scheduled departure time too close to that of other flights in the sample could be dropped and replaced with another flight with the same characteristics but a scheduled departure time during a period when the number of selected flights is not enough to keep the survey field teams occupied.

5.3.4 Survey Timing

At most airports, air passenger characteristics vary seasonally and it is therefore important to determine whether information on these characteristics are required for a specific period (e.g., the peak month) or on an annual basis. If information on air passenger characteristics is required on an annual basis, it will be necessary to perform the survey in two or more periods, reflecting the seasonal pattern of traffic. Depending on the information of interest, it would be desirable to select a peak and off-peak period that represent the highest and lowest levels of the relevant characteristics (e.g., private vehicle trips to and from the airport, or proportion of business travel). This method should allow the corresponding characteristics to be estimated for other months that are not surveyed, although this may not always be possible, depending on how the different characteristics vary during the year. The survey planning team may need to undertake some analysis of monthly variation in those characteristics in order to select appropriate months for the survey. Where seasonal variation in travel characteristics is more complex than can be expressed in terms of peak and off-peak conditions (e.g., winter travel patterns are very different from summer travel patterns as well as from travel patterns in the spring and fall), it may be necessary to divide the survey into three or four phases or conduct the surveys continuously throughout the year.

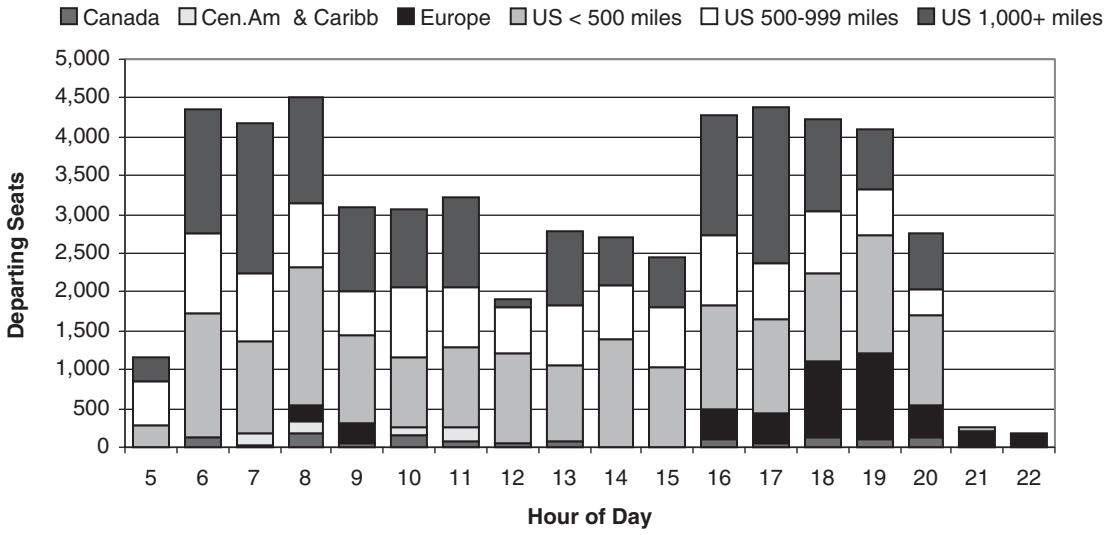
In addition to seasonal variation, at almost all airports air passenger characteristics vary by time of day and day of the week. This variation can be addressed by ensuring that the survey provides reasonable coverage of different times of day and days of the week. Ideally, the survey data

collection would take place throughout the day for at least a full week. At many airports, passengers begin arriving for early morning flights by 5 a.m. and the last flight does not depart until midnight or later; therefore, the survey would need to cover about a 19-hour day. However, the staffing levels required to achieve this coverage are often impractical, and spreading the desired sample size across every time period may unduly constrain the sampling in each period. Therefore, it is common to survey for a limited period each day (typically at least eight hours) but vary the timing of these periods from day to day. Where traffic peaks occur at certain times on particular days (e.g., Monday morning and Friday and Sunday evenings), the survey shifts should be scheduled to provide coverage for these periods.

While some flights may depart early in the morning or late in the evening, typically these are fairly few and the sampling strategy should reflect the relatively small proportion of passengers at these times. It may be adequate to have only one or two survey staff during these times and only survey on a few days. However, at airports with international service, departures for certain markets may take place late at night because of time zone differences or to allow early morning arrivals at the destination. Similarly, some eastbound flights from the West Coast depart late at night in order to arrive at mid-continent hubs or East Coast destinations early the next morning. This may require additional survey staffing at these times to make sure that those markets are adequately surveyed.

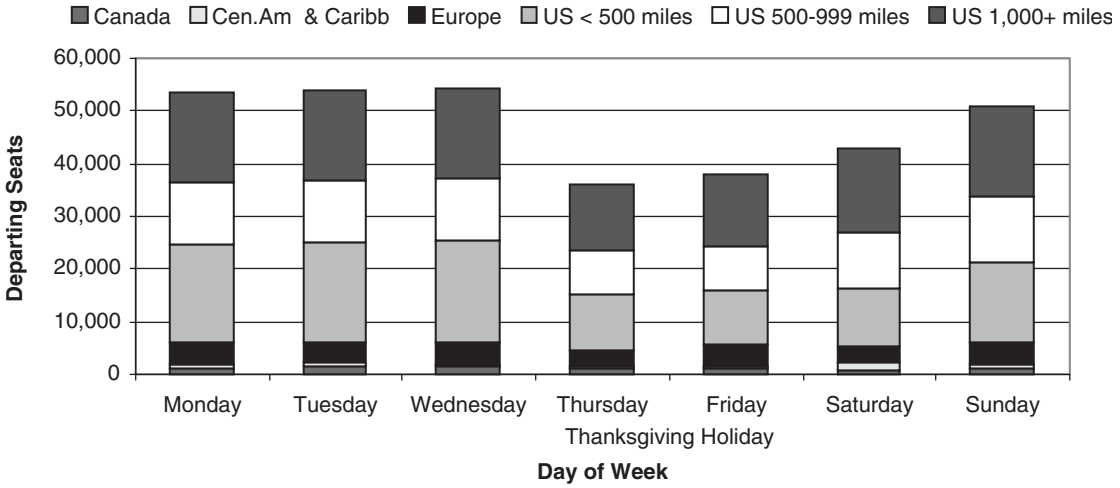
At other times of day, there may be very few departures for periods of several hours at a time. Such flight schedules can present a challenge to survey staffing, because in general staff will want to work a full shift. It may be possible to schedule staff so that meal breaks occur during periods of low activity, although there are constraints on how long staff can work between breaks, and obviously meal breaks need to occur around the middle of the shift. With careful scheduling, it may be possible to provide increased staffing levels during busy periods by scheduling shifts to overlap during these periods.

Figures 5-6 and 5-7 illustrate how traffic levels and the composition of the traffic can vary over the day or the days of the week. The figures show the distribution of departing seats from Logan International Airport in Boston for different markets for the week of the Thanksgiving holiday



Source: Official Airline Guide for November 19, 2007 (excluding flights to Africa, 185 seats Tuesday and Friday).

Figure 5-6. Numbers of departing seats from Boston Logan International Airport by time of day and destination region.



Source: Official Airline Guide for November 19, 2007 (excluding flights to Africa, 185 seats Tuesday and Friday).

Figure 5-7. Numbers of departing seats from Boston Logan International Airport by day of week and destination region.

in 2007. The traffic level varies widely over the day, with early morning and late afternoon/evening peaks and a sharp drop in long-haul domestic departures (stage length of 1,000 miles or more) between 12:00 and 1:00 p.m. (12 and 13). Very few flights depart after 9:00 p.m. (21), most of them to Europe.

As shown in Figure 5-6, departures for different international markets vary considerable through the day, with those to Central America and the Caribbean in the morning and those to Europe mostly in the evening. To adequately represent these markets in the sample, the sampling plan would need to ensure that the flights selected to be surveyed at those times include an appropriate number of international flights. Figure 5-7 shows a reduction in the number of flights on the Thursday of the Thanksgiving holiday, with the number of flights gradually returning to normal levels over the subsequent days.

One approach to ensuring that the survey responses are appropriately distributed by time of day is to schedule interviewers so that the distribution of total interviewer time by time of day and day of week is similar to that of the departing seat capacity of the airport. For smaller total sample sizes (e.g., under 1,000 responses), interviewers are assigned to cover a larger number of flights by sampling only a small number of passengers from each flight (e.g., four to twelve depending of the size of the aircraft). Because connecting passengers tend to arrive in airline gate lounges earlier than originating passengers, starting to survey flights too long before flight departure time will tend to over-sample connecting passengers. The interviews for a given flight should generally start no earlier than an hour before flight departure (90 minutes in the case of international flights) and be evenly distributed up to the time that boarding begins. This approach can work well at small to medium-sized airports. At larger airports, interviewer times would be determined for each terminal in proportion to the numbers of passengers or departing seats from those terminals. Responses are then weighted to match departing passengers by time of day, flight destination, and airline using flight schedules and estimated load factors.

As a practical matter it is difficult to schedule interviewers efficiently and match the interviewer time to the variation in departing seats on a daily basis. Instead, an attempt can be made to match interviewer time to departing seats in each hour separately for weekdays in total and weekend days in total. The start times and lengths of shifts and break times can be varied so there

is more coverage in the peak periods, with interviewers typically working between four and eight hours per shift.

Scheduling interviewers to match the distribution of departing seats (or passengers) has both staffing and cost implications. Having interviewers work for varying times per day and starting their shifts at different times can be done, but it may be necessary to pay more for people to work short shifts on some days or the earliest and latest shifts. Field supervision also becomes significantly more complicated with interviewers starting their shifts at different times. These factors need to be considered carefully in survey planning.

5.4 Questionnaire Wording and Length

The general principles for questionnaire design and length are discussed in Section 4.3, and a sample passenger questionnaire is provided in Appendix F. The sequence and wording of survey questions can significantly affect the reliability of the responses that are obtained, if respondents misunderstand a question being asked. Examples of problems that can arise include the following:

- Terminology for ground access modes, particularly modes such as scheduled airport bus, limousine, hotel courtesy shuttle, and charter van. In some areas, the term "limousine" is used for scheduled airport bus service and may appear in the name of the service, while a vehicle hired for the exclusive use of an air party may be referred to as a "hire car." However, some respondents may confuse hire car with rental car. The term "shuttle" is often used to refer to shared-ride van service (and again sometimes appears in the name of the operator). An air party taking a shared-ride van service from a hotel to the airport may consider this a "hotel courtesy shuttle," although that is not what is intended by the term. The distinction between shared-ride van service and charter van may be a matter of whether the operator is licensed to carry multiple travel parties in a single trip, which may not be known to the travelers, particularly if the trip to the airport was arranged by someone else.
- Trip purpose. Questions should generally provide more options than just business and personal. The term "leisure" would usually be considered to exclude a wide range of personal trip purposes (e.g., attending a funeral) and should be avoided. Response options should allow for trips that combine business and personal purposes, such as combining a business meeting or conference with vacation time or leisure activities, or visiting family or friends. Asking the "main purpose" or "primary purpose" of the trip may be meaningless in cases where the trip only occurred because it allowed multiple purposes to be satisfied. The key issue to consider is why information on trip purpose is needed. If trip purpose is sought to distinguish between trips where the respondent is paying the travel costs and those where the costs are paid by their employer or other organization, it may be better to ask this question directly rather than assume that respondents reporting business trips are not paying for their travel costs themselves.
- Trip origin. Typically the response sought is the origin of the ground access trip to the airport where the survey is being performed. However, if not carefully worded this question could be misunderstood by visitors as the origin of their entire trip from their home region. The expression "your trip to the airport today" is ambiguous to travelers making a one-day return trip. In some cases, even the term "this airport" can be ambiguous. In a recent survey, respondents were asked to state the final destination airport of the air trip that they were about to begin. This was followed by a question that asked: "Is this airport the home end of your trip?" The second question was intended to mean the airport where the survey was being performed, but could easily have been misunderstood to mean the destination airport referred to in the previous question.

- Air party. This term may not be understood by many respondents and needs to be expressed in other words (e.g., traveling together on the same flight). For ground transportation planning purposes it may be desirable to distinguish between the air travel party and the ground access travel party, because different members of the air travel party may have come to the airport separately.

5.4.1 Trip Origin Information

Sponsors of air passenger surveys often wish to obtain information on the ground access trip origin location (or ground egress trip destination location). This information is typically needed at a fairly detailed level to permit the trip origins or destinations to be coded to the system of transportation analysis zones used by the local regional transportation planning agency. This coding will allow information on highway and transit travel times and transit fares to be readily obtained from the data files maintained for regional transportation modeling. It will also allow the results of the air passenger survey to be integrated with other transportation planning studies. It is not uncommon for these zones to be significantly smaller than zip codes or postal codes. The usual approach is to request the street address and city of the trip origin. For obvious reasons, many survey respondents are reluctant to provide the actual address, although they may be willing to provide the block number or a nearby street intersection, which is sufficiently accurate.

However, visitors to the area may have started or ended their access or egress trip at a hotel, business, or other discrete location (such as cruise ship terminal or convention center) for which they do not know the address. In such situations respondents should be asked to provide the name of the hotel or other location, and these will have to be coded later so that the correct address can be assigned to the survey response. In such cases, the trip origin or destination city should also be obtained, to resolve situations in which there are several locations with similar or identical names. Hotel names can be particularly problematical. In a large city there may be several hotels in the same chain, and while they will typically each have a unique name, respondents may not use the formal names but simply refer to them by the name of the chain. A related problem can arise when ownership of a hotel has recently changed. Respondents who previously stayed in the hotel before the change may refer to it by its former name. Because respondents—visitors in particular—may give partial or even incorrect names for hotels and other locations, it will be helpful to also obtain a nearby street intersection or the name of the street if this is known. While this may be redundant information in many cases, it can be invaluable in resolving ambiguous or unclear responses.

In the case of printed questionnaires it will be necessary to obtain the redundant information from all respondents, because it would be too complicated to explain which respondents should provide it and which not. However, in the case of surveys using EDCDs, it may be possible to program the devices so that the street name or intersection question is skipped for responses that give location names that are clearly unambiguous.

The issue of the ground egress trip destination is often ignored and it is implicitly assumed that the ground access trip and egress trip are symmetrical. However, this is not always the case, and this may deserve explicit attention in the survey. In particular, situations where they are not the same may be an important factor in access and egress mode choice. Common examples include visitors who travel from the airport to a hotel on arrival in the area but return to the airport from another location, such as a business they are visiting, or residents who travel to the airport from their workplace but return home from their return flight. Collecting trip egress information requires some thought in questionnaire wording because the egress trip has not yet occurred for residents who are surveyed on the outbound leg of their travel.

Although public transportation is often referred to as public transit, at many airports public transportation includes a wide range of services, many operated by the private sector, in addition to the services provided by local transit agencies. Two reports produced under the Transit Cooperative Research Program provide a good overview of the issues involved in public transportation access to airports (Leigh Fisher Associates et al., 2000; Leigh Fisher Associates et al., 2002). Furthermore, transit services may be provided by several different agencies, such as in cases where rail transit service is provided by a different agency from local bus services, or where transit agencies that serve different areas each serve the airport.

5.4.2 Public Transportation Modes

Another aspect that requires careful attention is the treatment of public transportation modes in questions about access and egress trips. The use of public transportation is often an important policy issue in situations where airports are trying to reduce or mitigate ground transportation vehicle trips. It can also be a key consideration if one objective of the survey is to support the development of models of airport ground access mode choice.

There are two aspects to the use of public transportation modes that may need to be considered in the design of air passenger survey questions. The first is the appropriate definition of the different public transportation services available at the airport. Because different services will have different service areas and may have significantly different levels of service—such as frequencies, fares, and hours of service—it will often be necessary to distinguish between the services and not simply classify all such trips into broad categories. Self-completed surveys should avoid the use of terms such as "public transit," which can mean different things to different respondents.

The design of the questionnaire (and the EDCD program where EDCDs are used) should provide the ability to distinguish between different modes and services as necessary. In the case of surveys at groundside access points (discussed in Section 5.9), it may be necessary to develop unique questions or forms for different modes. Because of the potential for misreporting the actual public transportation service used, it is advisable to specify (or ask for) the name of the agency or firm operating the service and, in the case of local bus services, the number of the route. For other fixed-route services, it may be useful to request the name of the station or stop where the passenger boarded the service. While this level of detail may not be necessary for analyzing the results of the survey, it can be invaluable during data cleaning to correct misreported or misclassified services.

In the case of fixed-route services, it may also be helpful to ask how the respondents got to the station or stop where they boarded the service, because this can have a significant impact on the time and cost involved in using the service (e.g., a taxi trip to a transit station could easily cost more than the transit trip itself). While obtaining such information will increase the number of questions to be asked, these generally affect only a small proportion of respondents and so do not have a significant impact on the cost of the survey or the time required to complete it.

The second aspect that the survey planning team may wish to explore is the familiarity of the survey respondents with the public transportation system serving the airport. Do air passengers use public transit on a routine basis for other types of trips? This other usage will affect the familiarity of air passengers with the local transit system and may affect whether public transit is even considered as an option for getting to the airport. In the case of other forms of public transportation, such as privately operated scheduled airport bus services, air passengers (particularly visitors to the area) may not know anything about the services.

5.4.3 Parking Issues

Private vehicles are the most widely used means of traveling to or from most airports, and parking revenues compose a major component of airport revenues. Therefore, information on the use of airport parking by air passengers—and those dropping them off or picking them up—is an important aspect of most air passenger surveys. However, survey questions addressing the use of airport or off-airport parking should be carefully worded to prevent misunderstanding by respondents. Careful wording is particularly necessary with self-completed surveys.

The most important distinction to make is between vehicles parked by air passengers for the duration of their air trip and those parked by well-wishers or greeters. This distinction is complicated by the frequent practice of airports calling different parking lots or facilities short-term or long-term parking based on pricing and distance to the terminal, rather than the amount of time drivers are allowed to park. Long-term parking facilities may be located some distance from the terminal, and users may think of these as being off-airport, even though they are operated by the airport authority. Then there are privately operated parking lots in the vicinity, which are usually considered off-airport parking. In addition, some airport area hotels may offer parking at competitive rates with the airport.

Although most passengers parking a vehicle for the duration of their air trip will use the parking facilities designated for daily or longer parking, rather than those for hourly or short-term parking, some passengers making a one-day or overnight trip may choose to use the closest parking to the terminal, and pay the higher rate.

Finally, some survey respondents may think of a private vehicle standing at the terminal curb for a few minutes while the passengers and their baggage are unloaded as being "parked" for a short while.

It is therefore desirable to ask survey respondents to identify the **parking facility** where the vehicle is parked and the **duration** that it was (or will be) parked, rather than rely on vague categories such as "parked short term." These questions should provide response options that use the formal designation of different parking facilities (e.g., hourly parking, economy lot, terminal garage), but allow respondents to write in or state other locations if they do not recognize the correct names of the facilities. This will often be necessary anyway in the case of off-airport parking, where there may be a large number of different providers.

5.5 Weighting Survey Responses

In spite of the survey team's best efforts to design the sampling plan to obtain a representative sample of air passenger trips, it is very unlikely that the responses will fully reflect the composition of the target population, because of unavoidable consequences of the survey methodology as well as varying response rates by different categories of travelers. Therefore it will be necessary to weight the survey responses in order to improve the accuracy of the resulting data.

Because the exact composition of the air passenger population is generally unknown (this is why the survey is being performed), a variety of other types of data is needed to calculate the survey response weights. These data should be assembled at the time the survey is performed—or as soon as possible afterwards—and should include the following:

- Enplaned passengers on each flight (if available)[20] or enplaned passengers by flight destination for the month in question.[21]
- Number of connecting passengers on each flight (if available) or estimated from available data.[22]
- Parking lot exits from each airport parking facility by parking duration and hour for each day of the survey period.

[20] Some airports collect these data routinely. Where this is not the case, the airport may be able to obtain this information from the airlines for the period of the survey with an assurance that it will not be made public and only used to help analyze the survey results.

[21] These data are available from the U.S. Department of Transportation Bureau of Transportation Statistics T-100 database.

[22] Quarterly data on connecting passengers by airline and flight sector can be estimated from the U.S. Department of Transportation Bureau of Transportation Statistics Airline Origin and Destination Survey database.

- Automated vehicle information system counts (where available) by class of vehicle (taxis, limousines, shared-ride vans, shuttle buses, etc.) and by hour for each day of the survey period.
- Ridership statistics on airport-operated shuttle buses to remote rental car facilities or rail stations by hour for each day of the survey period. Where these are not routinely recorded, it will be necessary to arrange for their collection for the survey period.
- Ridership statistics on scheduled airport bus services by run (or hour) for each day of the survey period. Where these are not routinely reported to the airport authority, the airport may be able to obtain them from the operators with an assurance that they will not be made public and only used to help analyze the survey results.
- Terminal roadway traffic counts (where available) by hour for each day of the survey period. Where these data are not routinely collected, consideration should be given to placing traffic counters on the terminal roadways for the duration of the survey.

The process of calculating survey response weights consists of two steps:

1. Calculation of weights to correct for known bias in the survey sampling methodology.
2. Calculation of weights to correct for differences between the survey results and external data on traffic composition.

Each survey response should include the size of the air party. If the survey responses reflect **air passengers** (i.e., there are multiple survey responses for parties with more than one passenger), then counts obtained from the survey responses should be **divided** by the air party size in order to express the traffic composition in terms of air parties. Conversely, if the survey responses reflect **air parties** (i.e., there is only one survey response for each air travel party), then counts obtained from the survey responses should be **multiplied** by the air party size in order to express the traffic composition in terms of air passengers. Statistical computer software packages can perform these adjustments very easily in tabulating survey results.

The difference between expressing survey results in terms of *air passengers* or *air parties* is critically important to the correct interpretation of the survey results and should be clearly understood.

5.5.1 Proportional Weighting

Proportional weighting uses weights that adjust the proportions of the survey response data to reflect the proportions of the control data without changing the total number of responses. In general this will result in non-integer counts for many reported survey responses when expressed using weighted data. Proportional weights can only adjust survey response data to correspond to the proportions of a single characteristic of the control data. Separate weights can be determined for different characteristics, but in general it is not possible to determine response weights that adjust survey response data to correspond to the proportions of multiple characteristics of the control data.

If there are N total survey responses and n_i of those responses reported some characteristic i that composes a proportion p_i of the population in the control data, then the proportional weight w_i that should be assigned to each of the n responses is given by:

$$w_i = \frac{p_i N}{n_i}$$

Since all N of the survey responses must have reported some value for characteristic i (even if this was only "Don't know" or "Refused"), a weight w_i will be assigned to each survey response. Statistical analysis software can generally be set to optionally exclude missing data cases—such as "Don't know"—from the tabulated results. However, some users of the results may be interested

in knowing the extent of missing data in the survey responses. Therefore, it is better to set the weight for missing data responses to one rather than zero, and adjust the other weights so that the weighted total of the non-missing cases corresponds to the unweighted total of the non-missing cases (i.e., replace *N* by *N* minus the number of missing data responses in the above equation).

5.5.2 Correcting for Known Bias in the Sampling Methodology

The sampling methodology adopted for the survey may introduce some bias into the response data that can be calculated and corrected. The most obvious example occurs with self-completed surveys handed out to all adult passengers in an airline gate lounge where fewer responses are received from a given air party than the number of passengers in the party. This case will always occur where there are children in the air party (who do not complete the survey). Some passenger surveys have asked the respondents to indicate how many members of their air party have completed a survey form and have then used this information to weight the results. However, experience indicates that these statements are often unreliable. Some respondents may misunderstand the meaning of the term "air party," while others may not realize that another member of their party is also completing a form. Or they may think that another member of their air party is completing the form, but in fact that form is not turned in. It is therefore preferable (although more time consuming) to examine the survey responses; identify responses from the same party based on the party characteristics, such as their trip origin address or other information; and revise the reported survey completion information before calculating weights to correct for under-reporting of air party members.

It is also quite common to apply weights to self-completed survey responses to factor up the responses to the number of passengers boarding the flight. There are two problems with this approach:

- It can give a misleading impression of the number of survey responses, as discussed in Section 5.5.4, unless the resulting weights are normalized to ensure that the total of the weighted responses equals the actual number of survey responses.
- It will over-weight responses from under-sampled flights. For example, if generally 50% of passengers on sampled flights are surveyed, but on a particular flight only 10% of passengers are surveyed for some reason, the responses from passengers on the under-sampled flight will be weighted by a factor of 10, rather than the factor of 2 used on other flights.

Differences between the distributions of characteristics on a particular flight with only a few respondents compared to other flights in the same market are most likely due to the higher variance that occurs with small samples, not because the characteristics of all the passengers on that flight are different. Scaling up the responses to the total number of passengers on the flight implicitly assumes that all the passengers on the flight have the same distribution of characteristics as the respondents. For example, if only four respondents are surveyed on a particular flight and one of these is leaving on a 10-week trip to Japan, it would be incorrect to infer from this that 25% of the passengers on the flight are leaving on 10-week trips to Japan, but that would be the effect of scaling up the responses.

There is of course no way to tell from the results of a survey whether differences in the characteristics of the respondents on different flights are due to a true difference or are simply a result of the sampling variance. It is possible to perform statistical tests to determine whether the hypothesis that the results are drawn from the same distribution can be rejected at some level of confidence, but that is not the same thing as knowing that they *are* different. With a small sample size, the variance in any particular characteristic is likely to be so high that it is unlikely to be possible to reject the hypothesis that the results are from the same distribution as that for other flights in the market at any reasonable level of confidence. Therefore, one is left to make the not

unreasonable assumption that the underlying distributions of the characteristics of passengers in a particular market are the same, and that differences across flights in that market are due to sampling variance. Of course, the distribution of a particular characteristic within each market may vary by other dimensions, such as the time of day or day of the week, further complicating the analysis and reducing the ability to determine whether any apparent differences across flights in the market are simply due to chance.

Because passengers on under-sampled flights are likely to be less representative of the characteristics of passengers on other flights in that market, factoring up responses to the total number of passengers on a flight will over-weight those passenger responses that are less representative of the characteristics of the market in question, potentially biasing the results of the survey. Therefore, it is better to consider those passengers who did complete the survey forms as a representative sample of air passengers and make any required adjustment to correct for differences between the survey results and the distribution of air traffic across different markets, as discussed in the next section.

In the case of interview surveys, there is likely to be sampling bias that results from the sampling protocol:

- A sequential sampling strategy in an airline gate lounge will miss any passengers who arrive in the lounge after surveying has started and sit in areas that have already been sampled. Thus passengers arriving closer to the time boarding begins have a lower chance of being sampled.
- If the survey team performs approximately the same number of interviews in each gate lounge, irrespective of the number of passengers on the particular flight, the probability of a given air party being surveyed is lower on flights with more passengers.

If the distributions of characteristics of respondents who are over-sampled are the same as those who are under-sampled, the difference in sampling rate will not affect the survey results. However, if the distribution of some characteristic is different, the results will be biased. For example, it is likely that some passenger characteristics, such as trip purpose or air party size, will differ between those arriving in an airline gate lounge well before boarding begins and those arriving shortly before boarding begins. Similarly, if interviews of passengers exiting security screening are performed at approximately the same rate—as is likely with a survey team of a constant size—the result will be a lower sampling rate during busy periods. If passenger characteristics are different between busy periods and slow periods (as is quite likely), the results will be biased.

Weights can be calculated to adjust for these sources of bias by examining the results for different periods or subgroups of respondents to see if there are any differences in the distribution of characteristics that might vary by period or subgroup. If such differences are found, the survey responses can be weighted by the ratio of the number of air parties or air passengers in each period or subgroup to the number of responses obtained for that period or subgroup. Such weights should be normalized so that the total number of weighted responses is the same as the number of actual responses.

5.5.3 Correcting for Differences Between the Survey Results and External Data

Once a set of weights has been determined to correct for known bias in the sampling methodology, an additional set of weighting factors can be calculated, using the weighted results to correct for differences between the weighted results and external data on the composition of the passenger traffic using the airport.

The most obvious potential difference between the survey results and external data on the composition of the passenger traffic at the airport is if the percentage of passengers in each flight destination market given by the survey responses does not agree with the passenger traffic reported

by the airlines. Because connecting passengers may have been sampled at a different rate from originating passengers, it will generally be advisable to consider connecting passengers boarding a flight as a separate market from originating passengers and calculate separate weights for each.

Other characteristics of the survey respondents for which it may be worth calculating weighting factors include the following:

- Airline.
- Time of day and day of week of flight.
- Ground access mode use by originating passengers.

Where several different weighting factors have been calculated for different survey response characteristics, it will generally be advisable to compare the results for each characteristic using the appropriate weighting factor with the corresponding results using each of the other weighting factors, in order to determine the sensitivity of the results to the choice of weighting factor.

5.5.4 Weighting for Total Traffic

It is common for survey responses to be assigned weights that convert the total number of survey responses to the corresponding count of annual passenger traffic. While this process allows the survey results to be directly expressed in terms of the corresponding annual passenger characteristics, two important caveats should be borne in mind before doing this:

- The characteristics of the air passenger market at a given airport will vary throughout the year, while the survey data will generally have been obtained at one or two discrete points in time. Thus the resulting data may be quite misleading. For example, if a survey is performed during August, it will reflect a high proportion of vacation travel. This result is unlikely to correspond to the characteristics of the air passenger population during the rest of the year.
- Expressing the results of the survey in terms of annual passengers conceals the true size of the survey sample and may give a completely false impression of the accuracy of the results. For example, for a survey with 1,200 responses at an airport handling 12 million annual passengers, each survey response is equivalent to 10,000 annual passengers. Thus if the estimated number of annual passengers with some characteristic was given as 22,400 (after weighting for other considerations), it might easily be overlooked that this represents only two survey responses and is likely to be highly inaccurate.

Therefore, it is recommended that survey results **not** be expressed as annual traffic, but rather that weights be calculated so that the resulting totals of weighted responses equal the size of the actual survey sample. It is easy enough for users of the survey results to factor the results up to the level of annual traffic if they so desire, but they will then be fully aware that they have done this and should recognize the accuracy limitations that this implies.

One advantage of expressing the survey results in terms of the sample size is that it allows users to easily distinguish whether the results reflect the distribution of **air passenger** characteristics or **air party** characteristics, because the response totals will be quite different in each case. For example, if the average number of air passengers per air party is 1.4, a survey with 5,000 air party responses will show results summing to 5,000 when showing the distribution of air party characteristics and 7,000 when showing the distribution of air passenger characteristics. If the results are weighted so that the total is equal to the annual passenger traffic, it may be unclear whether they are showing the distribution of passenger characteristics or air party characteristics (which will typically be different).[23]

[23] If the survey results will be expressed in terms of annual traffic, it is important that results showing *air party* characteristics be weighted to give the total number of annual air parties, not air passengers.

5.6 Measures to Obtain Adequate Response

Clearly, getting people to respond to a survey is an important component of project success. If there are no respondents, there is effectively no survey. In addition, if the response rate is not high enough, it is questionable whether the results should be generalized to the population of interest.

Airline passengers are almost by definition in a hurry and stressed. If they are leaving home, they have all the emotions associated with that. If they are returning home, they may be rested and exhilarated from a wonderful vacation or exhausted from a difficult business trip. Regardless, departing passengers have to stand in what are often long lines, deal with security, remember the latest rules or instructions, worry about getting to the gate on time, and actually find the gate.

Actually departing passengers are generally inclined to participate in surveys despite the hurry and the stress (at least in part because they usually don't have anything better to do while standing in line or waiting for their boarding call), but there are still several things the survey planning team can do to maximize the response:

- Limit the length of the survey to the number of questions necessary to obtain genuinely needed information.
- Make sure that potential respondents understand that the survey is sponsored or sanctioned by the airport, both by the way the interviewers are dressed (perhaps in identifying clothing) and by the content of the introduction.
- Emphasize the survey purpose in the introduction, and explain why the information is needed.
- Ensure that the questions are clear, comprehensible, and sensitive to concerns about personal information and confidentiality.
- Hire interviewers (or people to hand out questionnaires) who are intelligent, personable, and not afraid to approach a wide variety of strangers.
- Make sure the interviewers smile as they approach people.
- Pay interviewers enough to attract capable people and to ensure they stay for the duration of the project. Aside from the difficulty of replacing interviewers, the longer interviewers stay, the more competent they tend to become.
- Provide a thorough and comprehensive training session.
- Ensure that interviewers are supervised, monitored, and coached as needed.
- Provide retraining as needed.
- Utilize positive feedback and incentives to maximize interviewer retention.
- Establish and enforce appropriate standards of dress, grooming, and conduct.
- Make sure all respondents are sincerely thanked.

One other issue that is often raised in this context is the use of incentives for survey respondents. Those who have tried respondent incentives are inclined to think they are not worth the cost or the challenge of hauling them around and accounting for them. As noted previously, most air passengers are inclined to participate in airport-sponsored surveys anyway; all airports really need to do to ensure high response rates is make it pleasant for them to do so.

5.7 Location-Specific Guidelines

Every airport is different. This section discusses some of these differences and how they can affect air passenger surveys.

5.7.1 Multi-Airport Cities

A metropolitan area served by a number of airports presents a problem in determining the characteristics of air passengers with respect to the entire metropolitan area. Analysis at this level

requires a coordinated survey approach at all airports. This coordination does not necessarily require simultaneous surveys but does require that the survey method and questionnaire are common at each airport, or the results will not be comparable or applicable to the total population. In general, it would be desirable for the different surveys to be performed within a few weeks of one another to minimize differences due to seasonal effects. A common approach is to conduct surveys at each airport over a period of several weeks, surveying at just one of the airports on any given day and scheduling the days at each airport to provide survey coverage of that airport on each day of the week at some point during the survey period. Stratified sampling could be used to ensure a representative sample across airports and sample sizes chosen so that similar levels of accuracy are obtained for each airport, if comparisons are required.

5.7.2 Multi-Terminal Airports

Because different terminals in a multi-terminal airport typically serve different airlines, and often different types of traffic (e.g., domestic or international), a survey that is designed to capture the characteristics of the air passenger population at the airport will need to survey passengers in every terminal. In this respect a multi-terminal airport is no different from a multi-airport city. The survey design must account for multiple terminals, with consideration given to an appropriate distribution of the survey responses among the terminals over the course of the survey period.

The sampling plan must also consider the multi-terminal environment. Interviewers will require time to switch terminals. Switching terminals may require leaving the secure area and re-entering it, which takes time. These factors must be taken into consideration in designing the survey.

5.7.3 Local Terminology

In designing survey questions, it should be recognized that words and phrases may have different meanings, or subtle variations of meaning, in different parts of the country. While it is possible to write a questionnaire using local terminology, many of the passengers will be visitors from outside the region and may misinterpret the questions. It is therefore critical that questions be worded using clear terminology understood by all passengers, and additional explanations given if necessary. With intercept interviews, interviewers must be trained so that they fully understand the questions and, if necessary, can restate a question in local terminology.

5.8 Information on Greeters and Well-Wishers

A survey sponsor may wish to gather information on greeters and well-wishers as part of an air passenger survey. Greeters and well-wishers account for a significant proportion of all airport access and egress trips, and some use airport facilities. The distinction needs to be made between greeters and well-wishers who come into the airport terminal building to meet arriving passengers or see departing passengers off on their trip, and those who come to the airport only to drop off or pick up passengers but do not come into the terminal. The latter are sometimes referred to as "serve passenger" trips.

Although greeters and well-wishers cannot access the secure part of the terminal and thus will not be intercepted by surveys in that area, passengers will be able to provide information on the well-wishers who accompanied them to the airport. However, they may not know how long the well-wishers remained at the airport after the passengers went through security or whether the well-wishers made any use of airport services or concessions before leaving.

Similarly, departing passengers who are visitors to the area may be able to recall information about greeters who met them on their arrival, but they may not know how long those greeters spent at the airport or whether they used any airport services or concessions while waiting. Departing passengers who are residents of the area are less likely to be able to provide information about greeters who will meet them on their return, because this has yet to take place.

Therefore, it may be desirable to survey greeters and well-wishers themselves in non-secure parts of the airport. This is especially true if it would be useful to have information on their use and satisfaction with the facilities, services, and concessions, or to obtain their suggestions. Because it will not always be obvious who are passengers and who are greeters or well-wishers without asking them, information on greeters and well-wishers will generally be obtained as part of a survey that includes passengers as well, but using separate questionnaires or separate questions on a common questionnaire. These surveys are typically performed at the various groundside locations.

The problems with sampling bias are more acute with greeter and well-wisher surveys than passenger surveys. Well-wishers will often not want to take the time to participate in a survey during the short period they have with the passengers, and they will typically not remain in the terminal long after the passengers proceed though security. Greeters are usually easier to interview as they wait for the passenger to arrive, but the sample will be biased towards greeters who spend a longer time at the airport, especially for delayed flights. This bias can result in biased estimates of characteristics such as the time spent in the terminal, the time their vehicle is parked, and the amount spent at the concessions.

Care must be taken to ensure that greeters and well-wishers are not double-counted when analyzing the results of surveys of air passengers in which multiple responses may be received from a given air travel party. Greeters and well-wishers will usually be at the airport to see off all members of the air travel party, which must be taken into account when tallying the numbers of greeters and well-wishers per passenger. There will often be more than one greeter or well-wisher meeting or seeing off an air travel party, but only one survey response will be obtained from each group. Thus the number of greeters or well-wishers in the group should be collected, as well as the size of the air travel party they are meeting or seeing off. Care should also be taken in expressing the results to account for air travel parties that do not have greeters or well-wishers. In the case of well-wishers, this information can be obtained from air passenger surveys. However, estimating the number of arriving air parties that are not met is more difficult. The total number of greeters and well-wishers can be estimated by comparing the reported use of short-term parking by greeters and well-wishers with statistics on exits from short-term parking by duration.

5.9 Groundside Surveys

Groundside surveys form a special type of air passenger survey that can be used to obtain detailed information for planning airport groundside facilities. Groundside surveys are characterized by two key factors: first, the survey sample is typically not a controlled random sample of the target population; and second, the interview process is directed at the occupants of a vehicle rather than individual travelers. In the absence of a structured sample plan from which to derive weight factors for each interview, it is necessary to obtain ancillary data in order to calculate appropriate weights for the survey responses.

5.9.1 Purpose

Groundside surveys are used to gather information on vehicle use patterns by air passengers and associated greeters and well-wishers to plan future groundside facilities or to create and calibrate a ground transportation model that will be used in future planning studies.

The vehicle trips associated with the passengers on a single flight place loads in time and space on the groundside facilities. The sum of these loads for all flights in a planning period gives the varying load on all groundside facilities, which determines the resulting level of service provided by those facilities.

Groundside surveys are designed to collect complete information on the vehicle trips serving arriving and departing air passengers, including the characteristics of the well-wishers and greeters that accompany those passengers. This information enables the development of four time curves associated with air passenger departure and arrival activity:

- The time before flight departure that air passengers and any accompanying well-wishers arrive at the airport.
- The time well-wishers leave the airport, either before or after the flight departure.
- The time that greeters arrive at the airport with respect to the arrival time of the flight they are meeting.
- The time that air passengers and any accompanying greeters leave the airport after the flight arrival.

5.9.2 Ancillary Data

To handle the sampling rates of this type of survey during the analysis, it is necessary to ensure the survey population is well defined. Groundside interviews will yield air passenger information linked to specific flights. Therefore, to know how each interview should be factored so that the survey results represent the characteristics of all O/D air passengers, passenger counts should be obtained for each flight. In the case of through flights, it will be necessary to obtain counts of both the terminating and originating passengers.

If passenger loads on each flight are not available from the airlines or the airport, they must be estimated using an alternative data source. The airline schedule for the airport can be obtained prior to the survey for the survey period from the OAG or similar sources. This dataset will provide scheduled arrival and departure times, along with aircraft type, from which the number of seats can be estimated. Recent data from the airlines can be used to apply load factors to each flight, by flight sector, to generate estimates of enplaned and deplaned passengers. Since connecting passengers do not use the groundside facilities, they must be subtracted to obtain estimates of O/D passengers.[24]

A key aspect of groundside surveys is that the interview is directed at the occupants of vehicles, rather than a group of air passengers. With this in mind, the survey planning team must be able to supplement the interview process with data from traffic counts, possibly in combination with other data sources. The factoring process, involving vehicles as the base unit, requires data from a variety of sources so that the interviews of the occupants of each vehicle can be made representative of the population.

These data sources include the following:

- Parking ticket data—to factor the interviews at the parking lots.
- Curb activity—to factor the interviews at the curbside, including both the public vehicle area and taxi queues.[25]

[24] Quarterly data on connecting passengers by airline and flight sector can be estimated from the U.S. Department of Transportation Bureau of Transportation Statistics airline Origin/Destination Survey database.

[25] Information on conducting curb activity surveys can be found in the documentation for the 2005 Groundside Survey at Toronto Pearson International Airport (see the Bibliography).

- Rental car activity—to factor interviews in the rental car area, both pick-up and drop-off.
- Hotel courtesy vehicles, rapid transit, and other public modes—possibly obtained from AVI systems.

5.9.3 Staff Requirements

Temporary staff requirements always drive the cost of an interview survey. With groundside surveys there is considerably more latitude in defining these requirements, although the required sample size remains a governing aspect.

Whether the survey is covering the entire airport for a short period or covering well-defined segments at different times over a longer period (as discussed in Section 5.9.4), the requirements will be about the same in terms of the total number of interviewer-days.

While the calculation of the survey sample size, discussed in Section 5.3, is a key consideration, interviewer requirements are also determined by the number of locations that need to be surveyed to ensure representative results. This need for enough interviewers to cover all locations may result in a higher number of survey responses from some locations than is required to meet the minimum requirements for desired statistical confidence.

The following interviewer staffing guidelines are based on an extensive groundside survey at Toronto Pearson International Airport in 2005:

- Curb area:
  - Three interviewers per terminal door for a single multi-use curb.
  - Two interviewers per terminal door for a public use (inner or outer)[26] curb area.
  - One interviewer for each taxi queue (arrivals area).
  - One interviewer for each of four designated stops for local bus or other services (shared-ride taxi, shuttle services, hotel courtesy, etc.) in arrivals area.
- Parking areas:
  - One interviewer per ticket spitter entrance area for a parking lot, or
  - Two interviewers per "pay on foot" parking payment machine area.
- Rental car and remote parking:
  - One interviewer per pick-up area, where the rental vehicle is picked up adjacent to the terminal.
  - One interviewer per drop-off area, where the rental vehicle is dropped off adjacent to the terminal.
  - One interviewer for each shuttle pick-up area for remote locations where air passengers are picked up adjacent to the terminal by a shuttle service that takes them to a remote or off-airport car rental agency or parking facility. (Where shuttle service for remote or off-airport vehicle drop-off or parking is provided, the interview coverage is typically provided by the curb interviewers.)
- Supervision requirements will vary with the airport configuration and experience of the interview staff and should be included in estimating staffing levels.

These guidelines should be used in conjunction with the requirements for sample size and the information in Table 5-4 showing the approximate number of responses per interviewer expected under different conditions.

[26] Inner curb areas are adjacent to the terminal and, at Toronto Pearson International Airport, are reserved for taxis, limousines and the like, while outer curb areas are dedicated to public use.

Table 5-4. Number of responses expected per interviewer by groundside location.

Area	Conditions	Estimated Number of Interviews per Eight-Hour Shift
Curb—public and taxi drop-off	Constant high volume of activity throughout the survey period, first door of the terminal	150
Curb—public and taxi drop-off, public pick-up	Constant high volume of activity throughout the survey period, second and subsequent doors of the terminal	125
	One peak period of activity and lower volumes during the shift	100
Curb—taxi waiting queue	As long as there are passengers waiting in the queue	150
Curb—shuttle stops	N/A	80
Parking—ticket spitter	Primary entrance to the parking lot; when traffic is heavy, the proportion of vehicles interviewed will be lower	125
Parking—"pay on foot"	As long as there are passengers waiting in the queue	150
Rental car—pick-up	Single lobby area for multiple agencies, or interviewers move between agencies during shift	100
Rental car—drop-off	Common drop-off area for all agencies, or interviewers move between drop-off areas	100
Rental car or remote parking—shuttle service	Pick-up area for service to remote area; rate assumes a lower volume of activity than in rental car lobby area	50

These estimates are based on the use of well-trained interviewers who can approach a vehicle, engage the party in the interview, and then complete a 20-question interview (including some observation entries) in less than two minutes.

5.9.4 Time and Space Considerations

Large international airports have multiple terminals and groundside facilities. Groundside surveys must be conducted at numerous locations and across the whole day of airport activity, from 6:00 a.m. (or earlier) to 11:00 p.m. (or later). This time span calls for at least two shifts per day of interviewers.

The groundside survey design, however, will not necessarily require that all terminals and all areas be covered at the same time. For medium- to large-sized airports, such a requirement would take an enormous and unwieldy number of interviewers for short periods of time. Instead, the airport or terminal can be subdivided in time and space to make the survey more manageable.

For this subdivision process, the survey design must maintain the link to the ancillary data so that the weighting can be completed for the analysis. Air passenger volumes will naturally divide into departing and arriving segments, as well as by terminal, and these volumes can be determined independently. In the analysis, it will then be possible to generate a weighting factor for each interview with a departing passenger as a function of the number of originating passengers.

Similarly, the groundside curb areas are often divided into separate arrival and departure areas. Under these conditions it is possible to design a groundside survey that segments the population into distinct groups, each of which can be surveyed independently.

As an example, consider the following survey plan for a single terminal with an upper level departures area and a lower level arrivals area. The departures level has a single curb, while the arrivals level has an inner and outer curb with taxis and buses at the inner curb and the general public at the outer curb. In addition, there are "pay on foot" parking payment machines at two locations in the terminal, a single lobby for the rental car agencies, no off-site remote service, and a common drop-off location for all rental car agencies. Table 5-4 shows the expected interview

completion rates per eight-hour shift for very short, focused interviews conducted by efficient interviewers. Note that completion rates depend on the length of the questionnaire, traffic volumes and flows, and the method used to conduct the interviews and, in some cases, may be significantly less than the rates shown. Actual completion rates will vary over the day, as traffic volumes vary.

Table 5-5 shows the corresponding interviewer staffing requirement for this example. Note that fewer interviewers are required for the departures area than the arrivals area, which is quite common.

With the interviewer resources established for each area, it is then a matter of making up a schedule of at least two shifts per day, so that the arrivals and departures areas are surveyed an appropriate number of times during the survey period. Based on the required number of interviews, the number of shifts and therefore the number of days required for the survey can be calculated. The shift plan will also have to cover each direction for each day of the week, so that, for example, an early shift for arrivals on each day of the week and an early shift for departures on each day are both included in the survey design, and likewise for the late shift. The survey design should also ensure that staff assigned to a late-night shift are not assigned to the next early-morning shift. It is assumed that week-to-week differences in the traffic pattern will be negligible.

With this plan in effect for a terminal with an adequate volume of traffic throughout the day from 6:00 a.m. to 11:00 p.m., each shift of interviewers will perform 1,500 to 2,000 interviews. This example demonstrates why the sample size is less of a concern than the coverage in time and space and the correct weighting of responses. When the survey is conducted over a week or more, the numbers of responses at each individual survey location are usually sufficient for detailed planning purposes.

5.9.5 Questionnaire

A generic groundside interview form should be developed first, to lay out the specific questions and establish the overall flow of the form. This form will then be modified to suit each of the interview locations for the survey. Experience has shown that interviewers have difficulties with a generic form that covers both activities that have already occurred and those that are yet to occur. Arriving passengers did some things in the past that departing passengers will do in the future. Keeping the past and future verb tenses in a logical order on a generic form is not easy. Therefore, it is preferable to design forms for each survey location and air passenger direction.

The first part of the form will contain observation information that the interviewer can complete as the target vehicle is approached. This information includes the interviewer, interview number,

Table 5-5. Example of number of interviewers required.

Area	Interviewers
Departures Area	
Departures curb—3 doors into terminal	9
Bus and shuttle drop-off	3
Rental car drop-off	1
Arrivals Area	
Arrivals curb—inner area, 12 stops, plus 2 taxi queues	5
Arrivals curb—outer area, 3 doors	6
Parking payment machines	4
Rental car pick-up lobby	1

time, location, vehicle type, number of occupants, and number of pieces of baggage (where baggage is visible). Standard rules for counting people and baggage must be defined, such as:

- Any child over the age of two is counted.
- All baggage is counted, except purses.

After a short introduction, the first question should always be: Have you been interviewed at the airport today?

This question has several purposes: to remove undue survey burden on the airport users, to eliminate duplicate information, and to count the number of vehicles that go to two groundside facilities in one airport trip. For departure trips visits to two groundside facilities could involve a stop at the curb followed by entry to the parking lot. For arrival trips it could involve the opposite, with exit from the parking lot followed by a stop at the curb to pick up passengers and baggage.

One section of the form will deal with the purpose of the vehicle trip: dropping off air passengers, picking up air passengers, or other activities (e.g., buying tickets, using airport concessions, or checking baggage for a later flight). While there will be several response options on the generic form, the number of responses on the form for each survey location may be reduced to a few or only one. For example, at the taxi drop-off or taxi queue areas, there are usually only air passengers; therefore, response options that greeters or well-wishers could choose would not appear on the survey form for those locations.

Another section will deal with the trip origin or destination within the local area. At departure locations this section typically appears early on the form, whereas with arrival locations this section should be later. These questions will include the type of trip origin or destination and a geographical location, as discussed in Section 5.4.

Another section will cover the air trip, which includes the number of air passengers (in this vehicle) as well as the baggage that was (or will be) checked. Experience has shown that air passengers usually do not know their flight number, but they do know the airline, where they are coming from or going to, and the approximate time of arrival or departure. A question about whether there will be a transfer en route to the final destination is normally required. This information is usually sufficient to identify the flight on which the air passengers are departing or arriving.

A final question will ask whether the air passengers are residents of the area served by the airport or are visitors to the area. Asking air passengers for their city and zip code (postal code) of residence can allow responses to be classified appropriately without relying on the respondent to decide whether they consider themselves a resident or a visitor, and can provide useful additional information to resolve ambiguous cases.

A sample set of groundside interview forms that were used in the 2005 Groundside Survey at Toronto Pearson International Airport is provided in Appendix G.

5.9.6 Calculating Response Weighting Factors

Each groundside survey interview will have a number of different response weights attached to it at the time of analysis. These weights will all be calculated from the proportion of interviews to a given population. During the analysis, the appropriate weights can then be applied to the responses.

Following is a partial list of weighting factors and the source data that are required to calculate the corresponding weights:

- Vehicle counts, possibly by mode. Given the total number of private vehicles that stopped at the departures curb and the number of vehicle occupant interviews in a specific time period,

a weight factor can be calculated. The sample percentage will naturally vary with fluctuating demand and a static interviewer resource. Time periods such as one-hour intervals, or peak and off-peak periods, could be used. Thus the weight assigned to each interview during the morning peak will be higher than the weight assigned to each interview during a slow mid-morning period. A similar approach can be followed for taxis, parking, and other modes.

- Passenger counts. Given the total number of originating or terminating passengers, a weight can be calculated based on the number of passengers covered by the interviews compared with this total number. An hourly weight can be calculated using the same approach as that for vehicle counts by time of day. A further refinement on the passenger-based weight factor can be calculated when passenger loads by flight are available, although the caution given in Section 5.5.2 about the use of flight-specific weights should be noted.

Other weighting factors can be specified and calculated, depending on the available data and the goals of the survey.

5.10 Checklists

Conducting airport passenger surveys involves numerous people conducting many different tasks. Checklists are a good way of identifying tasks, monitoring progress, and ensuring that all tasks are done. Checklists are particularly useful for organizational tasks involving a number of people. Common types of checklists used in passenger surveys, and examples of items covered, are as follows:

- Preparation of contract—defining contract, taking care of legal and administration details, setting survey schedule, preparing the RFP, defining evaluation criteria, determining where to publicize the RFP and/or to whom to send it, holding pre-bid meeting, conducting proposal evaluation and contractor selection (holding interviews if required), informing bidders, negotiating contract, obtaining legal approvals and signed contract, holding project initiation meeting.
- Questionnaire development—getting input from all parties, preparing initial draft, reviewing, formatting, conducting pre-test and pilot test (including printing or programming EDCDs), making final changes, final printing or programming of EDCDs.
- Training—dates, venue (including seating, display boards or projector, etc.), trainers, trainees, other project team members to be present, parking, airport tour (with escort if trainees are not badged), curriculum content, handouts (instructions, questionnaires, procedures, schedules, contingency plans, etc.), EDCDs, walkie-talkies, development of interviewing skills, practice interviews, testing, retraining.
- Forms and supplies—approvals for conducting survey (as required from airport operator, airlines, etc.), letter from sponsoring organization authorizing interviewers to conduct survey, printing of questionnaires (different colors for different versions), timesheets for staff, survey log books and flight record log sheets, check-out/check-in sheets for EDCDs, radios and other equipment, pre-paid mail-back envelopes, flight gate schedule sheet.
- Logistics—badging of interviewers, organizing of survey field office, equipment for field office (printer, copier, computers, Internet access, telephone, fax machine, power extension cords, etc.), storage space in field office for supplies and interviewers' personal items, locking and unlocking of field office, vests and/or name tags for interviewers, survey equipment (EDCDs and chargers, pens or pencils, clipboards, and bags), communication equipment (walkie-talkies and chargers), parking for staff.
- Contingency plans—interviewers absent or arriving late, cancelled or delayed flights, equipment malfunction (EDCDs, copier, printer, computer, Internet, walkie-talkie, etc.),

bad weather (for groundside surveys outside), abusive passengers, delays at security checkpoints, uncooperative airline staff, disruptions due to a breach of security or emergency situation.

Examples of checklists are provided in Appendix C.

5.11 Survey Budget

Given the complexity and variability of air passenger surveys, it would be misleading to offer even a range of budget numbers, let alone an approximate cost per response. Instead, the following is a list of questions that the survey sponsors will need to answer in order to come up with a realistic budget.

5.11.1 Planning

- How many people will be involved in the planning process?
- How many of these people will participate at no cost?
- How many meetings will there be?
- What sort of a meeting space will be required, and can this be obtained at no cost?
- Will travel expenses need to be reimbursed?
- Will there be beverages, snacks, or meals?
- Is parking cost an issue? Will someone need to arrange for parking permits?

5.11.2 Contractor Selection

- Who will prepare the RFP? Will this time be charged to the project?
- Who will evaluate proposals? Will this incur any costs?
- Will there be a pre-bid meeting? Will this incur any costs?
- Will bidders be interviewed? Who will be on the interview panel? Will this incur any travel expenses or other costs?
- Will the staff time involved in contract negotiation and approval be charged to the project?

5.11.3 Questionnaire Design and Testing

- Who will be responsible for questionnaire design?
- How long will the questionnaire be?
- Will the questions be easy or difficult to craft? Is a previous or similar questionnaire available?
- Will the survey be programmed into EDCDs? If so, who will do the programming? Will this incur any costs?
- How many people will test the programming of the EDCDs, if used? Who will do this? Will this incur any costs?
- How many completed interviews will be collected during the pre-test?
- Where will the pre-test staff be briefed and debriefed?
- Where will the pre-test be conducted?
- Who will be involved in the pre-test and at what hourly rates?
- If there is no programming, how many copies of the draft questionnaire will be required?
- Will mileage, per diems, or other travel expenses be required for pre-test staff?
- Will parking cost be an issue? Will someone need to arrange for parking permits?
- Will there be a supplemental hand-out/mail-back questionnaire? What printing costs will be involved? What postage costs will be incurred?

5.11.4 Sampling Plans

- Who will prepare the sampling plan for each day? How long will this take? (It will take longer than you think unless you have done it before.)
- How will the sampling plan be transmitted to the survey field team?
- Who will make sample adjustments as contingencies arise? How will these adjustments be communicated to the parties who need to be aware of them?
- How will the project adjust if sample quotas are not met, and who will be responsible for doing this?
- How many adjustments are likely to be made, and what are the implications for additional survey days?

5.11.5 Badging

- How many field staff will need to be badged?
- Who will be trained in the badging requirements and make the badging arrangements?
- How long will each field staff member need to spend on the badging process?
- What contingency plans will be needed for field staff who do not pass the background check?
- Is parking cost an issue? Will someone need to arrange for parking permits?

5.11.6 Training

- Will field staff need to be trained?
- How many interviewers will need to be trained?
- How many other staff will be involved, and who will they be?
- How many days or hours will the training take? Will it take place over more than one day?
- What training materials will need to be reproduced?
- What sort of training space will be required, and can this be obtained at no cost?
- Will mileage, per diems, or other travel expenses be involved?
- Will there be beverages, snacks, or meals?
- Is parking cost an issue? Will someone need to arrange for parking permits?

5.11.7 Pilot Testing

- What aspects of the survey will be pilot-tested?
- Who will conduct the test?
- Who will conduct the debriefing and make adjustments as needed?
- Where will the debriefing take place, and can this space be obtained at no cost?
- What is the contingency plan if the pilot test reveals problems that need to be addressed? Will this have any impact on costs?

5.11.8 Survey Implementation

- How many interviews will be completed or forms handed out and returned?
- On how many days will the survey take place?
- How many hours per day will need to be covered? Will very early and very late flights be included? If they are included, who will cover them?
- What shifts will be involved on each day?
- How many interviewers will this require?
- How many supervisors will be required based on shifts, airport configuration, and walking distances? What will the supervisors' responsibilities be?

- What are the pay rates for interviewers and supervisors? Will pay rates be higher for very early morning and late-night hours?
- Where will the field staff be based at the airport? Will this location provide for ready access, charging of electronic devices, security, and storage of both supplies and personal effects for those in the field? Will this incur any costs?
- Will field staff wear uniforms or identifiable clothing (e.g., vests or aprons)?
- What supplies will be required?
- Will it be necessary to purchase or rent EDCDs and chargers, or other electronic equipment? Do the EDCDs come with adequate software, or will software need to be purchased?
- How many copies of questionnaire forms will be required?
- Will show cards be used? How many sets will be required?
- Is there a supplemental hand-out/mail-back questionnaire? What printing costs will be involved? What postage costs will be incurred?

5.11.9 Quality Control

- Who will be responsible for checking completed work?
- What percentage of all work will be checked at the beginning? As the project progresses? When will this take place? (Beware of overtime!)
- What logic checks will be performed? Who will develop the protocols for these checks?
- How will completed and checked work be transmitted to the survey sponsor or technical expert for further review? At what frequency will this occur?
- How much time will these further checks take? (Again, likely more than you think unless you have done this before, particularly for a survey involving geocoding trip origins.)

5.11.10 Data Entry and Verification

- Will completed questionnaires need data entry?
- How will data entry be accomplished?
- How many mailed-back forms are likely to need processing?
- Will the data entry be verified? In what way and in what amount?

5.11.11 Analysis and Reporting

- What sort of report will be required?
- Who will prepare statistical tabulations or any computations needed?
- Will statistical software need to be purchased?
- Who will prepare the graphics? How many graphics will there be?
- Who will write each section of the report?
- How many sections will there be, and how long will each one be?
- Will there be an oral presentation?
- Will this presentation incur costs such as mileage or airfare, car rental, parking, and per diems?

5.12 Summary

Air passenger surveys are the most common type of airport user survey, but they involve many complex issues that need careful consideration if the results are to be useful and accurate. These issues include the following:

- Whether to interview passengers or use self-completed survey forms.
- Where to perform the survey.

- When to perform the survey and over how long a period.
- How large a sample size to aim for.
- Development of an appropriate sampling plan.
- Development of a well-designed and carefully worded questionnaire.
- Selection and training of field staff.
- Planning of survey logistics.
- How to weight the survey responses.

Because air passenger characteristics vary by hour of the day and day of the week, passenger surveys should generally take place over at least a full week and cover all hours of each day. These surveys are best conducted either in the airline gate lounges before a flight departs or as passengers arrive or depart from the security screening area. The choice of location will depend on factors such as the survey population, the types of information being collected, the layout of the terminal(s), and the survey method used.

The fact that many passengers will be traveling as part of a group needs to be considered in designing an air passenger survey. Self-completed surveys are usually handed out to every passenger on a selected flight (or at least those waiting in the gate lounge), while interview surveys generally interview only one person from each air travel party. This difference needs to be reflected in the questionnaire design, sampling plan, and analysis and reporting of the survey results.

Even with the most carefully designed sampling plan, it is inevitable that the resulting survey responses will not exactly correspond to the composition of the underlying target population. Some passengers will be over-sampled and some will be under-sampled. In particular, it is likely that those passengers arriving at the gate close to flight departure time will be under-sampled. Over-sampling or under-sampling may also result from variations in aircraft size, flight load factors, or constraints of the sampling plan. Therefore, it will generally be desirable to weight the survey results. Calculation of appropriate weights requires careful thought and the collection of ancillary information about the target population that can be used to determine the extent of any bias in the survey responses.

Groundside surveys of vehicle occupants form a special type of air passenger survey that can be used to obtain detailed information for planning airport groundside facilities. These surveys—which provide information on greeters and well-wishers as well as passengers—are performed at various locations on the airport landside, including terminal curbs, parking facilities, and shuttle bus or public transportation pick-up and drop-off stops. Because the sampling rate varies widely from location to location and time to time, the results need to be weighted using counts of vehicles at different facilities as well as counts of originating and terminating air passengers.

Finally, this chapter has discussed the logistical issues involved in conducting air passenger surveys and estimating the cost of planning and performing such a survey.

CHAPTER 6

Employee Surveys

Many of the issues related to planning and designing employee surveys are common to other types of airport user surveys, and the reader will be referred to those sections of the guidebook where applicable.

Employees working at the airport are an important user group. Although their numbers may be relatively small, they use the airport facilities and services frequently, and their attitudes to those facilities and services can affect other people's uses and perceptions. Airport employees for the purpose of this chapter include employees of the airport operator as well as those of airlines, government agencies, and other organizations providing services or support functions at the airport.

6.1 Purpose of the Survey and the Data to Be Collected

The reasons for conducting employee surveys are often similar to the reasons for conducting air passenger surveys, and frequently the two are part of the same study. Employee surveys are also conducted to address employee-related issues. The types of issues addressed through employee surveys include the following:

- Satisfaction with airport facilities and services—to identify areas where improvements are required, track trends, and assess whether specific actions have improved satisfaction levels.
- Concession planning and performance—to collect information on use of concessions, length of breaks, problems with current concessions, and desired improvements. Employees can be significant users of the concessions, especially food and beverage concessions, and should be considered in their design.
- Transportation planning—to obtain information on employees' modes of transport to and from work, routes, travel times, work schedules, parking requirements, and desired improvements.
- Employee issues—to obtain feedback on security or emergency procedures, and employee communications.

As with all airport user surveys, the first step in conducting an employee survey is to outline its goals and purpose. (See Chapter 2 for a discussion on specifying goals, defining the purpose of a survey, the importance of doing so, and who should be involved.)

The choice of employees to be included will depend on the purpose of the survey and could include the following:

- All people working on airport property.
- All employees based at the airport; this group excludes visiting flight crews, taxi drivers, etc.
- Selected employer or employee groups, such as airport authority staff or airline flight crew.

- Employees working in a specific facility or geographical location, such as the passenger terminal, the aircraft apron, or an airline maintenance base.

Confidentiality can be an issue. Employees may be reluctant to provide truthful responses if they think their responses could be used against them by their employer or the airport. Questions related to airport performance or communication could raise this concern. If such reluctance is an issue, the survey should be conducted by a third party with assurances that the individual responses will not be provided to the airport and results will be presented in aggregate form only. Alternatively, the survey could be set up so the responses are anonymous.

6.2 Survey Methodology

The choice of survey method is governed by the target employee group and the available information on those employees that allows them to be identified, sampled, and contacted. The methods appropriate for use in employee surveys are either on-site intercept surveys or self-completed surveys distributed on the basis of lists of employees provided by employers.

For surveys of employees based at the airport, ideally lists of employees should be obtained from each employer and used to identify the employees to be surveyed. Some employers may not be willing to provide a list of employees but may be willing to distribute the questionnaires themselves. If neither of these methods is possible, on-site surveys could be used, provided access can be obtained to work locations or areas where the employees have their breaks.

Surveys of all employees working on airport property—including flight crews, for example—will need to be conducted as on-site intercept surveys, or include an on-site intercept component.

6.2.1 On-Site Surveys

For on-site intercept surveys, each of the employee groups to be surveyed should be identified and optimal locations to conduct the surveys should be determined. Employees should not be surveyed when they are busy with work, and it may be difficult to contact them during breaks or immediately before or after work. In these situations, self-completed questionnaires that employees can fill out when not working are the best option. The questionnaires could be distributed to staff in the break rooms, at the check-in counters or work locations, or while they are seated in the food courts. Nobody should be approached in a restaurant or cafeteria unless permission has been obtained from the proprietor beforehand. In some situations, it may be possible to conduct intercept interviews.

There are various options for collecting self-completed questionnaires. The survey staff could return later to pick up the questionnaire and could clarify any questions or responses with the employee at that time. Otherwise, drop boxes could be provided in the employee break rooms or employer offices, or the forms could be mailed or faxed back.

In terms of logistics, employers at the airport should be notified of the survey and, where appropriate, access to employee break rooms and provision of drop boxes should be arranged.

The advantage of using on-site intercept surveys is that it is not necessary to obtain employee lists, which can be difficult to compile, especially if transient staff—such as airline crews, and shuttle bus and other ground transportation drivers—are to be included. The main difficulty with on-site employee surveys is obtaining a representative sample. However, if the number of employees in each employee group is known, at least approximately, weightings can be applied in the analysis phase so that the results better match the employee population.

6.2.2 Employer or List-Based Approach

The first step in using a list-based approach is to develop a list of all employees working at the airport by asking employers for contact information for their employees for use in conducting a survey. Some employers may prefer to distribute the questionnaire directly to their employees and not provide contact information.

The information available on the employees will determine which of the following methods can be used to contact them:

- Email—generally the quickest and easiest method, but email addresses may not be available for all employees. The message would ask them to participate in the survey and could provide a link to a Web-based questionnaire (see Section 1.4) that would be completed online. Alternative methods, such as including the questionnaire as an attachment or in the body of the email, are not recommended because inexperienced users often have trouble dealing with these files, and returning the completed questionnaires can be problematic. If email addresses are known for most, but not all, employees, those without email addresses could be surveyed by mail or telephone.
- Mail—usually the most reliable method for contacting employees whose home or work addresses are available, but responses are usually slow and response rates are typically low.
- Telephone—allows the use of interviews, rather than self-completed questionnaires, but is generally more costly to administer. It may take a number of calls just to reach the employee on the telephone, and many employees may not have a telephone at their work location. (Section 8.3 includes an extensive discussion on conducting telephone surveys.)
- Employer-distributed—recommended to be placed in an envelope with the employee's name on the envelope, so that it can be verified that each employee to be surveyed receives a questionnaire.

Completed questionnaires could be collected using a drop box at the employee's work location, or by mail or fax. Another option with printed questionnaires distributed by mail or via employers is to include a Web address on the questionnaire and invite recipients to fill in the questionnaire online, if they prefer this method and have Internet access. If returning questionnaires by mail is an option, pre-paid envelopes should be provided.

The advantage of a list-based method is that it is possible to use a structured approach to the sampling of employees to ensure an unbiased representative sample is chosen. The main disadvantage is that it may not be possible to identify all employees working at the airport and include them on the list, and a biased sample may result. Compiling the lists can also be time consuming, and some employers may not cooperate, resulting in an incomplete list. The initial step should be to ask employers if they will provide a list of employees and, if some will not, then decide how to proceed. It may be necessary to switch to an on-site survey or a hybrid approach in which some employees are surveyed with a list-based method and others are surveyed using an on-site method. Switching approaches part way through the survey planning process can increase the time and cost involved.

6.3 Sampling Methodology

The sample size and the method used to select the sample of employees to survey will depend on the total number of employees (population) and any specific subgroups to be analyzed, and the desired accuracy. If using mail, email, or employer distribution of questionnaires, the low response rates associated with these methods, sometimes well below 50%, should be considered. When using one of these methods at a small airport, it may be best to survey all people on the list (i.e., to conduct a census survey).

Table 6-1. Sample sizes required for accuracy of better than 5 percentage points in a categorical variable.

Total Number of Employees at Airport	Sample Size Required for Category Proportion:		
	$p = 0.5$	$p = 0.25$	$p = 0.1$
50	44	43	37
100	80	74	58
200	132	118	82
500	218	183	108
1,000	280	225	122
5,000	360	272	135

Note: Assumes random sampling.

For on-site surveys, the number of responses to be collected should be determined in advance. (See Chapter 3 for a discussion on the different sampling methods and required sample sizes.) An estimate of the number of employees at the airport will be required, even if this is only approximate. For random sampling, required sample sizes to achieve an accuracy of better than ±5 percentage points[27] for a categorical variable are given in Table 6-1 for a range of total numbers of employees at the airport. As discussed in Section 3.4, the required sample sizes vary depending on the proportion of the population in the category of interest. This proportion will not be known at the time of planning the survey and must be estimated, at least approximately, based on past surveys, experience of other airports, and knowledge of the airport. Required sample sizes are given for three values of this proportion: 0.5, 0.25, and 0.1.[28] The largest samples are required when the proportion of the population in the category of interest is 0.5. Because most surveys ask multiple questions with various unknown proportions in each category, the sample size corresponding to a proportion of 0.5 should be used unless the survey sponsor is primarily interested in questions where the proportion is lower. Further examples for determining the required sample size are provided in Appendix B.

Note that for categorical questions with a fairly low proportion of respondents in a category of interest, a margin of error of ±5 percentage points may not be considered accurate enough.

On-site surveys should cover weekday and weekend periods and morning, afternoon, and evening shifts as well as a wide range of locations. The locations should include areas where the employee groups go during their breaks, such as break rooms and public food courts.

Given the ad hoc nature of selecting employees to interview, the resulting sample may not be truly representative of the employee population. It is therefore recommended that responses be weighted to match subgroup sizes, for example by employer category, shift schedules, or work location.

6.4 Questionnaire Wording and Length

Questionnaire length, format, and clarity, and the use of pre-tests and pilot tests, are discussed in Chapter 4.

The questionnaire for employee surveys should be relatively short, as employees are usually busy during work time and value their breaks. The time needed to complete the survey should be no more than 5 to 10 minutes.

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[27] As discussed in Section 3.2, accuracy to within 5 percentage points is very different and usually much less stringent than accuracy to within 5% of the proportion in the category.

[28] For proportions (p) greater than 0.5, the required sample size is the same as for the proportion $1-p$. For example, for a proportion $p = 0.75$, the required sample size is the same as for $p = 0.25$.

Chapter 4 provides examples of types of wording that can be confusing, many of which are applicable to employee surveys. Other examples of confusing wording include the following:

- Amounts spent at concessions—confusion may occur as to whether the amount is per visit (in which case the number of visits per day is also required) or the amount spent per day. It is difficult for employees to estimate the average amount spent per day for concessions that they only use once a week or once a month. A better approach is to ask when they last visited a particular concession and how much they recall spending. The responses then provide a distribution of the frequency of visits and the amount spent. The question should make it clear whether taxes and tips should be included.
- Work location—some employees work in multiple locations.
- Category of employer—employees often do not recognize categories of employers such as "concessions." It is better to provide a wide range of options so few people will respond with "other." Include volunteer positions in the response options if the airport uses them (e.g., in information booths).

Two sample questionnaires for employees are provided in Appendix H.

6.5 Measures to Obtain Adequate Response

The two main considerations in obtaining an adequate response rate are to clearly explain the purpose of the survey in a way that will make the survey of interest to employees and to ensure that it is easy for them to respond. The introduction should identify who is conducting the survey and who it is for. It should state how the results will be used, highlighting aspects that could benefit them as airport employees.

Aspects such as the quality and friendliness of interviewers and the length, format, and ease of understanding and completing the questionnaire (discussed in Section 5.6) apply equally to employee surveys.

If questionnaires are being handed to employees while they are at work, they should be approached when not busy, asked to fill out the form at their convenience, and informed what to do with the completed questionnaire. Options, discussed earlier, include returning later to collect the completed questionnaire, having a drop box, or using pre-paid reply mail. It will be necessary to go to the same work locations over a range of times and days of the week to cover employees working different shifts.

Interviews in employee break rooms or food courts are often very successful. The topics can become points of conversation among employees and they develop more interest in the issues being covered.

6.6 Survey Budget

The budget for employee surveys will include the following components: survey design and planning, including development of employee lists if a list-based approach is used; questionnaire design, testing and printing, or loading onto a survey website; survey field staff and supervisor wages and other on-site expenses; data entry, checking, and analysis; and reporting and presentation of findings. (See Section 2.5 for a more detailed discussion of the steps in developing a survey budget.)

Concession and satisfaction surveys of employees are often conducted in conjunction with passenger surveys, which can significantly reduce the costs of the employee survey, especially an on-site survey. Contact with employees is best done during quiet periods at the airport, so employee

interviews can often be conducted by the same set of interviewers in periods when they are not busy with passengers. Costs for developing the questionnaire may also be lower as there will often be overlap between the employee and passenger versions.

Costs will vary depending on the collection method, size of the sample (less so for Internet-based surveys), difficulty in developing employee lists (for a list-based approach), and local factors. However, for a typical on-site airport satisfaction survey of around 150 employees at a small- to medium-sized airport using a two-page questionnaire and conducted by a contractor, costs will range from approximately:

- $10,000 to $15,000 for a stand-alone survey.
- $6,000 to $10,000 if conducted in conjunction with a passenger survey.

Costs for large airport access surveys can be much greater. One airport sampling 3,000 employees reported a cost of $80,000 for such a survey where questionnaires were handed out to employees and collected by either drop box or return mail.

Where the employee survey is being conducted in conjunction with a passenger survey, costs could be reduced by keeping differences in the questionnaire and data analysis to a minimum, and reporting results as a section in the report for the passenger survey. Reductions in the sample size and time spent setting up the survey will decrease the costs but will lead to reductions in the accuracy of the results. When determining the scope and budget for an employee survey, note the proportion of users represented by employees and scale the budget accordingly. This proportion is usually relatively small, but at large hub airports, with airline crew bases, maintenance bases, and extensive cargo facilities, the ratio of average daily employees to average daily enplaning passengers can range from 25% to over 50%. At airline connecting hubs, the ratio of daily employee ground access trips to originating passenger access trips frequently approaches and in some cases exceeds 100% (Gosling, 2008).

6.7 Summary

Employees make up a significant group of airport users and need to be considered when planning airport facilities and services. Employee surveys are conducted for a variety of reasons, including assessing satisfaction with facilities and services, obtaining information for transportation or concession planning, or addressing employee-related issues such as communication and knowledge of airport procedures. Two approaches can be used: develop a comprehensive list of all employees on which to base the survey or conduct on-site intercept surveys.

Questionnaires are usually self-completed, but an on-site intercept survey could collect responses through interviews. At smaller airports, using a list-based approach with mail, email, or employer distribution of questionnaires usually requires sampling all employees because of the high nonresponse rates. At larger airports and for on-site surveys, a sample of employees is selected, but the sample size is typically smaller than for passenger surveys because the surveyed population is smaller. Concession and satisfaction surveys of employees are often conducted in conjunction with passenger surveys, decreasing the costs and time involved.

CHAPTER 7

Tenant Surveys

Many of the issues related to planning and designing tenant surveys are common to other types of airport user surveys, and the reader will be referred to those sections of the guidebook where applicable.

Airport tenants include a wide range of organizations, such as concession operators (retail, food and beverage, car rental, courier, entertainment, etc.), airlines, government agencies, organizations providing aircraft and aviation services, organizations handling cargo and mail, general aviation aircraft owners and fixed-base operators, and often non-aviation businesses as well. The particular tenants to survey will depend on the goals and purpose of the survey.

7.1 Purpose of the Survey and the Data to Be Collected

Tenant surveys are conducted for a variety of reasons. Typical examples, and the types of data collected, include the following:

- To obtain information to determine the economic impact of an airport. The types of information collected typically include data on gross revenues, wages, and taxes; numbers of employees by part-time or full-time status and type of work; and the value of capital assets and capital expenditures.
- To determine satisfaction with the services provided by the airport in its role as landlord. This survey could include tracking tenant satisfaction and service requirements, identifying key factors that influence overall tenant satisfaction, gathering feedback about the quality of the services provided by the airport and its efficiency in meeting tenant needs, and identifying opportunities for enhancing tenant satisfaction and value. This type of survey should be conducted by a third party, and responses should be kept confidential and released in aggregate form only.
- To obtain information on customer service through techniques such as "mystery shopper" surveys. The survey could also include price comparisons with identical or similar off-airport shops and services (e.g., restaurant chains). The results are used to make specific improvements to concessions.

As with all airport user surveys, the first step in conducting a tenant survey is to outline its goals and purpose. (See Chapter 2 for a discussion on specifying goals, defining the purpose of a survey, the importance of doing so, and who should be involved.)

7.2 Survey Methodology

The options for conducting tenant surveys include using Internet, fax-in, or mail surveys (or a combination of these) or on-site visits. Because the number of tenants is generally relatively small,

all tenants in the categories of interest are usually surveyed, especially if the results will be compiled for tenant subgroups. Where there are many tenants, selection of a sample is appropriate. Surveying all tenants will help ensure an adequate response rate.

Mystery shopper surveys must obviously be conducted on site. These surveys are very different from other tenant surveys and are discussed separately in Section 7.7.

7.2.1 Internet Surveys

Internet surveys are ideal for conducting tenant feedback and economic impact surveys. The airport should have contact information for all tenants, which will generally include email addresses. There may be exceptions in the case of general aviation aircraft owners or small, independent concession operators, who may have to be surveyed using another method.

All tenants to be surveyed are sent an email asking them to participate in the survey and providing a link to the questionnaire on the World Wide Web. (See Section 1.4 for a discussion on setting up a Web-based survey.) It is often a good idea to notify tenants in advance of the survey by email or telephone and to follow up with non-responding tenants, again by email or preferably telephone.

Using Web-based surveys with initial contact via email has the following advantages:

- The survey is relatively easy to set up and administer.
- The use of email allows the survey invitation to be easily forwarded to the appropriate person in the company.
- It allows respondents to complete the survey at a time convenient to them and to do so in more than one session, if they wish (depending on the software used).
- It allows easy tracking of the number of responses and requires no data entry.
- Response rates are usually much better than with mail surveys.

The main disadvantages are that some effort may be required to compile a tenant email address list and some tenants may not have email addresses or easy access to the Internet. A mail or fax-in survey could be used for those tenants without email addresses. Many Web-based survey tools allow for mailed and faxed replies to be entered manually so that they can easily be incorporated into the Web-based survey results. However, response rates for Web-based surveys are not as high as with on-site visits.

7.2.2 Mail or Fax-in Surveys

Mail and fax-in surveys are similar in approach to Internet surveys but require each tenant's mailing address rather than email address. Questionnaires are mailed to each tenant with a prepaid reply envelope, and responses are either mailed or faxed back.

The advantage of mail surveys is that all tenants will have a mailing address. The main disadvantages are that response returns are often slow, the response rate is typically low, and responses must be entered into a database for analysis. Non-responses are usually followed up by telephone, which is more costly than sending bulk reminders via email but is generally more effective, particularly if the emails have not been reaching the correct person.

7.2.3 On-Site Surveys

On-site surveys are the only viable method for mystery shopper surveys (discussed in Section 7.7). On-site surveys can also be used for tenant feedback and economic impact surveys, but Internet or mail surveys are generally preferable. Tenant staff available on site will often not be able to provide

the required information and may be busy with customers, so interviews should be done by appointment. Tenant staff may also have to check company records to respond to some questions, thus some questions might go unanswered with only a single interview. Generally, tenants are contacted by mail or telephone to advise them about the survey and possibly schedule an appointment. Sending the questionnaire in advance gives the tenants a chance to assemble any information needed.

The advantage of on-site surveys is that a deeper understanding of the issues is possible through in-person interviews. The major disadvantages are that scheduling all the required interviews is often difficult and on-site surveys are more costly to conduct.

7.2.4 Confidentiality

As confidentiality is an issue for tenant surveys, it is recommended that they be conducted by respected third parties. Assurances should be given to the tenants that the information will be kept in strict confidence and provided to the airport operator in aggregate form only.

7.3 Sampling Methodology

In the case of Internet or mail surveys, questionnaires or survey requests will generally be sent to all tenants at the airport. However, including all tenants could be costly, especially for on-site interviews at large airports. If only a sample of tenants is required, a stratified sample of tenants should be surveyed where the tenants are grouped by category—for example, concessions, airlines, government and security agencies, individual aircraft owners, and other organizations. The sample size will depend on the purpose of the survey, the desired level of accuracy, and the number of tenants in each category.

For random sampling, required sample sizes to achieve an accuracy of better than ±5 percentage points for a categorical variable are given in Table 7-1 for a range of total numbers of tenants at the airport. As discussed in Section 3.4, the required sample sizes vary depending on the proportion of the population in the category of interest. This proportion will not be known at the time of planning the survey and must be estimated, at least approximately, based on past surveys, experience of other airports, and/or knowledge of the airport. Required sample sizes are given for three values of this proportion: 0.5, 0.25 and 0.1.[29] The largest samples are required when the proportion of the population in the category of interest is 0.5. Because most surveys ask multiple questions with various, unknown proportions in each category, the sample size corresponding to a proportion of 0.5 should be used unless the survey sponsor is primarily interested in questions where the

Table 7-1. Sample sizes required for accuracy of better than ±5 percentage points in a categorical variable.

Total Number of Tenants at Airport	Sample Size Required for Category Proportion:		
	$p = 0.5$	$p = 0.25$	$p = 0.1$
30	28	27	25
50	44	43	37
75	63	60	49
100	80	74	58
200	132	118	82
400	196	168	103

Note: Assumes random sampling.

[29] For proportions (p) greater than 0.5, the required sample size is the same as for the proportion $1 - p$. For example, for a proportion $p = 0.75$, the required sample size is the same as for $p = 0.25$.

proportion is lower. Further examples for determining the required sample size are provided in Appendix B.

Depending on the purpose of the survey, it may be appropriate to sample a greater proportion of some subgroups than others. If a similar level of accuracy is desired for each subgroup, a higher sampling fraction would be used for smaller subgroups or for subgroups where the variance of the characteristic of interest, say economic impact, is greatest. Thus, subgroups with a high economic impact such as airlines would have a higher sampling fraction than owners of individual private aircraft.

For economic impact surveys, the treatment of non-responses can significantly affect the results. The economic impact of individual tenants varies greatly, particularly between groups of tenants. Use of only the data from responding tenants would lead to underestimation of the total impact, and expanding the sample results on the basis of the average response for each group of tenants could result in large errors, depending on the tenants that did not respond. Every effort should be made to obtain some response from all tenants, even if only basic information—such as the number of employees or gross revenues—is obtained from some organizations. This information can then be used to develop weights to expand the data received from each group of tenants to represent the total group. If no information can be obtained from some tenants, the airport will always know something about the size of each tenant. In many cases they will know the number of employees from issuing security badges. They will also know the size of the area leased and in many cases will have traffic or revenue data from required reports or concession fees. This information can be used to estimate the relevant economic measures for the non-respondents, based on the data from the responding tenants.

Mystery shopper surveys will generally be conducted on all food and beverage and retail concessionaire tenants (see Section 7.7).

7.4 Questionnaire Wording and Length

Tenant feedback and economic impact surveys should take less than 20 minutes, preferably much less, including finding the data. There is always a temptation to ask for more detailed information than is required; however, this can significantly affect the response rate. The survey should be restricted to requests for information that a knowledgeable person within the organization will know immediately or be able to obtain easily. As discussed in Section 4.3, determine in advance exactly what information is required and how the response from each question is going to be used.

A sample tenant questionnaire is provided in Appendix I.

7.5 Measures to Obtain Adequate Response

A high response rate is important for obtaining accurate, unbiased results. The following measures could be taken to improve the response rate:

- Include the name of the company or organization conducting the survey and the survey sponsor in the introduction to the survey. The introduction should clearly state the purpose and how the results will be used, highlighting aspects that could benefit the respondents as airport tenants.
- Make it easy for the tenants to respond. Use of email to distribute the questionnaire allows it to be easily forwarded to the appropriate person. Try to keep the requested data to things the respondent will know immediately or be able to find out easily.

- Alleviate confidentiality concerns. The survey should be conducted by a third party with an assurance that all responses will be kept confidential and information will only be released in aggregate form so that responses from individual tenants cannot be identified. It may be useful to include some information about the survey organization to show that it is a respected organization with much to lose by breaking the confidentiality commitment.
- If conducting a Web-based survey, use software that allows respondents to save partially completed responses and complete them at a later time.
- Follow up with non-responding tenants. Initially this can take the form of email reminders, but should include a telephone call if nothing has been received after two or three reminders. The telephone call would be a good opportunity to attempt to obtain at least an estimate of the number of employees or gross revenue for those declining to complete the survey.
- Give recipients adequate time to respond. The deadline for responding should allow sufficient time for people on vacation, leave, or work-related trips to respond when they return. Two weeks is a reasonable period, increased to three weeks in July and August or around Christmas (although it is preferable not to schedule tenant surveys during these periods if possible). Reminders should be sent weekly, with a final reminder within 48 hours of the survey's closing time.

7.6 Survey Budget

Tenant surveys are relatively inexpensive to conduct using an Internet approach, but costs can increase significantly if initial response rates are low and many telephone follow-up calls are required.

The budget for tenant surveys will include the following components: survey design and planning, including development of tenant lists; questionnaire design, testing, loading onto a survey website; follow-up of non-respondents; checking and analysis of responses; and reporting and presentation of findings. (See Chapter 2 for a more detailed discussion of budgeting.)

Costs will vary depending on the collection method, sampling method, size of the sample (less so for Web-based surveys), difficulty in developing tenant lists, and the initial response rate. However, for a typical Web-based survey with 10 to 20 questions where email addresses can be provided by the airport and telephone follow-up is only required for 25% of tenants, costs might be approximately:

- $8,000 for a survey of 50 tenants.
- $12,000 for a survey of 100 tenants.
- $15,000 for a survey of 150 tenants.
- $18,000 for a survey of 200 tenants.

If the tenant survey is conducted on a regular basis, some items—such as survey questionnaire development and implementing it on the website—may entail minimal costs after the first survey. The start-up costs that could be avoided in subsequent surveys are typically in the $2,000 to $5,000 range.

Costs could be less if the initial response rate is very high or if non-respondents are followed up via email only. However, if response rates are low, the confidence in the results will be reduced and there will be additional costs for the analysis of non-responses.

7.7 Mystery Shopper

A mystery shopper survey is a very different type of tenant survey from the tenant feedback and economic impact surveys discussed above.

A mystery shopper survey is part of an overall program to assess the performance of concessions and identify deficient areas and specific improvements that could be made. The purpose of a mystery shopper survey is to anonymously evaluate customer service, operations, employee integrity, merchandising, and product quality of airport concessionaires. Product returns are also conducted where possible. Each concession is "shopped" at least twice—once during a busy period and once during a slower period. By shopping the store at least twice at different times, the survey staff will likely encounter different employees. Mystery shopper surveys are usually conducted on an ongoing basis every three or six months. The types of information collected on each concession include the following:

- Staff attributes—such as the greeting and assistance given, friendliness, courteousness and appearance, helpfulness, knowledge of the store's products, and whether a uniform or name badge was worn.
- Product selection—range, quality, display, items available and easy to find, prices clearly marked either on or in front of items.
- Purchase/checkout—length of queue, time in queue and being served, whether cashier stated purchase total and offered a bag and receipt, and whether transaction was accurate.
- Returns—whether returns are accepted, length of queue, duration of transaction, staff knowledge of the return process, accuracy of refund, whether customer was asked why the product was returned, and whether staff suggested another product where appropriate.

The mystery shoppers assess the concession while making a purchase or return, and immediately after leaving the store answer a series of questions related to each attribute, with most attributes simply requiring a numerical ranking, a yes/no answer, or time duration. Price comparisons can also be made with similar off-airport stores or with other airports.

Usually more than one shopper is used and each assesses a concession once. Some of the questions call for judgment (e.g., "friendliness of greeting"), and using a number of survey staff reduces dependence on a single opinion. It is essential that survey staff go through a training session with the supervisor, so that they fully understand exactly what they should be looking for when rating an attribute and there will be some consistency in the results. The shoppers also should provide comments or explanations where relevant, especially if poor ratings are given. These comments will be particularly useful when identifying specific improvements to be made.

When analyzing the results, both the average score and any variation between scores should be considered. One low score may not be cause for concern, but if a number of shoppers give a low score, or other related attributes also receive low scores, further examination should be conducted. These concessions should be surveyed again to determine if the poor rating is a trend or an anomaly.

The main advantage of mystery shopper surveys is that they provide assessments of the detailed attributes of concessions. Respondents to air passenger or employee surveys generally will not be able to recall these attributes in such detail or will not be able to answer this type of question due to time constraints. Mystery shopper surveys can be used in conjunction with passenger satisfaction surveys to identify areas with deficiencies as well as specific improvements that could be made.

The major disadvantages of mystery shopper surveys are that a very limited number of shopper surveys of a concession are made, many of the assessments rely on judgment, and the rating is dependent on the person making the assessment. Thus if there is significant variation in service quality over time, or in how the mystery shoppers rate the same attribute, the resulting ratings may not be accurate. Results can be skewed if an infrequent event occurs during a particular survey. The variation between mystery shoppers can be reduced with good training and by selecting survey staff that are typical of the profile of airport concession users.

When using the results of a mystery shopper survey, it is important to take these potential limitations into consideration.

7.8 Summary

Surveys of tenants are usually conducted to collect information for studies of the economic impact of airports or to determine tenant satisfaction with the airport as landlord. The best method for conducting these types of surveys is to send invitations to participate by email with a link to a Web-based survey. All tenants will usually be surveyed using this approach, with follow-up emails and telephone calls to those not responding. The surveys should be conducted by respected third parties with assurances that the data will remain confidential. Tenant surveys are relatively inexpensive to conduct compared to other airport user surveys.

Mystery shopper surveys are a different form of tenant survey. Their purpose is to anonymously collect detailed information for assessing the performance of airport concessions. This information is used to identify each concession's strengths and deficiencies as well as specific improvements that could be made.

CHAPTER 8

Surveys of Area Residents

Many of the issues related to planning and designing surveys of area residents are common to other types of airport user surveys, and the reader will be referred to those sections of the guidebook where applicable.

8.1 Purpose of the Survey and the Data to Be Collected

Most surveys of area residents are conducted to obtain information for marketing and airport planning purposes. Common areas of inquiry include reasons residents choose one airport over another, the extent to which residents of one area are using an airport in another area, the trip characteristics (airline, final destination, airfare, etc.), why the other airport is preferred, what might make the local airport more attractive to prospective passengers, what messages about the airport would resonate with these passengers, and what information sources passengers are using to make airport choices.

8.2 Survey Methodology

Surveys of members of the general public are most commonly conducted by telephone, because this is by far the most cost-effective method. Although some contend that such surveys can now be conducted via the Internet, the fact remains that only 45% to 60% of households are online, depending on whose figures one uses and the community in question. In addition, online surveys generally have the lowest response rates of any of the available survey strategies, which can lead to results that are unrepresentative of the population of interest.

For these two reasons, the telephone remains the preferred approach. Whether the Internet comes into its own as a vehicle for general public surveys will depend on its future rate of penetration. Of course, telephone surveys also have their drawbacks. These, and the methods used to overcome them, are discussed in the following section.

8.3 Sampling, Coverage, and Timing

8.3.1 Types of Telephone Survey Samples

Unfortunately, there are no lists of telephone numbers of *all* members of the general public from which an airport could select a list of people to call. Accordingly, less than optimal lists or some alternative approach must be utilized.

Various types of lists do exist, but none of them represent randomly selected samples of all people in a given geographical area. In addition, most such lists, usually purchased from brokers, are

compilations of people with particular characteristics. Typically, these lists contain non-random samples of "low-incidence" target groups—groups whose proportion in the general population is small. If such a target group is of interest, it is acceptable to sample from non-random lists because the cost of searching for members of low-incidence groups is usually prohibitive. If the target is the general public as a whole, however, the non-randomness of lists makes them widely frowned on as sampling sources.

The alternative, which is theoretically elegant but messy in practice, is to use something called "random-digit dialing" (RDD). In brief, RDD samples are constructed by combining known pairs of area codes and prefixes (the first three digits of a telephone number) with a random four-digit suffix. The elegant aspect of an RDD sample is that it represents a true random sample of every telephone-owning household in an area. Households without telephones are excluded, but this is only an issue in areas with high proportions of non-telephone households. Overall, about 97% of American households have telephones. Households with multiple land lines are also oversampled, but this usually has a trivial impact on survey results.

Importantly, households with unlisted numbers (as well as newly listed and erroneously listed numbers) are included. Because about a third of numbers in the United States are unlisted, this is a key benefit of RDD.

One challenging aspect of RDD is that it includes a lot of "junk" numbers: fax machines, data lines, businesses, non-working numbers, and the like. Although this does not affect the response rate for an RDD sample—these numbers are simply excluded from the calculations—it does affect the cost of the survey. It is not at all unusual to have to generate and dial 8 to 10 numbers for every completed interview in a relatively simple survey. Completion rates are generally between 1.25 and 1.75 interviews per interviewer per hour, which becomes boring for the interviewers and expensive for the sponsors.

Another challenging aspect of RDD sampling is what happens with a "ring-no-answer"—a number that is never answered when repeatedly dialed. Answering machines usually give sufficient clues for categorizing the number as either a residence or a business, but many of these numbers have no answering machines. Dialing such numbers dozens of times usually resolves their status, but this is extremely expensive and usually done only during large academic or federal government surveys. How these numbers are treated in final response rate calculations thus becomes problematic.

8.3.2 Call Sequence and Design

If most studies do not dial numbers dozens of times, how many calls are usually placed? This matters, because the more calls that are made, the more representative the sample becomes as more and more hard-to-reach people are included. However, multiple dialings lead to increased costs.

The general rule among public opinion researchers outside academia is to use a sequence of between four and six calls spread over different days of the week and different times of day. Most call centers dial from 5 to 9 p.m. local time Monday through Thursday or Friday (Friday evening is the least productive time) and during some hours Saturday and Sunday (Sunday evening is the most productive time). Generally, calls past 9 p.m. are frowned upon, as are calls before 10 a.m. Saturday. Whether calling before noon on Sunday makes sense is a function of the area and how many people attend church, go to Sunday brunch, or both.

8.3.3 Sources of Bias

As noted previously, one small source of bias in telephone surveys derives from the exclusion of non-telephone households, and another emerges from households with two land lines. Both of these are quite trivial and in most cases dismissed as inconsequential.

A larger potential source of bias is how ring-no-answer numbers are handled. Whether these numbers actually create a bias in any given study is generally unknown, because in most cases the numbers are fairly rapidly abandoned.

A potentially more important source of bias is refusals, because it is clear from many studies that people who refuse differ from those who do not. As a result, it is generally wise only to use call centers that focus on and keep refusals under control. For a medium-interest, relatively brief and well-designed survey of the general public, a refusal rate of more than 30% is an indicator that refusals are not being controlled.

Many call centers now attempt refusal conversions, and the general consensus is that these efforts are worthwhile. In conversions, the most persuasive interviewers try a number at which a refusal occurred another time. Only if they are refused a second time is the number abandoned.

It is also worth noting in this regard that most people refuse not because they never do surveys, but because the interviewer called at an inconvenient time. Frequently, callbacks occur at a better time for the respondent, and consent is readily obtained. It is also possible that someone else eligible to participate in the survey and with a generally more favorable attitude will be reached.

At the same time, so-called "hard refusals"—those who say they don't do surveys or who request to be placed on a do not call list—are never called back, because the outcome is predictable. (Survey research is not subject to the do not call laws, but many people do not know this and ask for do not call protection anyway. Most call centers oblige them.)

If sample types other than RDD are used, a major source of bias is the exclusion of households with unlisted telephone numbers. This is particularly true in areas where the proportion of unlisted numbers is high; in some parts of the United States, the unlisted rate currently exceeds 70%.

Finally, there is the issue of cell-phone-only households. Although estimates on the number of such households vary, this problem is not trivial. The problem is compounded by the fact that it is illegal to use automated dialing equipment, which many call centers use, to call cell phones. In addition, if interviews are actually conducted on cell phones, the respondent may be paying for the privilege with precious minutes.

At present, the survey research profession has not come up with a satisfactory solution to this problem. Recent experiments with dual sampling frames (one for cell phones and one for land lines) have had some success in reaching the cell-phone-only population, but these experiments are in their infancy. In the meantime, it probably makes sense to stay with a traditional RDD sample.

8.3.4 Dates to Avoid

Although it may seem obvious that certain dates should be avoided in conducting a telephone survey, some organizations have overlooked this basic concept. Dates to avoid include:

- Major holidays, including the day before, day of, and day after Thanksgiving.
- The annual income tax due date in April.
- Any date from December 15 through January 2.
- The day of any major sporting event.

8.3.5 Sample Size

Generally, sample sizes for surveys of area residents are determined using the formula for proportional data, as most of the results that are obtained in such surveys are expressed as percentages. It is also generally assumed that the distribution of the data will be the worst-case scenario (a 50/50 split). True pilot tests in order to establish a different and more favorable benchmark are rarely conducted in telephone research. Further parameters for the sample are usually fixed in

advance based on the available budget, assumptions about the importance of the results, and the risk of making wrong decisions based on the findings.

Customarily in opinion research, the confidence level is fixed at 95%. The confidence interval or margin of error is then stipulated based on the factors outlined in the previous paragraph. For public opinion research, the margin of error is most often fixed at ±5 percentage points, leading to a sample size of 400 (rounded up from 384). A margin of ±3 percentage points requiring a sample size of 1,000 is also common. Larger sample sizes are utilized for high-risk projects and when subgroup analysis will be conducted. Commercial market researchers frequently use a ±6 percentage point margin of error and thus a sample size of 300. Selection of sample sizes and the associated errors and confidence intervals are discussed in detail in Section 3.4, and further examples for determining the required sample size are provided in Appendix B.

8.4 Questionnaire Wording and Length

Experience suggests that surveys of the general public will start to experience unacceptable rates of refusals and terminations (people who quit in the middle of the interview) when the interview goes past about 10 minutes. Cooperation rates are highest when interviews are five minutes or less, although it is admittedly difficult to craft such a short survey on most topics.

A detailed discussion of question wording issues can be found in Section 4.3. There are nuances in how questions are worded across methods (e.g., the phrase "the following list" works well for self-completed questionnaires but sounds nonsensical over the telephone), but the fundamental principles are the same for all methods.

A sample questionnaire for area residents is provided in Appendix J.

8.5 Measures to Obtain Adequate Response

As pointed out in previous sections, obtaining an adequate response is key to a survey's success. A low response rate leads to questionable results. Important aspects in conducting a telephone survey include the following:

- A centralized facility where interviewers are closely supervised and regularly monitored, ideally during every shift.
- A thorough interviewer training program.
- A comprehensive and proactive approach to coaching interviewers whose skills need improvement or who are doing something wrong during their interviews.

Generally, data quality will be superior if a computer-assisted telephone interviewing (CATI) system is used, although this is not necessarily the case. However, complicated questionnaires with many skips and branches should always be done on CATI systems; they are simply too difficult for interviewers to follow correctly on paper.

Finally, there is the issue of languages. There are some communities in which interviewing needs to be conducted in a language other than English. However, even in areas with high percentages of people who speak other languages, many of these people also speak English, and some would prefer to be interviewed in English to show they are trying to learn, even if the interview takes longer as a result. It is therefore wise to ask the call center what their experience is when questionnaires are translated; often the translation is not worth the time and cost.

It is also important to note that interviewing in other languages requires a written translation of the questionnaire in addition to bilingual interviewers. If interviewers are simply asked to translate

on the fly, they will come up with many different wordings, which will cause inconsistencies in the way questions are interpreted and possibly the responses obtained. This occurrence can compromise the utility of the results.

8.6 Survey Budget

A number of factors influence a telephone survey budget. In terms of the survey itself, interview length, types of questions (open-ended versus closed-ended), languages to be used (both the number of languages to be used and the difficulty of recruiting interviewers who are fluent), call sequences, the level of data analysis required, and the nature of desired deliverables all play important roles.

Geography is also important, in two respects. In areas with a high cost of living, survey costs will be higher because rents, salaries, and wages are higher. And in urban areas, costs will be higher because cooperation is more difficult to achieve than it is in rural or suburban areas.

Given these factors, it is difficult to give "a price" for a telephone survey. However, if one considers a typical survey, which is 10 minutes long, directed to the general public, conducted in a moderately cooperative market, and includes two open-ended questions, the unit price (cost per interview) is likely to be in the $40 to $50 range. Surveys that are shorter, are targeted to more cooperative areas, or have fewer open-ended questions will generally cost less; those that have a narrower target audience (e.g., only people who have made an air trip in the preceding year) will tend to cost more.

8.7 Summary

Most surveys of area residents are conducted to obtain information for marketing and airport planning purposes. Typically, these surveys are conducted by telephone. Unfortunately, there are no lists of telephone numbers for all members of the general public from which an airport could select a list of people to call. The widely accepted alternative approach is to use RDD.

Perhaps the greatest source of bias in telephone surveys is the refusal of potential interviewees to participate. Smaller sources of bias are non-telephone households and telephone numbers that are not answered after repeated calls. A more recent, and growing, cause for concern is households that have only cellular telephones. Most RDD samples exclude cell phones because it is illegal to dial cell phone numbers automatically and because the respondent must pay the cost of the call.

Experience suggests that surveys of the general public will start to experience unacceptable rates of refusals and terminations when the interview exceeds about 10 minutes. Cooperation rates are highest when interviews are five minutes or less.

The cost for a telephone survey is influenced by a wide variety of factors—including interview length, types of questions, languages to be used, how many calls are placed to each number, the level of data analysis required, and the nature of desired deliverables—making it difficult to provide a generalized cost estimate. If one considers a typical 10-minute survey, however, the unit price (cost per interview) is likely to be in the $40 to $50 range.

CHAPTER 9

Surveys of Area Businesses

Many of the issues related to planning and designing surveys of area businesses are common to other types of airport user surveys, and the reader will be referred to those sections of the guidebook where applicable.

Note that "area businesses" are typically not restricted to private companies, but include government departments and public institutions such as universities and health care providers.

9.1 Purpose of the Survey and the Data to Be Collected

Surveys of area businesses and other organizations are undertaken for a number of reasons, such as the following:

- Determining the importance of the airport to the business community for use in economic impact studies.
- Collecting information on air travel needs for use in preparing cases to present to airlines to attract improved air services at the airport.
- Collecting information on business travel characteristics, use of airports in the region for both commercial and business aviation, and desired improvements in aviation facilities and services.
- Determining awareness of the facilities and services at the airport and the value of the airport to the community.

As with all airport user surveys, the first step in conducting a survey of area businesses is to outline its goals and purpose. (See Chapter 2 for a discussion on specifying goals, defining the purpose of a survey, the importance of doing so, and who should be involved.)

9.2 Survey Methodology

Surveys of area businesses and other organizations are perhaps the most difficult of all airport user surveys to perform in a way that gives results that accurately reflect the characteristics and views of the target population. The size and types of businesses, and their air travel requirements and use of airports in the area, vary widely from one business to another. Clearly defining the goals of the survey and the target population of businesses, selecting the appropriate sampling strategy and deciding how to handle non-responses are critical to producing reasonable results. Typically, all organizations in an area will compose the population of interest. To define a sample of these organizations, a list of all of them would ideally be developed, as—unlike air passengers—they cannot be sampled as they make use of the airport. Development of such a list can be difficult, if not impossible, and the surveyed population is often restricted to businesses for which contact information is readily available.

Lists of businesses are often obtained by cooperating with local business organizations such as the board of trade, chamber of commerce, or economic development council or corporation. In some instances, such as studies to improve air service at the airport, the local business organization may be a survey co-sponsor and will be willing to send the questionnaire out to its members. In other cases, local business organizations may be unwilling to burden their members with yet another survey. In these cases other sources, such as telephone directories, may have to be used.

Four methods can be used in surveys of area businesses:

- Mail—slow and typically gives a very low response rate. It can be more costly than an email/Internet approach. Use of fax to send the survey request and return responses can reduce the time to conduct the survey and postage costs. However, because of the large amount of junk fax marketing, a fax request is unlikely to be answered unless it is sent to a specific individual.
- Telephone—time consuming and costly, difficult to schedule interviews, and as a practical matter limits surveys to a sample of businesses, but response rates are better than mail or fax. A follow-up call may be required if the respondent has to look up an answer to a question. (Section 8.3 discusses telephone surveys in more detail.)
- In-person—very time consuming and costly, difficult to schedule interviews, and as a practical matter limits surveys to a smaller sample of businesses than telephone surveys, but can provide a better understanding of the issues and better response rates than mail or Internet surveys. When answers require research on the part of the respondent, a follow-up call may be required.
- Internet—easiest and least costly, allows emailed survey requests to be easily forwarded to the appropriate person, and provides flexibility for respondents to complete the Web-based survey at a convenient time and answer the questionnaire in stages. It also facilitates easy follow-up of non-responses and eliminates data entry. Response rates can be low, but can be improved significantly with telephone contact before and/or after sending the request to participate in the survey. This approach can only be used if email addresses are available, but most business organizations now collect the email addresses of their members.

Each of these survey methods are discussed further in Section 2.2.

Non-response can be a significant problem with surveys of area businesses, particularly mail and Internet surveys. If the purpose of the survey is to estimate air travel demand and characteristics, non-response is highly correlated with a business's use of air travel. Businesses making little or no use of air travel will be much less likely to see any value in completing the questionnaire. When analyzing the results, assuming that non-respondents have the same air travel characteristics as responding businesses or assuming they do not make any air trips at all could lead to significant errors. This problem can be reduced, to some extent, by following up with a sample of non-respondents and asking them for general information about the size of their organization and use of air travel.

Weighting of responses can be an issue due to the potential differences between large and small businesses. For example, in airport awareness studies, should all businesses be treated equally, or should large businesses be given more weight and, if so, by how much? Similar issues come up in other types of area business surveys for questions not scaled by the size of the business or level of air travel. For example, where businesses are asked "How critical is air service to your business?" should all businesses be weighted equally, or should larger businesses be given more weight? The weighting to be used should depend on the intended use of the results. For example, responses could be weighted by the number of local employees or results reported separately for organizations of various size categories.

9.3 Sampling Methodology

The first step in determining the sampling methodology will be to define the population of interest. Is it all businesses in the area, a particular industry segment, or just businesses that make use of the airport? The sampling method and sample size will depend on the survey method used. Using the Internet method in a small city, it may be possible to survey all businesses for which email addresses are available, but generally only a sample will be surveyed. The low response rates for Internet and mail surveys need to be taken into account when determining the sample size.

For telephone or in-person interviews, the budget will usually only permit a survey of a proportion of area businesses. Given the wide range of businesses and their varying air travel requirements, businesses should be grouped and a stratified sample of businesses selected to survey. Stratification should be based, if possible, on the type of business and number of local employees or some other measure of the size of the business. Unfortunately, data on businesses from business organizations do not always include a measure of the size of the business. If possible, categories of businesses should be chosen so that they are comparable to categories used by other organizations or government departments (e.g., the North American Industry Classification System codes of the U.S. Census Bureau) to allow comparison and sharing of data.

Where stratified sampling is used, the proportion of businesses in each stratum (group) will generally not be the same for all strata. As discussed in Section 3.3, the sampling fraction should be greater in strata with higher variation in the variables of interest within the stratum. For example, if interested in the numbers of air trips by employees of a business, the variation in the numbers of trips per employee will vary by type of business. Variation for consulting firms is likely to be much greater than for retail firms. Thus, for determining the total air trips by employees in the area, the proportion of consulting companies in the area surveyed should be higher than the proportion of retail firms. (Appendix B provides information on determining the sample size for each stratum.)

Alternatively, sample sizes for each stratum could be set so that the level of accuracy in the variable of interest is similar in each stratum. For a categorical variable using random sampling within a stratum, Table 3-3 could be used to determine the sample size for each stratum. With strata based on the size of the business, there will be few very large businesses and many very small businesses and so a much higher proportion of the very large businesses will be required than of the very small businesses to obtain a similar level of accuracy.[30]

9.4 Questionnaire Wording and Length

Questionnaires for surveys of area businesses should be kept short to maximize response rates. The time required to complete the questionnaire should not exceed about 20 minutes for businesses where air travel is very important to the business and about 10 minutes in other cases.

The questionnaire should be structured so that businesses that rarely or never use air service will only answer the first few questions. For Internet surveys, these questions could even be included in the email message so that businesses can respond with this information very easily.

The questionnaire format, structure, and clarity, and the use of pre-tests are important considerations, as discussed in Chapter 2. To keep the questionnaire as short as possible, it is very important to match the questions to the purpose and goals of the survey, eliminating "nice to know" questions and focusing only on "need to know" information.

[30] For example, if there are 10,000 businesses with fewer than 10 employees and 50 with more than 500 employees, to obtain similar accuracy in the two groups for a categorical question, 370 of the 10,000 very small businesses (3.7%) and 45 of the 50 large businesses (90%) would have to be surveyed to give an accuracy of ±5 percentage points.

Questions asked when surveying businesses are very different from the questions used in other airport user surveys, which typically survey individuals. In medium- and large-sized organizations, for example, uncertainty can arise over which office or department should be responding to the survey. For business locations that are branches of a larger organization, the question wording should be clear as to whether information should be provided for the local branch or the whole organization.

In general, branches of larger organizations should provide information for only the branch in question. Not only may the branch personnel not have the relevant data for other branches, but also this procedure will avoid double counting in the event that some of the other branches also respond to the survey.

Another issue is whether any reasons given or opinions expressed are those of the person responding to the survey or represent the position of the organization as a whole. While it may be desirable to obtain reasons or opinions for the organization, rather than the individual responding to the survey, this might require a level of internal approval that would preclude a response. One potential solution is to ask the respondents to indicate their personal view of the organization's position.

In addition, questions should differentiate between commercial air service and corporate or charter services the business may use, since many medium- and large-sized businesses use several types of air transport.

9.5 Measures to Obtain Adequate Response

Measures that should be taken to improve the response rate of surveys of area businesses include the following:

- Market the survey. Seek the support of local business organizations and ask them to let their members know about the survey and why it is being performed, and encourage their participation.
- In the introduction to the survey, include the name of the company or organization conducting the survey and the survey sponsor, and make it clear what the survey is for, how the information being sought could benefit local businesses, and that all information provided will be treated as confidential and only released in aggregate form.
- Keep the questionnaire short and avoid asking for information that is difficult to obtain; let respondents know that approximate numbers are sufficient.
- Allow respondents adequate time to reply. The deadline for responding should allow sufficient time for people on vacation, leave, or work-related trips to respond when they return. Three weeks is a reasonable period, but longer may be advisable in July and August or around Christmas. Reminders should be sent weekly, with a final reminder within 48 hours of the survey's closing time.
- For Internet surveys:
  - Make a telephone call for the initial contact (if the budget permits) to explain the reason for the survey and identify the correct recipient.
  - Allow respondents to save a partially completed response and come back later to complete it.
  - Follow up non-responses and partially completed responses with emails and/or telephone calls.

9.6 Survey Budget

The cost to conduct surveys of area businesses varies greatly with the survey method and the level and type of follow-up of non-responses. The topic of the survey and the support it receives from the business community are primary determinants of response rates.

The budget for Internet surveys of area businesses will include survey design and planning, including the development of a list of businesses; questionnaire design, testing and loading onto a survey website; follow-up of non-respondents; data checking and analysis; and reporting and presentation of findings. (See Chapter 2 for a more detailed discussion of the budget.)

Costs for an Internet survey with 10 to 20 questions and an initial response rate (before follow-up) of 40% are approximately:

- $10,000 for 100 businesses with only email follow-up of non-responses.
- $15,000 for 100 businesses with telephone and email follow-up of non-responses.
- $12,000 for 500 businesses with only email follow-up of non-responses.
- $15,000 for 1,000 businesses with only email follow-up of non-responses.

Costs could be less if there is good cooperation from local business organizations or the initial response rate is higher. However, costs could be higher if additional follow-up and analysis of non-responses is required. Depending on the response rates, the results may be of limited value without such additional follow-up and analysis, especially if estimates of total population values are required.

Costs for conducting telephone surveys of businesses increase almost proportionally with sample size and are roughly two to three times the values for Internet surveys, and costs for in-person interviews are even higher.

9.7 Summary

Surveys of area businesses and other organizations are typically conducted to obtain data for economic impact studies, air service development, or airport awareness studies. The assistance of local business organizations is very beneficial in promoting the survey, providing lists of businesses, and improving the response rate.

Internet surveys are by far the most cost-effective means of conducting such surveys, with follow-up of non-respondents by email and, budget permitting, by telephone. Telephone surveys are another option. Although more costly, they will likely result in better quality data.

All businesses should be included in Internet surveys. For telephone surveys, it will only be possible to survey a sample of businesses, and a stratified sample that includes a higher proportion of large businesses should be used. Non-response can cause significant bias in the results. Measures should be taken to improve the response rate and collect at least minimal data, so that appropriate weights can be developed for the data analysis.

CHAPTER 10

Cargo Surveys

The modern airport is a hub not only for passengers but also for air cargo. As the world continues to shrink, and demand for faster transportation of goods, as well as people, continues to grow, the volume of air cargo will rise accordingly.

This chapter discusses typical target populations for air cargo surveys, such as air cargo operators and freight forwarders, and the key factors relevant to cargo surveys. Note that air cargo is not restricted to dedicated aircraft, as considerable volume is carried in the belly holds of passenger aircraft, particularly on international flights.

10.1 Need for Air Cargo Data

The cargo activity at an airport generates a requirement for dedicated terminal and apron facilities as well as producing truck traffic, both within the airport boundaries and on the surrounding road system.

One purpose of collecting air cargo data is to forecast the amount of cargo activity in order to determine future facility requirements. A second purpose is to develop a relationship between the air cargo tonnages and the resulting truck traffic, both volumes as well as temporal and geographical trip patterns. The latter encompasses the immediate road system of the airport itself, as well as the connections to the major highways throughout the region. Metropolitan planning organizations should include the airport as a generator of both truck and passenger traffic in their plans and forecasts.

While the purpose of an air cargo survey can be clear, there is little experience with collecting data in this area. Considering the increasing importance of air cargo on the world economy—and the lack of experience in the conduct of air cargo studies and the collection of air cargo data—there is a requirement for research in this area.

10.2 Collection of Air Cargo Data

The tonnage of air cargo handled at an airport is the starting point for both facility and municipal planning purposes, but other information about the characteristics of the cargo is also required. It should be noted that cargo activity at an airport is not necessarily all air cargo. A cargo consolidation facility is sometimes located at the airport to serve an air cargo function as well as a freight consolidation and transfer function between other modes, including truck-to-truck transfer.

International—and to some extent national—air cargo flows are influenced by the volume of passenger activity between particular airports, because passenger volume affects the size of air-

craft and availability of belly hold capacity in the market. For this reason, air cargo is often consolidated over a wide geographic area and trucked to a gateway or major hub airport where adequate capacity exists to fly the cargo to its destination.

Air cargo data are collected and are available at an aggregate level from federal statistics agencies as a reporting requirement under various regulations. These data are available as total tonnages for inbound and outbound cargo. In the case of international trade, there may be additional data available on tonnages of air cargo by commodity.

In the preparation of any cargo study, these sources should be explored thoroughly as a preliminary source of data. However, given the purpose of air cargo studies, this aggregate level of data is frequently inadequate. Additional characteristic data are required, including the following:

- Weight and/or volume.
- Ultimate origin and destination.
- Times at origin and destination.
- Commodity type or value.
- Flight information.
- Truck trip characteristics.

Basically, this is the information available on an air cargo waybill. This information is, naturally, highly valued by the shippers and forwarders, guarded by privacy rules, and not released easily. A concerted effort is required to obtain even a small sample of data for a single highly focused study. It may, however, be possible to obtain information at a summary level.

While the best data for an air cargo study may not be available, there are many other sources that should be investigated before taking on the expense of a survey. As mentioned, some air cargo data are available through regulatory reporting requirements. Another source of data might be municipal and state agencies that conduct truck surveys and interviews. For basic truck volumes in and out of airport cargo facilities, the local municipality may have traffic count information, which can be used to estimate both the volume of activity and patterns over the counting period.

With the advent of Intelligent Transportation Systems, there are an increasing number of automated truck pseudo-tracking systems. The I-75/AVION is one such system. It allows selected transponder-equipped trucks to be cleared electronically at weight and inspection stations, while allowing all participating U.S. states and the Province of Ontario to maintain existing regulatory regimes. The weight and inspection stations are equipped with automatic vehicle identification (AVI) and automated weigh-in-motion (WIM) scales. Such systems are based on intelligent tags that track the truck and, by extension, its contents along a corridor. Exploring such data sources may provide information related to air cargo activity.

When all these sources of data have been investigated and the available information is still insufficient for the planned analysis, then consideration should be given to collecting additional data through a survey.

10.3 Survey Methods

Planning an air cargo survey is not a simple matter of planning a routine survey. There is little experience to draw upon, and therefore virtually no standard practices that can be applied, or modified, for a particular airport. Any survey designed to capture air cargo data is likely breaking new ground.

To date, the most common survey method for air cargo is similar to stakeholder interviews. Although shippers and forwarders may be reluctant to release detailed information on air cargo

shipments or cargo activity at their facility, it is possible to construct a survey in the form of an interview. Using the survey purpose as a base, a series of questions can be constructed to form a structured interview to be conducted with all, or selected, air cargo operators at the airport.

Each selected shipper and forwarder would be approached to participate, and an interview conducted at a convenient time. The cost and duration of such a survey would depend on the number of interviews to be conducted.

As an alternative or supplementary method, it may be possible to conduct driver interviews at a roadside location near the cargo facility. This survey method was adopted for the extensive survey performed at Toronto Pearson International Airport in 2005 (the questionnaire used is included in Appendix K). The actual methodology is similar to the roadside interviews used by state agencies, and the experience of such agencies would be valuable in the design of a roadside intercept interview at an airport.

The numbers of truck movements by truck category can be collected through observational studies. Such a study will not provide the detailed data on loaded weight and origin and destination, but it would act as a census of the volume of truck movements.

10.4 Summary

Air cargo surveys may be required when the available data sources do not provide the level of information needed. Waybill data would be a superior data source for analysis, but there is currently no easy way to access detailed waybill data for air cargo shipments and freight forwarding companies are reluctant to release this information. There is limited experience in conducting air cargo truck interviews, which may be the best approach to getting access to waybill data.

References

Babbie, E.R. (1973), *Survey Research Methods,* Wadsworth, Belmont, Calif.

Dillman, D.A. (2000), *Mail and Internet Surveys: The Tailored Design Method,* John Wiley & Sons, New York, N.Y.

Gosling, G.D. (1996), "Analysis of Changes in Airport Ground Access Mode Use," in *Meeting the Challenge: Rebuilding Inner City Airports,* Proceedings of the 24th International Air Transportation Conference, Louisville, Ky., June 5–7, 1996, American Society of Civil Engineers, New York, N.Y.

Gosling, G.D. (2008), *ACRP Synthesis of Airport Practice 5: Airport Ground Access Mode Choice Models,* Transportation Research Board of the National Academies, Washington, D.C.

Gosling, G.D., and B. Maric (revised December 2006), *Proof of Concept Study for a National Database of Air Passenger Survey Data,* Research Report UCB-ITS-RR-2006-8, National Center of Excellence for Aviation Operations Research, Institute of Transportation Studies, University of California, Berkeley, Calif.

Groves, R.M., and L.E. Lyberg (1988), "An Overview of Nonresponse Issues in Telephone Surveys," in R.M. Groves, P.P. Biemer, L.E. Lyberg, J.T. Massey, W.L. Nicholls II, and J. Waksberg, eds., *Telephone Survey Methodology,* John Wiley & Sons, New York, N.Y.

Leigh Fisher Associates, M.A. Coogan, and MarketSense (2000), *TCRP Report 62: Improving Public Transportation Access to Large Airports,* Transportation Research Board, National Research Council, Washington, D.C.

Leigh Fisher Associates, M.A. Coogan, and MarketSense (2002), *TCRP Report 83: Strategies for Improving Public Transportation Access to Large Airports,* Transportation Research Board, National Research Council, Washington, D.C.

Lessler, J.T., and W.D. Kalsbeek (1992), *Nonsampling Error in Surveys,* John Wiley & Sons, New York, N.Y.

Montaquila, J.M., J.M. Brick, M.C. Hagedorn, C. Kennedy, and S. Keeter (2007), "Aspects of Nonresponse Bias in RDD Telephone Surveys," in J.M. Lepkowski, C. Tucker, J.M. Brick, E.D. de Leeuw, L. Japec, P.J. Lavrakas, M.W. Link, and R.L. Sangster, eds., *Advances in Telephone Survey Methodology,* John Wiley & Sons, Hoboken, N.J.

United Kingdom Civil Aviation Authority (2006), *CAA Passenger Survey Report 2005,* Economic Regulation Group, London, England.

Glossary and Acronym List

Glossary

Around the Airport

Airfield	The maneuvering area for aircraft, including the gates, apron, taxiways, and runways. Also referred to as airside.
Airport user	For the purpose of this guidebook, an airport user is anyone using the facilities on the airport property, whether as an air passenger, greeter, or well-wisher; an employee; or someone picking up or delivering cargo, doing business at the airport, making deliveries to the airport, or just sightseeing.
Airside	See airfield. May include the area of the terminal beyond security.
Arriving–departing air passengers	Also known as A-D passengers, this refers to the number of passengers on the plane when it arrives or departs. A-D passengers include passengers that remain on the plane during any stopover.
Connecting passengers	Air passengers that transfer between flights at the airport. These passengers are an important statistic for terminal activity.
Curb area	Also known as the curbside or curb front, it is the area immediately in front of the terminal where vehicles are permitted to drop off and pick up passengers.
Enplaned–deplaned passengers	Also known as E-D passengers, this is the most commonly air used statistic for air passengers and refers to the number of passengers that get on (enplane) or get off (deplane) each flight. It includes connecting passengers. There are more A-D passengers than E-D passengers.
Groundside	The portion of the airport property dedicated to vehicle usage, including the roadways, parking lots, and curb area immediately adjacent to the terminal. Sometimes also referred to as landside.
Landside	See groundside. May include the area of the terminal before security.
Load factor	Ratio of passengers to passenger seats on a flight.

Origin–destination air passengers	Also known as O-D passengers, this is the number of passengers starting or finishing their air trip at the airport. It is an important statistic because it relates to the number of passengers that will use the groundside area and airport access roads. The difference between O-D and E-D passengers is the connecting passengers.
Pay on foot machines	Parking payment machines that are normally inside the terminal building and are provided for easy payment of parking fees before returning to the vehicle to exit the lot. This saves time at the exit booth from the parking lot.
Planning peak day	The amount of activity, passengers or vehicles that occurs during a single day. This is not the highest day of activity, but is representative of a typical day in the peak month.
Planning peak hour	The amount of activity, passengers or vehicles that occurs during a peak hour for planning purposes. Typically either the 85th highest hour of activity over a year, or the busiest hour of a typical day in the peak month, is used as the planning peak hour.
Planning peak period	A period of the year that is considered the appropriate level of demand for future planning. This period is not the highest peak, but is representative of a typical day in the peak month.
Terminal	Usually refers to the main air passenger facility or facilities.
Ticket spitter	The machine at the entrance to the parking lot that dispenses the ticket showing the time and date of entry.

Statistical Terms

Bias	The amount an estimate differs from a true population value because of some quality of the measurement device, sample selection method, or other aspect of the survey.
Central Limit Theorem	The Central Limit Theorem is a statement about the characteristics of the sampling distribution of means of random samples from a given population. That is, it describes the characteristics of the distribution of values we would obtain if we were able to draw an infinite number of random samples of a given size from a given population and we calculated the mean of each sample. The Central Limit Theorem consists of three statements: [1] The mean of the sampling distribution of means is equal to the mean of the population from which the samples were drawn. [2] The variance of the sampling distribution of means is equal to the variance of the population from which the samples were drawn divided by the size of the samples. [3] If the original population is distributed normally (i.e., it is bell shaped), the sampling distribution of means will

	also be normal. If the original population is not normally distributed, the sampling distribution of means will increasingly approximate a normal distribution as sample size increases (i.e., when increasingly large samples are drawn).
Cluster sampling	A sample selection method where individuals in the population belong to natural groups, or clusters (e.g., passengers on airplanes), and members of the population are selected first by selecting a sample of clusters, then selecting all or some of the individuals within each selected cluster (the latter case is a two-stage sampling scheme—see multi-stage sampling).
Confidence interval	A range above and below the estimated value that may be expected to contain the true value with a known probability. The known probability is referred to as the level of confidence. For example, a 95% confidence interval implies that if 100 samples were taken, we would expect the confidence interval to contain the true population value in all but five cases.
Dataset	Data, which is usually stored electronically, collected in a particular survey.
Estimate	The value of a measure of some characteristic of the population that is determined from the sample.
Estimation	The process of producing an estimate.
Mean	The average of the values of a particular characteristic of individuals in the population.
Median	A measure that identifies the middle-point value (or 50th percentile) in a set of values when they are arranged in order of magnitude. Thus 50% of the sample is greater than this value and 50% is smaller.
Mode	The most common value of a particular characteristic in a sample.
Multi-stage sampling	A sample that is selected in stages, where the sampling units at each stage are subsamples from the previous stage.
Non-probability sampling	A sampling selection method where it is not possible to determine the probability of individuals being selected.
Non-proportional stratified sampling	A sampling method where different sampling fractions are used to improve the accuracy of estimates for a given overall sample size.
Percentage points	Refers to the numerical value of a variable which is expressed as a percentage. For example, a range of 50% ±5 percentage points is equivalent to the range 45% to 55%.
Population	The target population is the entire group of individuals about which information is desired. The survey population is the group of individuals that have a chance of being selected for the sample. The survey population should ideally be identical to the target population, but may not be exactly the same in practice.

Probability sample	A sample selected in such a way that each individual in the population has a non-zero chance of being included and, in principle, the probability can be calculated.
Proportional stratified sampling	A sampling method where the proportions of individuals in each group (referred to as the sampling fractions) are equal.
Random sampling	A probability sample selection method where each member of the population has an equal probability of selection.
Sample	A subset of the population that is chosen to be representative of the total population and that can therefore be used to make generalizations about the population.
Sample mean	The average of the values of a particular characteristic of individuals in a sample.
Sample size	The number of individuals composing the sample.
Sample variance	Sample variance of a particular characteristic is a measure of the spread, or dispersion, of values of that characteristic within a set of sample data.
Sampling fraction	The ratio of the sample size to the population size.
Sampling frame	A list of all members of a population used as a basis for sampling.
Sampling plan	Also referred to as sample design or survey design, the sampling plan specifies the type of sampling to be used (e.g., single or multi-stage, random, sequential, stratified, cluster sampling), the definitions of strata or clusters, and the sample size.
Sequential sampling	Also known as systematic sampling. A probability sample selection method in which the sample is obtained by selecting every *n*th individual in the population, where *n* is an integer greater than 1. The first member of the sample must be selected randomly within the first *n* units.
Standard deviation	A measure of the spread or dispersion of a set of data. It is calculated by taking the square root of the variance. The more widely the values are spread out, the larger the standard deviation.
Standard error of the estimate (SEE)	A measure of the amount of sampling error present. The standard error is an estimate of the standard deviation of the sample mean, based on the sample data.
Stratified sampling	A probability sample selection method in which the population is divided into homogeneous groups (strata) and members of each strata are sampled, possibly using different sampling methods.
Systematic sampling	See sequential sampling.
Variance	A measure of the spread or dispersion of a set of data. It is calculated by summing the square of the difference between each value and the mean value of the data.

Surveying Terms

Categorical question	A type of closed-ended question that allows respondents to select one or more predefined responses.
Census	Survey of the total population of interest.
Closed-ended question	A type of survey question that has a finite set of answers predetermined by the researcher from which the respondent chooses. Easy to standardize and lends itself to statistical analysis.
Coding	The process of converting answers to questions into numerical form (codes) to facilitate compilation of survey statistics.
Computer-aided personal interviewing	The use of an electronic device programmed with a survey questionnaire, including interviewer instructions, to interview people in person. Interview types to which this technique applies include on-site intercepts and in-office interviews.
Computer-assisted telephone interviewing	The use of a computer to support telephone interviews by displaying questions and allowing the interviewer to enter responses.
Electronic data collection device	An electronic unit, such as a personal digital assistant, that can be programmed to display survey questions and allow responses to those questions to be entered and stored in the unit. See computer-aided personal interviewing.
Intercept interview	A type of interview survey where respondents are approached (or intercepted) in high-traffic locations.
Internet survey	See Web-based survey.
Interviewer	A person who collects information from individuals in the sample by conversing with the individual.
Interviewer bias	A type of non-sampling error caused by the interviewer. Errors may include influencing the respondent in some way, asking questions in the wrong order, or using different phrasing or tone of voice than other interviewers, as well as intentional errors such as fraudulent data entry.
Mail survey	A survey methodology in which the questionnaire is distributed to the target sample by mail.
Multiple-choice question	A type of closed-ended question that allows respondents to select the most appropriate answer from among a set of possible answers. Good for "profiling" respondents.
Mystery shopper survey	A type of survey that anonymously evaluates customer service, operations, employee integrity, merchandising, and product quality of concessions and service providers.
Non-representative sample	This type of sample occurs when the characteristics of respondents in a survey do not match those of the desired target population.

Numerical question	A type of closed-ended question that allows respondents to give a numerical value. Example: What is your current age?
Open-ended question	A type of survey question to which there are no predefined responses. Allows respondents to answer in their own words. Used in exploratory research.
Pilot survey	A small trial run, or "dress rehearsal," of the entire survey process completed before the actual survey commences. The intention is to alert the survey team to any difficulties that were not anticipated at the survey planning stage. Pilot surveys are conducted after pre-tests.
Pre-test	A small trial run of questions or the questionnaire to be used in the survey. The intention is to alert the survey team to problems with the questions such as confusing wording, inappropriate responses, additional responses to closed-ended questions, incorrect flow of questions, inappropriate length or format of questionnaire, etc.
Respondent	A person who is providing responses to a survey.
Response bias	Difference in the mean of the characteristics of interest between survey respondents and the population being surveyed.
Sample bias	This type of bias may result if the sample is limited only to respondents within a certain demographic group (e.g., highly educated). If the survey goal is to measure the opinions of the general population, this could bias the sample.
Self-completed survey	A survey in which respondents complete the questionnaire themselves.
Survey codebook	A document prepared by the survey planning team to code responses to questions in the survey. This document could be used as an aid in the data entry process or incorporated in the data entry software.
Survey implementation team	Team responsible for conducting the field work, performing data entry, and validating and cleaning the data.
Survey method	Method used to collect the survey data (e.g., intercept or telephone interviews or self-completed questionnaires handed out or distributed via mail or email).
Survey planning team	Team of people responsible for the design, conduct, and reporting of results. Includes the project manager, survey technical expert, survey sample design expert, data analyst, survey logistics manager, and survey administrator.
Surveyor	Person who collects information from or about individuals in the sample by observation or by interview.
Telephone survey	A survey methodology in which respondents are interviewed by telephone. Advantages include broad reach to potential respondents, and interviewers can ask clarifying questions.

Web-based survey	A survey methodology in which respondents complete a questionnaire online. Advantages include rapid response rate, low cost, and increased respondent flexibility. Also called an Internet survey.

Other Useful Glossaries

Super Survey: http://knowledge-base.supersurvey.com/glossary.htm

Organization for Economic Cooperation and Development Glossary of Statistical Terms: http://stats.oecd.org/glossary/

European Society for Opinion and Marketing Research Glossary: www.esomar.org/index.php/glossary-a.html

Acronyms and Short Forms

AVI	Automatic vehicle identification
CATI	Computer-assisted telephone interviewing
EDCD	Electronic data collection devices
FAA	Federal Aviation Administration
MPO	Metropolitan planning organization
OAG	Official Airline Guide
PDA	Personal digital assistant
RFP	Request for Proposals
SAS®	Statistical Analysis Software, copyright of SAS Institute, Cary, NC
SEE	Standard Error of the Estimate
SPSS®	A statistical software program, copyright of SPSS Inc., Chicago, IL
TSA	Transportation Security Administration

Bibliography

Chapter 1. Introduction

Survey Methodology

Baber, C.M., "Using License Plate Survey Data in Transportation Planning Applications," *Proceedings of the 4th International Conference on Microcomputers in Transportation,* Baltimore, Md., July 22–24, 1992, American Society of Civil Engineers, New York, N.Y., 1992, pp. 247–256.

Baker, J., *Ground Transportation Facilities Survey Manual,* Document AK-69-12-000, Report TP 1570, Transport Canada, Airport Facilities Branch, Ottawa, December 1983.

Barton-Aschman Associates, Inc., *Airport Travel Survey Manual,* Report DOT-FH-11-7889, Prepared for the U.S. Department of Transportation, Federal Highway Administration, Chicago, Ill., July 1973.

Blechinger, W., W. Broeg, and H.W.B. Messelink, "Comments on Airport Survey Methods Using Schiphol Airport in Amsterdam as an Example," *Transportation Research Record: Journal of the Transportation Research Board, No. 1025,* Transportation Research Board, National Research Council, Washington, D.C., 1985, pp. 22–26.

Cripwell, J.P., and M. Turpin, "Groundside Interview Survey Concepts and Design, Toronto Pearson International Airport, 2005," Paper presented at the 85th Annual Meeting of the Transportation Research Board, National Research Council, Washington, D.C., January 22–26, 2006.

Denstadli, J.M., "Analyzing Air Travel: A Comparison of Different Survey Methods and Data Collection Procedures," *Journal of Travel Research,* Vol. 39, August 2000, pp. 4–10.

Gosling, G.D., and M.M. Hansen, *Implementation of a National Database of Air Passenger Survey Data,* Research Report UCB-ITS-RR-2006-7, National Center of Excellence for Aviation Operations Research, Institute of Transportation Studies, University of California, Berkeley, Calif., December 2006.

Groves, R.M., et al., *Survey Methodology,* John Wiley & Sons, 2004.

Richardson, A.J., et al., *Survey Methods for Transport Planning,* Eucalyptus Press, Parkville, Vic., Australia, 1995.

Schaller, B., *TCRP Synthesis of Transit Practice 63: On-Board and Intercept Transit Survey Techniques,* Transportation Research Board, National Research Council, Washington, D.C., 2005.

Spitz, G.M., F.L. Niles, and T.J. Adler, *TCRP Synthesis of Transit Practice 69: Web-Based Survey Techniques,* Transportation Research Board, National Research Council, Washington, D.C., 2006.

Reports on Specific Airport User Surveys

Applied Management and Planning Group, *2001 Air Passenger Survey Final Report – Los Angeles International Airport,* Prepared for Los Angeles World Airports, Los Angeles, Calif., April 2004.

Applied Management and Planning Group, *2001 Air Passenger Survey Final Report – Ontario International Airport,* Prepared for Los Angeles World Airports, Los Angeles, Calif., April 2004.

Applied Management and Planning Group, *2006 Air Passenger Survey Final Report – Los Angeles International Airport,* Prepared for Los Angeles World Airports, Los Angeles, Calif., December 2007.

Charles River Associates, Inc., and Polaris Research & Development, *Ground Access to the Bay Area's Airports, 2001 and 2002. Volume 1: Overview and Methods,* Final Report, Prepared for the Metropolitan Transportation Commission, Oakland, Calif., Report CRA No. D03144-00, Boston, Mass., revised January 2004.

Franz, J.D., *1995 Metropolitan Transportation Commission Airline Passenger Survey,* Final Report, Prepared for the Metropolitan Transportation Commission, Oakland, Calif., by JD Franz Research, February 1996.

JD Franz Research, Inc., *Metropolitan Transportation Commission 2006 Airline Passenger Survey: Oakland International Airport and San Francisco International Airport,* Prepared for the Metropolitan Transportation Commission, Oakland, Calif., January 2008.

United Kingdom Civil Aviation Authority, *CAA Passenger Survey Report 2006,* Economic Regulation Group, London, England, 2007.
United Kingdom Civil Aviation Authority, *CAA Passenger Survey Report 2007/2008,* Economic Regulation Group, London, England, 2008.

Chapter 2. Planning a Survey

Dillman, D.A., *Mail and Telephone Surveys: The Total Design Method,* John Wiley & Sons, 1978.
Greenbaum, T., *The Handbook for Focus Group Research,* Sage Publications, 1998.
McDaniel, C., and R. Gates, *Contemporary Marketing Research: The Impact of the Internet,* South-Western College Publishing, 2001.
Stewart, D.W., et al., *Focus Groups: Theory and Practice,* Sage Publications, 2006.

Chapter 3. Statistical Concepts

Blalock, H.M., Jr., *Social Statistics,* McGraw-Hill, 2nd ed., 1979.
Cochran, W.G., *Sampling Techniques,* John Wiley & Sons, 3rd ed., 1977.
Kalton, G., *Introduction to Survey Sampling,* Sage Publications, 1999.
Levy, P.S., and S. Lemeshow, *Sampling of Populations: Methods and Applications,* John Wiley & Sons, 4th ed., 2008.
Moore, D.S., and G.P. McCabe, *Introduction to the Practice of Statistics,* W.H. Freeman, 5th ed., 2006.
Stockburger, D.W., *Introductory Statistics: Concepts, Models and Applications,* available at http://www.psychstat.missouristate.edu/sbk00.htm, revised February 19, 1998.

Chapter 4. Survey Design

Centre for Health Promotion, University of Toronto, "Conducting Survey Research," Version 2.0, March 31, 1999.
CMOR [Council for Marketing and Opinion Research] and Marketing Research Association, *Interviewer Training: Basic Training,* Interviewer/Supervisor Training Modules, 2nd ed.
CMOR and Marketing Research Association, *Interviewer Training: Customer Satisfaction Interviewing,* Interviewer/Supervisor Training Modules, 2nd ed.
CMOR and Marketing Research Association, *Supervisor Training: Basic Training,* Interviewer/Supervisor Training Modules, 2nd ed.
CMOR and Marketing Research Association, *Supervisor Training: Interviewer Motivation,* Interviewer/Supervisor Training Modules, 2nd ed.
Griffiths, R.E., *2005 Washington-Baltimore Regional Air Passenger Survey,* Metropolitan Washington Council of Governments, January 26, 2006.
Payne, S.L., *The Art of Asking Questions,* Princeton University Press, 1951.
Schuman, H., and S. Presser, *Questions and Answers in Attitude Surveys: Experiments on Question Form, Wording, and Context,* Academic Press, 1981.
Statistics New Zealand, *A Guide to Good Survey Design,* Wellington, New Zealand, July 1995.
Sudman, S., and N. Bradburn, *Asking Questions: A Practical Guide to Questionnaire Design,* Jossey-Bass, 1982.
Weisberg, H.F., et al., *An Introduction to Survey Research, Polling, and Data Analysis,* Sage Publications, 1996.

Chapter 5. Air Passenger Surveys

Baker, J., *Ground Transportation Facilities Survey Manual,* AK-69-12-000, Surface Structures Division, Airport Facilities Branch, Transport Canada, December 1983.
Cripwell, J.P., *Coding Manual,* 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.
Cripwell, J.P., *Interviewer Manual,* 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.
Cripwell, J.P., *Observer Manual,* 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.

Cripwell, J.P., *Supervisor Manual,* 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.
Cripwell, J.P., *Survey Design Report* (includes observation and interview survey forms), 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.
Cripwell, J.P., *Training Presentations for Interviewers and Supervisors,* 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.
Cripwell, J.P., and M. Turpin, *Terms of Reference for Temporary Surveyors,* 2005 Ground Transportation Survey, Toronto Pearson International Airport, June 2005.
DelCan Corporation, *Ground Transportation Facility Requirements Analysis,* prepared for Surface Structures Division, Airport Facilities Branch, Transport Canada, June 1982.
Hickling Corporation, *Ground Transportation Survey: Lester B. Pearson International Airport July 1991,* prepared for Public Works Canada, June 1991.
Leigh Fisher Associates, M.A. Coogan, and MarketSense, *TCRP Report 62: Improving Public Transportation Access to Large Airports,* Transportation Research Board, National Research Council, Washington, D.C., 2000.
Leigh Fisher Associates, M.A. Coogan, and MarketSense, *TCRP Report 83: Strategies for Improving Public Transportation Access to Large Airports,* Transportation Research Board, National Research Council, Washington, D.C., 2002.
Transport Canada, *Ground Transportation Facilities "Rule-of-Thumb" Sizing Methodologies Including "Categorization,"* AK-67-09-119, Surface Structures Division, Airport Facilities Branch, May 1978.
Transport Canada, *Ground Transportation Planning Methodologies Course,* AK-77-69-003, Surface Structures Division, Airport Facilities Branch, November 1982.
Transport Canada, *Ground Transportation Facilities Planning Manual,* AK-69-13-000, Surface Structures Division, Airport Facilities Branch, July 1984.

Chapter 8. Surveys of Area Residents

Groves, R.M., et al., *Telephone Survey Methodology,* John Wiley & Sons, New York, N.Y., 2001.

Chapter 10. Cargo Surveys

Cripwell, J.P., *Documentation for the 2005 Ground Transportation Survey, Toronto Pearson International Airport, January to June 2005:* Working Papers on Cargo Studies; Cargo Survey Manual; Training Presentation – Cargo.
Puget Sound Regional Council, *PSRC Regional Air Cargo Strategy,* Final Report, Seattle, Wash., October 2006.

APPENDIX A

Airport User Surveys: Summary of Research

Introduction

The research team responsible for developing this guidebook was tasked by the ACRP to conduct research on the current state of knowledge and practice in performing airport user surveys by airports and other sponsors. The research consisted of a review of the literature, a Web-based survey, and detailed interviews with selected airports and agencies regarding their current survey practices. The results of this research are summarized below. More detailed information is provided in the final report of the project.

Literature Review

The literature that was reviewed fell into five broad categories:

- Guidance documents on performing airport user surveys.
- Journal papers and reports on studies related to airport user surveys.
- Literature on survey methods in the transit industry.
- Literature on survey methods in transportation planning in general.
- Reports on specific airport user surveys.

The literature is heavily oriented toward the conduct of passenger surveys to identify air traveler characteristics, with very little attention given to other types of airport users or other types of surveys, such as tenant or air passenger satisfaction with airport services, or surveys to collect information for economic impact studies.

Nonetheless, the various issues discussed in the literature raised a large number of important considerations that needed to be addressed in this guidebook, namely:

- Whether to use self-completed questionnaires or interview surveys.
- Whether to attempt to collect a complete profile of traveler characteristics in a single intercept survey or perform multiple surveys, each focused on a subset of the total market.
- How best to account for travelers who arrive at the airport or airline departure gate close to flight departure time.
- The importance of distinguishing between the air travelers and the well-wishers who may come to the airport in the same vehicle.
- The need to collect ancillary data on airport activity and facility use at the same time as intercept surveys of airport users are being conducted in order to provide a basis for survey expansion and interpretation.
- The potential use of household telephone surveys and Web-based surveys to complement or replace traditional intercept surveys at the airport.

Web-Based Survey

The research team designed, developed, and conducted a Web-based survey to determine:

- The types of surveys conducted by airports, metropolitan planning organizations (MPOs), state aviation agencies, and consulting and survey firms.
- Survey methods.
- Challenges or problems encountered during surveys.
- Topics that respondents would find useful in a guidebook on airport user surveys.

Responses to the survey were received from 70 organizations, with a roughly equal level of representation of large and medium hub airports (23%), metropolitan planning organizations (21%), state aviation agencies (26%), and consulting and survey firms (30%). Of the responding organizations, 48 (69%) had sponsored or performed airport user surveys in the past five years.

Survey Types

The Web-based survey confirmed the research team's assumptions about the types of surveys being conducted and the information being collected. For example, as shown in Table A-1, over half of the respondents have carried out air passenger surveys in the last five years and over one-third have carried out observational studies. Fewer respondents have carried out other types of surveys. The results of the survey also showed that there are some differences in who conducts the different types of surveys. Large- and medium-sized airports collectively have conducted the full range of survey types, with most airports performing air passenger surveys. Relative to airports, fewer of the MPOs and state aviation agencies conduct airport surveys, particularly tenant and airport-based employee surveys, which are less likely to interest them than air passenger surveys. State aviation agencies appear to conduct more surveys of area businesses relative to other surveys and other respondents. This part of the survey was used to help determine the structure and content of the guidebook.

Survey Purpose

In order to gather more details on the various surveys, respondents were asked to provide summary information on up to five airport user surveys that they had sponsored or performed in the past five years. Respondents provided summary information on a total of 89 different surveys.

The summary information included the purpose for which the surveys were performed. As shown in Table A-2, the main reason for conducting these surveys was to obtain information on air passenger/airport user characteristics, including information on ground access mode use. Because airport ground access was expected to be a major reason to perform airport user surveys, it was identified as a separate category.

Table A-1. Types of surveys.

Type of Survey	% of Agencies Responding*
Air passenger	53%
Tenant	19%
Airport-based employee	20%
Area residents	21%
Area businesses	29%
Observation studies	37%

* Percentage of all agencies responding to the survey.

Table A-2. Survey purpose.

Survey Purpose	% of Airport User Surveys*
Air passenger characteristics	29%
Ground access travel, mode use	28%
Model development and testing	16%
Passenger satisfaction or needs	16%
Airport, air travel or mode choice	12%
Economic impact study	12%
Investment, facility planning	11%
Regional or system planning	10%
Benchmarking	3%
Tenant or agency satisfaction	2%
Airport processing times	2%
Greeter/well-wisher characteristics	1%
Employee satisfaction	1%
Tenant contract compliance	1%
Environmental impact study	1%
Airport operational data	1%
Air freight characteristics	1%

* Percentage of surveys for which summary information was provided by survey respondents.

Multiple reasons were given for performing some of the surveys. Because the respondents expressed the survey purpose in their own words, the stated reasons were classified into the categories listed in Table A-2 where necessary. Although all air passenger surveys necessarily collect some information on air passenger characteristics, this was counted as a survey purpose only if the respondents expressly indicated that obtaining information on air passenger characteristics was one purpose of the survey.

Survey Collection Methods

Table A-3 shows the methods that were used for the various types of surveys for which summary information was provided. There were many cases where more than one survey method was used on the same type of survey; notably hand-out/hand-back and hand-out/mail-back forms were used in conjunction with other survey methods. While the table shows the dominance of the conventional paper form interview technique for air passenger surveys, it also appears that there is a reasonably high use of electronic technology such as hand-held data collection devices and laptop or tablet computers. There was little reported use of Internet-based surveys and no reported use of automated kiosks for performing self-completed surveys.

In a few cases, a single survey targeted more than one type of airport user and it was not possible to determine from the responses which of the methods were used for each type of user. In these cases it was assumed that each of the reported methods was used for each type of user where this would make sense.

Challenges Encountered

The survey asked what challenges or problems respondents encountered in conducting their surveys. The most frequently cited challenges were associated with obtaining an adequate response rate, interviewer staffing, question wording, security, costs and adequate funding. Other but less frequent comments were related to sample size, sample bias and use of cluster sampling (a sampling approach discussed in Chapter 3 of this guidebook), obtaining accurate

Table A-3. Survey collection methods.

Collection Method	Percentage Use of Method for Each Survey Type					
	Passenger	Tenant	Employee	Resident	Business	Observation
Intercept interview: paper form	66%	45%	0%	0%	0%	0%
Intercept interview: PDA	25%	27%	0%	0%	0%	0%
Intercept interview: laptop or tablet computer	18%	27%	0%	0%	0%	0%
Hand-out/hand-back questionnaire	38%	18%	50%	0%	0%	0%
Hand-out/mail-back questionnaire	11%	36%	25%	0%	8%	0%
Mailed questionnaire	0%	64%	25%	25%	69%	0%
Faxed questionnaire	0%	36%	0%	0%	15%	0%
Internet questionnaire	7%	0%	0%	25%	0%	0%
Kiosk-based self-completed	0%	0%	0%	0%	0%	0%
Observation	3%	45%	0%	0%	8%	100%
Other	2%	27%	0%	75%	23%	22%

origin and destination data, weighting, airline coordination, use of external consultants, and use of electronic devices. The issues raised by the respondents, although already well known to members of the research team, were beneficial in the design and development of the guidebook.

Other Findings

The Web-based survey also confirmed that the topics being considered for the guidebook would be of interest. Unfortunately, it revealed limited useful cost information. This was attributed to the wide scope of surveys under consideration and the many factors that affect cost (e.g., scope, sampling strategy, survey period).

Research on Airport Survey Practices

The airports and other organizations that responded to the research team's Web-based survey identified a number of significant challenges in conducting airport user surveys. Although the research team was familiar with these issues, it concluded that it would be worthwhile to supplement this experience with additional, more in-depth research. The team therefore held detailed interviews with representatives of 12 selected airports, MPOs, and consultants regarding their survey practices. The interviews focused on their experience with passenger surveys, although some information was collected on other types of surveys. The following topics were addressed in this research:

- Tradeoffs between survey costs, survey design, and results.
- Measures to obtain an adequate survey response.
- Questionnaire design.
- Use of advanced technologies.
- Interviewer staffing.
- Measures to overcome security constraints.

A detailed summary of the interview findings is included in the final report of the project. These findings include the following major points:

- Most of the organizations interviewed are aware of seasonal variation in traffic characteristics, but choose to perform surveys over a single time period of one or two weeks for cost reasons and to obtain the results more quickly.
- Although the appropriate sample size depends on the sampling method and the degree of accuracy desired for various sub-populations, this is not well understood by all the organizations interviewed.

- Many organizations interviewed indicated that cost is a significant factor in deciding whether to use intercept interviews or self-completed questionnaires, although it was noted that intercept interviews are more robust, reliable, and accurate than self-completed questionnaires and have fewer misunderstood or incorrectly skipped questions.
- All of the organizations interviewed recognize the problem of obtaining responses from passengers who arrive at the gate after the first boarding call and have adopted various measures to improve the response rate from these passengers, including providing mail-back questionnaires and training interviewers to complete a survey while passengers are waiting in line to board the flight.
- The wording of questions is critical to reduce misunderstanding and obtain valid responses. Many air passengers will not understand fairly common airport or transportation planning terminology.
- Departure lounge surveys should generally take 10 minutes or less to complete. One organization indicated that they had conducted stated preference surveys that took 15 to 20 minutes.
- Many of the organizations interviewed indicated that the use of electronic data collection devices has a number of advantages, including cost savings and improved data quality, although interviewers require training to use the devices effectively.
- The organizations interviewed reported obtaining survey interviewers from a variety of sources, including market research firms, temporary staff agencies, and survey contractor or airport staff. Retention is often a problem, although this is influenced by the pay rates offered.
- Airport security requirements can significantly affect the conduct of surveys undertaken at an airport. Survey staff working in the secure area of the terminal will generally need to be issued with a security badge, which takes time and may disqualify potential candidates, as well as making it difficult to replace staff who become sick or quit.

The information gained during these interviews was used in the development of this guidebook.

APPENDIX B

Sample Sizes, Sample Estimates, and Confidence Intervals

This appendix outlines how to determine the sample size so that the confidence interval of a sample estimate will be within a specified range and, when analyzing the results, how to estimate values and confidence intervals for characteristics of the population. The determination of sample sizes and confidence intervals are provided for the four types of probability sampling, namely: random, sequential, stratified, and cluster sampling. The description is only a brief summary of the methods as applicable for airport surveys and the reader is encouraged to refer to statistical texts listed in the bibliography for a more complete description.

Examples are then provided for applying these methods to determine sample sizes for small population sizes such as employee or tenant surveys, and for passenger surveys using each of the possible sampling strategies.

Throughout this section, it is assumed that the sample size will be large enough that the sample means will be approximately Normally distributed, per the Central Limit Theorem. Generally a sample size of at least 30 is considered to provide a reasonably good approximation to the Normal distribution. Most airport user surveys will have a much larger sample size than this.

Random Sampling

Suppose we are interested in a characteristic of the population which we denote by *X*. For example, *X* could be the variable, gender, where:

$X = 0$ if passenger is male
1 if passenger is female

Let the mean value of this characteristic be μ. In the example, μ is the proportion of the passengers that are female. Using random sampling the sample mean is an unbiased estimator for the population mean, μ. If the sample size is *n,* the sample mean is:

$$\bar{X} = \sum x_i / n \qquad (1)$$

where $\bar{X}$ is the sample mean
x_i is the i^{th} individual in the sample, $i = 1, \ldots, n$.

The 95% confidence interval for μ (the range that contains the true value of μ with a probability of 0.95) is given by:

$$\bar{X} \pm 1.96\,\sigma_{\bar{X}}$$

where $\sigma_{\bar{X}}$ is the standard deviation of the sample mean. For random sampling without replacement, it can be shown that:

$$\sigma_{\bar{X}} = \sigma_X \sqrt{\left(1 - n/N\right)} \Big/ \sqrt{n}$$

where σ_X is the standard deviation of the variable, X
N is the number of individuals in the population.

Hence the 95% confidence interval for μ is given by:

$$\bar{X} \pm 1.96\, \sigma_X \sqrt{\left(1 - n/N\right)} \Big/ \sqrt{n} \tag{2}$$

For very large populations $(1 - n/N)$ is approximately one, and this reduces to:

$$\bar{X} \pm 1.96\, \sigma_X \Big/ \sqrt{n}$$

The constant, 1.96, is applicable for a 95% confidence interval. For a 99% confidence interval, the constant should be 2.58, and for a 90% confidence interval, use 1.65.

If the sample size is to be chosen so that the sample mean is within w of the population mean, μ, with a probability of 0.95, then the 95% confidence interval is given by:

$\bar{X} \pm w$ (note that the width of the confidence interval is $2w$)

Thus, $w = 1.96\, \sigma_X \sqrt{\left(1 - n/N\right)} \Big/ \sqrt{n}$

This can be solved to give the sample size, n:

$$n = \frac{1.96^2 \sigma_X^2}{w^2 + 1.96^2 \sigma_X^2 / N} \tag{3}$$

In the survey planning stage when trying to determine the sample size, the standard deviation of the variable X, σ_X, will be unknown and must be estimated based on data from previous surveys, other similar airports, or knowledge of the airport.

For **categorical variables,** the standard deviation is related to the expected proportion of individuals in a category:

$$\sigma_X = \sqrt{\left[p\left(1 - p\right)\right]}$$

$$w = 1.96 \sqrt{\left[p\left(1 - p\right)\left(1 - n/N\right)/n\right]}$$

where p is the proportion of the population in the category of interest.

For the example above, where the categorical valuable is the respondent gender, assume that we are interested in estimating the proportion of female passengers. Thus, p is the proportion of female passengers. If we initially estimate this proportion to be 0.5, then for a sample size of $n = 400$ and population size, N, of 50,000, the width of the 95% confidence interval, w, is $\pm$ 0.049. The sample size can be chosen to obtain the required accuracy using Equation 3.

If X represents the mode of transport to the airport, and the category, *taxi or limousine,* has an estimated proportion of 0.20, then the width of the 95% confidence interval, w, is $\pm$ 0.039 for a sample size of $n = 400$ and population size of $N = 50{,}000$.

For a **non-categorical variable,** such as time in the terminal before departure or expenditure at the concessions, the standard deviation is determined from the variation of the variable. Again, this

will be unknown at the planning stage of the survey. If an estimate of the standard deviation, σ_X, can be obtained from past surveys, other similar airports, or knowledge of the airport, the required sample size for a given confidence interval width can be determined in a similar way using Equation 2.

Once the survey has been completed, the standard deviation of X, σ_X, can be estimated from the sample values of X for use in determining the accuracy of the estimated population mean and confidence intervals. The sample standard deviation is the square root of the sample variance, s_X^2, which is given by:

$$s_X^2 = \sum \left(x_i - \bar{X}\right)^2 \Big/ \left(n - 1\right)$$

where $\bar{X}$ is the sample average.

Sequential Sampling

Sequential sampling is equivalent to random sampling if the order of the sample with respect to the characteristics of interest is essentially random. In this case, sample sizes and estimates of standard deviation and confidence intervals are determined in the same way as outlined above for random sampling.

Sequential sampling can result in a more representative sample, and thus narrower confidence intervals, by ensuring a more even spread of sampled individuals over the population (provided the cases where serious biases can occur are avoided[31]). Calculation of the confidence intervals and required sample sizes are difficult and dependent on the relationships between the ordering variable and the characteristics of the population of interest. In airport surveys, it can usually be assumed that the width of the confidence interval is no wider than that which would occur with random sampling and the expressions given for random sampling above can be used.

Stratified Sampling

With stratified sampling, the population is divided into groups, referred to as strata, and each stratum is sampled separately using random or sequential sampling. Assume there are *ns* strata and the proportion of the population in the i^{th} strata is W_i. The sample mean for the i^{th} stratum is:

$$\bar{X}_i = \sum_{j=1}^{n_i} x_{ij} \Big/ n_i \tag{4}$$

and the sample mean for the population is estimated by:

$$\bar{X} = \sum_{i=1}^{ns} W_i \bar{X}_i \tag{5}$$

where $\bar{X}_i$ is the sample mean of the stratum i
x_{ij} is the value of characteristic X for individual j in stratum i
n_i is the number of individuals in stratum i
W_i is the proportion of the population in stratum i, N_i/N.

The standard deviation of the sample mean, $\bar{X}$, is given by:

$$\sigma_{\bar{X}} = \sqrt{\left[\sum_i W_i^2 \sigma_{\bar{X}_i}^2\right]}$$

[31] Serious biases can occur if a characteristic of interest occurs in a cyclic order in the population list and the length of each cycle corresponds to the sampling fraction, but this would be rare in airport surveys.

where $\sigma_{\bar{X}i}$ is the standard deviation of the mean for members of stratum *i,* $\bar{X}_i$, and is given by:

$$\sigma_{\bar{X}i} = \sqrt{\left[\sigma_{Xi}^2\left(1 - n_i/N_i\right)/n_i\right]}$$

where σ_{Xi} is the standard deviation of X for members of stratum i
n_i and N_i are the sample and population sizes for stratum *i,* respectively.

Hence the standard deviation of the sample mean can be expressed as:

$$\sigma_{\bar{X}} = \sqrt{\left[\sum_i W_i^2\ \sigma_{Xi}^2\left(1 - n_i/N_i\right)/n_i\right]}$$

The accuracy of the sample estimate is improved if the variation within each stratum (measured by $\sigma_{\bar{X}i}$) is less than the variation over the whole population.

As above, the 95% confidence interval, 2*w,* that the sample mean is within *w* of the population mean, μ, is given by:

$$w = 1.96\,\sigma_{\bar{X}} \tag{6}$$

With **proportional stratified sampling,** the sampling fraction is the same for each stratum and equals the proportion of the population in the stratum, W_i. Thus,

$$n_i/N_i = n/N \quad \text{and} \quad W_i = n_i/n = N_i/N$$

where n and N are the total sample and population sizes, respectively.

In this case, the sample mean given by Equation 4 reduces to that for a random sample, Equation 1, and

$$\sigma_{\bar{X}} = \sqrt{\left\{\left[\left(1 - n/N\right)/n\right]\sum_i\left(W_i\ \sigma_{Xi}^2\right)\right\}} \tag{7}$$

To determine the required sample size, estimates of σ_{Xi} can be determined in the survey planning stage. These must be estimated from results of previous surveys, other similar airports, or knowledge of the airport. Once approximate estimates of σ_{Xi} have been obtained, the total sample size, *n,* for a confidence interval of width 2*w* is then found using the relationship (from Equations 6 and 7):

$$w = 1.96\sqrt{\left\{\left[\left(1 - n/N\right)/n\right]\sum_i\left(W_i\ \sigma_{Xi}^2\right)\right\}}$$

which can be solved to give the sample size, *n,* as:

$$n = \frac{1.96^2\left[\sum_i\left(W_i\ \sigma_{Xi}^2\right)\right]}{w^2 + 1.96^2\left[\sum_i\left(W_i\ \sigma_{Xi}^2\right)\right]/N} \tag{8}$$

If separate estimates for each stratum cannot be obtained in the planning stage, an approximate estimate of the standard deviation of X over the total population could be used to provide a conservative estimate of the sample size, *n.* For proportional stratified samples, the sample size for each stratum, n_i, is then found by:

$$n_i = n\,W_i$$

For determining confidence intervals of the final estimates using the survey data, the standard deviation of X in each strata, σ_{Xi}, can be estimated by the sample standard deviation, s_{Xi}, determined from the sample values in each stratum. The 95% confidence interval is then:

$$\bar{X} \pm 1.96\sqrt{\left\{\left[\left(1-n/N\right)/n\right]\sum_i \left(W_i\, s_{Xi}^2\right)\right\}} \tag{9}$$

With **non-proportional stratified sampling,** the sampling fractions differ for each stratum. The sample mean for each stratum and overall sample mean can be found using Equations 4 and 5, respectively.

The sample sizes, n_i, are chosen so that a confidence interval of width $2w$ is given by the relationship:

$$w = 1.96\sqrt{\left[\sum_i W_i^2\ \sigma_{Xi}^2\left(1-n_i/N_i\right)/n_i\right]} \tag{10}$$

In this case, many different combinations of n_i could be chosen to produce a confidence interval width of $2w$. The choice of n_i is dependent on the reason for choosing to use non-proportional stratified sampling. To achieve a similar level of accuracy in the results for each stratum, it will be necessary to use non-proportional stratified sampling, with the sample size in each stratum inversely proportional to the variance of the characteristic within that stratum. Thus, $n_i = k / \sigma_{Xi}^2$, where k is a constant. Substituting this into Equation 10 and solving for k gives:

$$k = \frac{\sum_i W_i^2\left(\sigma_{Xi}^2\right)^2}{w^2/1.96^2 + \sqrt{\left(\sum_i W_i^2\ \sigma_{Xi}^2/N_i\right)}}$$

The sample size for each stratum is then found using the relationship: $n_i = k / \sigma_{Xi}^2$

Because the actual variance in the characteristic in the survey responses for each stratum, σ_{Xi}^2, will not be known until the survey has been performed, it will be necessary to make an initial assumption of the differences in the variance across the strata in order to determine the proportion of the survey responses to assign to each stratum. These assumptions can be based on the results of prior surveys or of surveys performed at similar airports.

As before, confidence intervals for the final estimates can be determined using the survey data. The standard deviation of X in each strata, $\sigma_{Xi,}$ can be estimated by the sample standard deviation for each strata, s_{Xi}, determined from the sample values. The 95% confidence interval is then:

$$\bar{X} \pm 1.96\sqrt{\left[\sum_i W_i^2\ s_{Xi}^2\left(1-n_i/N_i\right)/n_i\right]} \tag{11}$$

Cluster Sampling

As described in Section 3.2 of the guidebook, with cluster sampling the population is divided into clusters (or groups) and clusters rather than individual members of the population are sampled. In single stage cluster sampling, all individuals in the cluster are sampled so a complete picture of the population with the sampled clusters is obtained. For example in a survey of departing passengers, flights could be used as clusters and a sample of flights would then be chosen and all passengers on those flights would be surveyed. If two-stage cluster sampling is used, individuals within each cluster are also sampled.

Let N be the numbers of clusters in the population
n be the numbers of clusters sampled
M_k be the number of individuals in the k^{th} cluster in the population
m_k be the number of individuals in the k^{th} cluster included in the sample
x_{kj} be the value of X for the j^{th} individual in the k^{th} cluster.

The average number of individuals per cluster is the total population size divided by the number of clusters:

$$\bar{M} = \sum_{k=1}^{N} M_k / N \tag{12}$$

The sample mean for the k^{th} cluster is:

$$\bar{X}_k = \sum_{j=1}^{m_k} x_{kj} / m_k \tag{13}$$

The population mean is estimated by:

$$\bar{X} = \sum_{k=1}^{n} \left(M_k / \bar{M} \right) \bar{X}_k / n \tag{14}$$

When the numbers of individuals in each cluster are equal, $M_k = \bar{M}$, and the mean for the population reduces to simply the average of the cluster means, $\bar{X}_k$.

Where the clusters to be sampled are drawn randomly from the population of all clusters, and a sample of individuals are drawn randomly from each cluster, the variance of the sample mean, $\bar{X}$, includes two components of variation, the between and within cluster components, and for a categorical variable is estimated by:

$$\sigma_{\bar{X}}^2 = \underbrace{\left(1 - n/N\right)/n\,\sigma_c^2}_{\text{Between cluster component}} + \underbrace{\left(n/N\right)\sum_{k=1}^{n}\left(1 - m_k/M_k\right)p_k\left(1 - p_k\right)/\left[n^2\left(m_k - 1\right)\right]}_{\text{Within cluster component}} \tag{15}$$

where p is the proportion of the total population in the category of interest
p_k is the proportion of individuals in cluster k in the category of interest
σ_c is the variance of the cluster means around the population mean and can be estimated by:

$$\sigma_c^2 = \sum_{k=1}^{n} \left(\bar{X}_k - \bar{X} \right)^2 / \left(n - 1 \right)$$

if all individuals in each selected cluster are sampled, $m_k = M_k$, and the variance is given by the "between cluster component" term only.

Clusters could be selected using stratified sampling to reduce the variance between clusters within a given stratum and thus improve the accuracy of the estimate. For example, where the clusters are flights, flights could be stratified into groups such as domestic and international and short- and long-haul.

Assume that the clusters are stratified into ns strata and in each stratum, n_i clusters are sampled. The population mean is estimated by:

$$\bar{X} = \sum_{i=1}^{ns} \sum_{k=1}^{n_i} \left(M_{ik} / \bar{M} \right) \bar{X}_{ik} / n \tag{16}$$

where n_i is the numbers of clusters sampled in the i^{th} stratum
M_{ik} is the number of individuals in the k^{th} cluster in the i^{th} stratum
$\bar{X}_{ik}$ is the mean of individuals in the k^{th} cluster in the i^{th} stratum
n is the total number of clusters sampled over all strata.

With proportional stratified sampling of clusters, the between cluster variance component of Equation 15 becomes:

$$\mathrm{Var}\left(\bar{X}_c\right) = \left(1 - n/N\right)/n \sum_{i=1}^{ns} W_i \sigma_{ci}^2 \tag{17}$$

where n is the number of clusters sampled (over all strata)
N is the number of clusters in the population (over all strata)
σ_{ci}^2 is the variance of cluster means for clusters in stratum i
W_i is the proportion of clusters sampled that are in stratum i ($= n_i / n = N_i / N$ for proportional stratified sampling).

Assuming that the clusters within each stratum have the same size, M_i, the same sample size, m_i, and the same proportion of individuals with the category of interest, p_i, the within cluster variance component becomes:

$$\begin{aligned}\mathrm{Var}\left(X_c\right) &= \sum_{i=1}^{ns} \sum_{k=1}^{ni} \left(n_i/N_i\right)\left(1 - m_i/M_i\right) p_i\left(1 - p_i\right)/\left[n_i^2\left(m_i - 1\right)\right] \\ &= \sum_{i=1}^{ns} n_i\left(n_i/N_i\right)\left(1 - m_i/M_i\right) p_i\left(1 - p_i\right)/\left[n_i^2\left(m_i - 1\right)\right] \\ &= \sum_{i=1}^{ns}\left(1/N_i\right)\left(1 - f\right) p_i\left(1 - p_i\right)/\left(m_i - 1\right)\end{aligned} \tag{18}$$

where f is the fraction of passengers sampled and is assumed to be constant in all clusters.

The calculation of the accuracy of estimates, required sample sizes, and confidence intervals is complex and the reader is referred to Levy and Lemeshow, *Sampling of Populations,* and Cochran, *Sampling Techniques,* listed in the bibliography. Comprehensive statistical software programs exist which would be useful for analyzing data from cluster sampling.

It should be noted, however, that cluster sampling is less efficient that random, sequential, and stratified sampling and larger sample sizes will be required to obtain the same levels of accuracy. Use of the expressions applicable for random sampling will underestimate the true standard errors of estimated population characteristics and the associated confidence intervals. Preferably, clusters should be chosen so that variation in the characteristics of interest between clusters is small, but within clusters is large.

In airport surveys, cluster sampling is commonly used for sampling of flights in departing passenger surveys. For many characteristics such as trip duration, airfares, trip purpose, time at airport, spending in airport concessions, and of course destination and sector, passengers on the same flight will be more likely to have similar values of these characteristics than passengers in general. This homogeneity of characteristics within a flight significantly reduces the efficiency of cluster sampling for analyzing these characteristics.

There are relatively few air party characteristics that have a similar distribution across different flights. For characteristics such as household size, the variation of the characteristics across passengers on one flight is likely to be fairly similar to that of all passengers. In this case, use of cluster sampling should not greatly reduce the sampling efficiency.

It can be shown that the variances of the estimates of mean of the characteristic of interest for cluster sampling can be expressed, approximately, as a function of the variance for random sampling:

$$\sigma_{\bar{X}C}^2 = \sigma_{\bar{X}R}^2\left[1 + \rho\left(m_{av} - 1\right)\right] \tag{19}$$

where $\sigma_{\bar{X}C}^2$ is the variance using cluster sampling
$\sigma_{\bar{X}R}^2$ is the variance using random sampling

ρ represents the population intra-class correlation
m_{av} is the mean number of cases sampled per cluster.

The variance using cluster sampling will be greater than using random sampling unless either $m_{av} = 1$ or $\rho_i \leq 0$. $m_{av} = 1$ corresponds to the special case where each cluster consists of a single case and is equivalent to random sampling. The intra-class correlation, ρ, is a measure of homogeneity and if individuals in a cluster are more homogeneous than the population as a whole, ρ will be greater than zero.

The ratio of the variances: $\sigma^2_{\bar{X}C}$ / $\sigma^2_{\bar{X}R}$ is often referred to as the design effect, *DE,* and is given by:

$$DE = 1 + \rho\left(m_{av} - 1\right) \tag{20}$$

The effective sample size is given by: $m_{av}\, n$ / *DE.*

Examples of Calculation of Sample Sizes

Small Population Size—Using Random or Sequential Sampling for Categorical Variables

In this example, the sample size is required for a survey of a relatively small population, such as an employee or tenant survey, using random sampling. The critical characteristics of the population being determined are categorical variables, e.g., percentage of employees accessing the airport by private vehicle.

The sample sizes depend on the expected proportion in the category and the level of accuracy desired. Sample sizes were determined using Equation 3 for a range of population sizes; for two values of the expected proportion in the category: 50% and 20%; and for three levels of accuracy: ±5 percentage points, ±3 percentage points, and ±2 percentage points (the latter for the expected proportion of 20% only). As discussed in Section 3.2 of the guidebook, an error of ±5 percentage points represents a percentage error in the category proportion of 10% for an expected proportion of 50% and 25% for an expected proportion of 20%. As is evident in Table B-1, large sample sizes are required if an accuracy of 10% is required for categories with low proportions of the population.

Table B-1. Sample sizes required for categorical variable with expected proportions of 50% and 20% and varying levels of accuracy.

Total Number in Population *N*	Sample Size, *n*, Required for:				
	Expected Proportion in Category = 50%		Expected Proportion in Category = 20%		
	Accuracy of ±5 Percentage Points	Accuracy of ±3 Percentage Points	Accuracy of ±5 Percentage Points	Accuracy of ±3 Percentage Points	Accuracy of ±2 Percentage Points
	(Equivalent to ±10% of Proportion)	(Equivalent to ±6% of Proportion)	(Equivalent to ±25% of Proportion)	(Equivalent to ±15% of Proportion)	(Equivalent to ±10% of Proportion)
50	44	48	42	47	48
100	80	92	71	87	94
200	132	168	110	155	177
500	218	340	165	290	377
1,000	280	515	200	405	605
5,000	360	880	235	600	1,175

Note: Assumes random sampling without replacement.

Table B-2. Assumed number of flights and average number of originating passengers per flight by market sector and day of week.

Day of Week	Sector of Flights			
	Short-Haul Domestic	Long-Haul Domestic	International	Total
Monday	60	20	8	88
Tuesday	60	20	8	88
Wednesday	60	20	8	88
Thursday	60	20	9	89
Friday	60	20	12	92
Saturday	50	16	12	78
Sunday	55	20	12	87
Total	**405**	**136**	**69**	**610**
Avg. Originating Passengers/Flight	50	120	170	79.2

Passenger Survey—Using Random, Stratified, and Cluster Sampling

A survey of air passengers is to be undertaken to obtain information on airport access trips. A critical question to be answered is (say): What is the percentage of passengers dropped off at the curb outside departures check-in?

It was decided to determine the sample sizes for each of the different sampling types and chose the most cost-effective method. It is known that the percentage dropped off at the curb varies greatly by characteristics such as trip purpose, flight sector (e.g., short-haul domestic, long-haul domestic, international), day of the week, time of day, etc. The trip purpose distribution of passengers is not known at the sampling stage and so could not be used. In addition to random sampling, stratified sampling with passengers stratified by flight sector or day of the week, and cluster sampling with flights stratified by flight sector were examined.

The survey is planned to be conducted during a two-week period.

The flight schedule is obtained from the Official Airline Guide and the numbers of flights per sector by day of the week and the estimated average number of originating passengers per flight (estimated using average load factors and percentages of connecting passengers) are as in Table B-2.

To determine the sample size required, it is necessary to have at least approximate estimates of the mean and standard deviation of the variable of interest—in this case the percentage of passengers dropped off at the curb. From knowledge of passengers using the airport, the percentage of passengers dropped off at the curb was estimated in Table B-3.

Table B-3. Estimated percentage of passengers dropped off at the curb.

Sector of Flight	Passengers Dropped Off at Curb		Total Pass.
	Mean, p	Standard deviation	
Short-Haul Domestic	40%	0.490	20,250
Long-Haul Domestic	60%	0.490	16,320
International	90%	0.300	11,730
Overall	**58.9%**	**0.492**	**48,300**

The overall mean percentage of 58.9% is a weighted average of the means for each sector with weights being the numbers of passengers in each sector.

Since the variable of interest is a categorical variable, the standard deviation (SD) is given by: $\sqrt{\left[p(1-p)\right]}$, where p is the proportion of the population in the category of interest (i.e., percentage dropped at curb).

Random Sampling of Passengers

A random sample of originating passengers could be surveyed as they exit the security line. In this case, the sample size is determined for a given width of confidence interval using Equation 3, where

Total population	$N = 48{,}300$
Mean proportion using curb	$\bar{X} = p = 0.59$
SD for individual pass.	$\sigma_X = 0.492$

The sample size, n, was found using Equation 3 for three widths of the 95% confidence intervals (C.I.)—±2%, ±3%, and ±4%—as shown in Table B-4.

A simple approximation, given in Section 3.4.1 of the guidebook[32], could also have been used: $n = 40{,}000\, p(1-p) \big/ (100\, w)^2$

Using this equation, the estimated sample sizes for the ±2%, ±3%, and ±4% cases are: 2,411, 1,074, and 606. The approximation leads to slightly higher estimates of the required sample sizes.

If, for example, it was decided that the narrow confidence interval is appropriate, i.e., the mean estimate should be accurate to within ±2%, a sample size of 2,218 is required. This corresponds to a sampling fraction of 4.6% for a population of 48,300, and if using sequential sampling every 21st passenger passing through security should be surveyed.

Stratified Sampling of Passengers—Stratified by Sector

Consider the case where stratified sampling is used to select passengers to be surveyed and passengers are stratified by the sector of the flight. Assume that at this airport, passengers on the different sectors use different security screening checkpoints, thus allowing passengers on each flight sector to be sampled separately.

We consider here the simple case where proportional stratified sampling is used. Thus the proportion of the sample size in each flight sector is equal to the proportion of the total passengers in each flight sector, $W_i = n_i/n = N_i/N$.

Table B-4. Sample sizes for random sampling of passengers for 95% confidence interval widths ±2%, ±3%, and ±4%.

95% C.I. Mean ± *w*	95% C.I. ± *w* *w* as % of mean	Sample *n*
2.00%	3.40%	2,218
3.00%	5.10%	1,012
4.00%	6.79%	574

[32] The denominator in the equation in Section 3.4.1 is a^2 where the width of the 95% confidence interval is ± a where a is expressed in percentage points. Since w above is not expressed in percentage points, $w = a/100$.

Table B-5. Calculation of standard deviation of sample mean for stratified sampling of passengers by market sector.

Sector of Flight	Enplaned Pass. Total, N_i	% of Total W_i	Est. Avg. Proportion at Curb, p	SD σ_{Xi}	$W_i\sigma_{Xi}^2$
Short-Haul Domestic	20,250	0.4193	0.40	0.49	0.10062
Long-Haul Domestic	16,320	0.3379	0.60	0.49	0.08109
International	11,730	0.2429	0.90	0.30	0.02186
Total	**48,300**	**1.0000**	**0.59**		**0.20357**

The sample size is determined using Equation 8. Table B-5 shows the calculation of the summation over the three flight sectors.

The standard deviation for each sector is found using the relationship applicable for categorical variables: $\sqrt{\left[p_i\left(1-p_i\right)\right]}$, where p_i is the proportion of the population in the category of interest for flights in sector i (i.e., percentage dropped at the curb).

Substituting 0.20357 from Table B-5 for $\sum_i(W_i\,\sigma_{Xi}^2)$ in Equation 8 for three C.I. widths of ±2%, ±3%, and ±4% gives the sample sizes, n, in Table B-6.

The sample sizes for each flight sector are then found, based on the proportion of passengers in each sector, W_i, to be as shown in Table B-7.

Comparing the total sample size with that found with random sampling, we find that stratification by flight segment has reduced the required sample size for the ± 2% case from 2,218 to 1,879—a reduction of 15%. **Note that the size of the reduction is very dependent on the variation in the mean responses across the different strata.**

Table B-6. Sample sizes for stratified sampling of passengers by sector of flight for 95% confidence interval widths ±2%, ±3%, and ±4%.

95% C.I. Mean ± w	95% C.I. ± w w as % of mean	Sample n
2.00%	3.40%	1,879
3.00%	5.09%	854
4.00%	6.79%	484

Table B-7. Sample sizes by sector for stratified sampling of passengers by sector of flight for 95% confidence interval widths ±2%, ±3%, and ±4%.

Sector of Flight	Sample Size for C.I. Width		
	± 2%	± 3%	± 4%
Short-Haul Domestic	788	358	203
Long-Haul Domestic	635	288	163
International	456	207	118
Total	**1,879**	**853**	**484**

Table B-8. Calculation of standard deviation of sample mean for stratified sampling of passengers by day of week.

Day	Originating Passengers					Est. Avg. Proportion at Curb, p_i	SD σ_{Xi}	$W_i\sigma_{Xi}^2$
	Short-Haul Domestic	Long-Haul Domestic	International	Total N_i	% of Total W_i			
Monday	3,000	2,400	1,360	6,760	0.1400	0.572	0.495	0.03427
Tuesday	3,000	2,400	1,360	6,760	0.1400	0.572	0.495	0.03427
Wednesday	3,000	2,400	1,360	6,760	0.1400	0.572	0.495	0.03427
Thursday	3,000	2,400	1,530	6,930	0.1435	0.580	0.494	0.03496
Friday	3,000	2,400	2,040	7,440	0.1540	0.602	0.490	0.03692
Saturday	2,500	1,920	2,040	6,460	0.1337	0.617	0.486	0.03160
Sunday	2,750	2,400	2,040	7,190	0.1489	0.609	0.488	0.03546
Total	**20,250**	**16,320**	**11,730**	**48,300**	**1.0000**	**0.589**		**0.24175**

Stratified Sampling of Passengers—Stratified by Day of Week

Now consider the case where the passengers are stratified by the day of the week. This form of stratification is easy to implement during the conduct of the survey, and numbers of passengers are known, at least approximately, at the sample design stage.

Again consider the simple case where proportional stratified sampling is used. Thus the proportion of the sample size on each day of the week is equal to the proportion of the total passengers in each day of the week.

It was assumed that the proportion of people using the curb on each weekday was entirely explained by the sector of their flight. Thus, the average percentage of passengers using the curb was estimated for each day by the weighted average of the percentages for each flight sector, with weights equal to the numbers of passengers on that day to each sector.

The sample size is determined using Equation 8. Table B-8 shows the calculation of the summation over the days of the week.

The standard deviation for each day is found using the relationship applicable for categorical variables: $\sqrt{\left[p(1-p)\right]}$, where p_i is the proportion of the population in the category of interest (i.e., percentage dropped at curb) on day *i*.

Substituting 0.24175 from Table B-8 for $\sum_i(W_i\sigma_{Xi}^2)$ in Equation 8 for three C.I. widths of ±2%, ±3%, and ±4% gives the sample sizes, *n,* in Table B-9.

The sample sizes for each day of the week are then found, based on the proportion of passengers on each day of the week, W_i, to be as shown in Table B-10.

Table B-9. Sample sizes for stratified sampling of passengers by day of week for 95% confidence interval widths ±2%, ±3%, and ±4%.

95% C.I. Mean ± *w*	95% C.I. ± *w* *w* as % of mean	Sample *n*
2.000%	3.40%	2,215
3.000%	5.09%	1,010
4.000%	6.79%	574

Table B-10. Sample sizes for each day for stratified sampling of passengers by day of week for 95% confidence interval widths ±2%, ±3%, and ±4%.

Day of Week	Sample Size for C.I. Width		
	± 2%	± 3%	± 4%
Monday	310	141	80
Tuesday	310	142	80
Wednesday	310	142	80
Thursday	318	145	82
Friday	341	156	89
Saturday	296	135	77
Sunday	330	150	86
Total	**2,215**	**1,011**	**574**

Comparing the total sample size with that found with random sampling, we find that stratification by day of the week has reduced the required sample size for the ±2% case from 2,218 to 2,215—a reduction of only 0.1%. Thus, in this case stratification makes almost no difference to the required sample size. This is due to the low variability in the average percentage of passengers at the curb, p_i, over the various days of the week. **Note that the size of the reduction is very dependent on the variation in the mean responses across the different strata. This varies depending on the variable of interest and in some cases could vary greatly over the days of the week making stratification by day of the week worthwhile.**

Cluster Sampling of Flights—Additional Assumptions

A very common form of sampling for passenger surveys is to select a sample of flights to survey and to sample either all, or a portion, of passengers on those flights. This is a form of cluster sampling where each flight represents a cluster.

Using the same example as above, the pertinent characteristics required to estimate the sample size are given in Table B-11.

Cluster sampling is very dependent on one parameter not relevant to the passenger sampling considered above—the variation in the mean value for each flight of the characteristic of interest (i.e., percentage of passengers dropped at the curb) over the range of flights, σ_{ci}. An estimate of

Table B-11. Assumed characteristics for flights in three market sectors for illustrative examples of cluster sampling.

Quantity	For Flight Sector, *i*				Total	
	Symbol	Short-Haul Domestic	Long-Haul Domestic	International	Symbol	Value
No. of Departing Flights	N_i	405	136	69	N	610
Avg. Originating Pass./Flight	M_i/N_i	50	120	170	M/N	79.2
Total Originating Passengers	M_i	20,250	16,320	11,730	M	48,300
Proportion of Flights in Sector	$W_i = N_i/N$	0.6639	0.2230	0.1131		1.0000
% Dropped at Curb	$\bar{X}_i = p_i$	40%	60%	90%	$\bar{X} = p$	58.9%
Difference from Overall Avg.	$\bar{X}_i - \bar{X}$	-19%	1%	31%		
SD in % Between Flights:	$\sigma_{c\,i}$	10%	10%	10%	σ_c	21.1%

this variation, expressed in terms of the standard deviation, is given in Table B-11. It is estimated from previous surveys and knowledge of passengers at the airport that the standard deviation is 10% around the mean value for each sector[33]. Thus, for short-haul flights the mean value of the percentage using the curb for each flight would be expected to be between 20.4% and 59.6% for 95% of flights [= 40% ± 1.96 x 10%]. The standard deviation over all flights includes both the variation between flights within each sector and the variation between sectors and is given by:

$$\sigma_c = \sqrt{\left\{\sum_i W_i \left[\sigma_{ci}^2 + \left(\bar{X}_i - \bar{X}\right)^2\right]\right\}}$$

where W_i is the proportion of flights in sector i ($= N_i / N$).

Cluster Sampling with Random Sampling Flights

If a random sample of flights is selected and all passengers on each of the selected flights are surveyed, the sample size is determined for a given width of confidence interval using Equation 3, where

Total population (flights)	$N = 610$
Mean proportion using curb	$\bar{X} = p = 0.589$
SD for individual flight	$\sigma_X = \sigma_c = 0.211$

The number of flights to be sampled, *n,* was found using Equation 3 for three widths of the 95% confidence interval—±2%, ±3%, and ±4%—as shown in Table B-12.

Since all passengers on each flight are sampled, the number of passengers sampled is the number of flights sampled multiplied by the average number of passengers per flight ($\bar{M} = M / N$).

Comparing the total passenger sample size with that found with random sampling of passengers, we find that cluster sampling by flight has increased the required sample size greatly—for ±2% accuracy from 2,218 to 19,953. This is due to the high variation in the characteristics of interest between flights. In other cases, the additional sample size with clustering may be much less. For example, if the mean percentage was 50% for each sector (instead of 40%, 60%, and 90%), the sample size for ±2% accuracy would be 83 flights or 6,572 passengers. **The increase in the sample size is very dependent on the variation in the mean responses for a flight across the different flights and the above example may not be typical in general.**

Table B-12. Sample sizes for cluster sampling with random sampling flights for 95% confidence interval widths ±2%, ±3%, and ±4%.

95% C.I. Mean ± *w*	95% C.I. ± *w* *w* as % of mean	Sample *n* (flights)	Sample Pass.
2.00%	3.40%	252	19,953
3.00%	5.10%	146	11,560
4.00%	6.79%	92	7,285

[33] Note that if there was no difference between sectors, so that the mean percentage of passengers dropped off at the curb was 58.9% for all flights, the standard deviation in the percentage between flights, σ_{ci}, would equal the standard deviation of the mean for each flight. Then $\sigma_{ci}^2 = p_i (1 - p_i) / (N_i / M_i)$ where N_i / M_i is the average numbers of passengers on each flight in sector *i*. Thus the values of σ_{ci} for the short-haul, long-haul, and international sectors would be 7.0%, 4.5%, and 3.8%, respectively, and σ_c would be 6.2%.

Table B-13. Calculation of standard deviation of sample mean for cluster sampling with flights stratified by sector and all passengers on selected flights surveyed.

Sector of Flight	Departing Flights		Est. Avg. % at curb, p_i	SD σ_{ci}	$W_i\sigma_{ci}^2$
	Total N_i	$W_i = N_i/N$			
Short-Haul Domestic	405	0.6639	0.40	0.10	0.00664
Long-Haul Domestic	136	0.2230	0.60	0.10	0.00223
International	69	0.1131	0.90	0.10	0.00113
Total	**610**	**1.0000**	**0.589**		**0.01000**

Cluster Sampling with Stratified Sampling of Flights and All Passengers on Selected Flights Surveyed

Now consider the case where flights to be surveyed are determined using stratified sampling and all passengers on each of the selected flights are surveyed. The flight sample size is determined for a given width of confidence interval using Equation 8, where the units sampled in each stratum are clusters rather than individuals. Since flights are being sampled, rather than passengers, the standard deviation σ_{Xi} in Equation 8 is the standard deviation of the average percentage of passengers using the curb for each flight, σ_{ci}, as shown in Table B-13.

Substituting 0.01000 from Table B-13 for $\sum_i(W_i\ \sigma_{ci}^2)$ in Equation 8, the number of flights to be sampled, *n,* was found for three widths of the 95% confidence intervals—±2%, ±3%, and ±4%—as shown in Table B-14.

The numbers of flights in each sector and estimated number of passengers (based on average numbers of passengers per flight in that sector) are as shown in Table B-15.

Table B-14. Sample number of flights for cluster sampling with flights stratified by sector and all passengers on selected flights surveyed for 95% confidence interval widths ±2%, ±3%, and ±4%.

95% C.I. Mean ± *w*	95% C.I. ± *w* *w* as % of mean	Sample *n* (flights)
2.00%	3.40%	83
3.00%	5.09%	40
4.00%	6.79%	24

Table B-15. Sample sizes by sector for cluster sampling with flights stratified by sector and all passengers on selected flights surveyed for 95% confidence interval widths ±2%, ±3%, and ±4%.

Sector of Flight	C.I. Width ± 2%		C.I. Width ± 3%		C.I. Width ± 4%	
	Flights	Pass.	Flights	Pass.	Flights	Pass.
Short-Haul Domestic	55	2,750	27	1,350	16	800
Long-Haul Domestic	19	2,280	9	1,080	5	600
International	9	1,530	5	850	3	510
Total*	**83**	**6,560**	**41**	**3,280**	**24**	**1,910**

* Total may be higher than previous table as number of flights must be an integer

The stratification of flights by sector results in a large reduction in the numbers of flights and passengers to be surveyed. In this example, much of the variation in the variable of interest is explained by the flight sector, which results in a large reduction in sample size compared to random sampling of flights. By sampling the flights by sector, the likelihood of selecting a sample with close to the actual proportions of passengers in each sector is much greater than when randomly sampling flights. **Again note that the results here reflect the assumptions regarding variation considered in this example and will vary in other situations.**

Cluster Sampling with Stratified Sampling of Flights and a Sample of Passengers on Selected Flights

Now consider the case where flights to be surveyed are determined using stratified sampling and a sample of passengers on each of the selected flights are surveyed. Assume initially that 50% of passengers on the selected flights are surveyed. The variance of the estimate is greater than with 100% sampling of each flight as it includes both the variation between flights (as before) and the variation due to sampling of passengers on individual flights. It is calculated from Equations 17 and 18 as follows:

$$\sigma_{\bar{X}}^2 = \left(1 - n/N\right)/n \sum_{i=1}^{ns}\left(N_i/N\right)\sigma_{ci}^2 + \sum_{i=1}^{ns}\left(1/N_i\right)\left(1-f\right)p_i\left(1-p_i\right)/\left(m_i - 1\right)$$

where σ_{ci} is the standard deviation of the mean percentage using the curb across flights in sector i
N_i is the number of flights in sector i (N is total over all sectors)
n_i is the number of flights sampled in sector i (n is total over all sectors)
M_i is the average number of passengers on a flight in sector i
m_i is the average number of passengers sampled on a flight in sector i ($= f M_i$)
p_i is the probability of a passenger on a flight in sector i being dropped off at the curb
f is the proportion of passengers sampled on a flight ($= m_i / M_i$, assumed the same for all flights).

The flight sample size is determined for a given confidence interval $\bar{X} \pm w$ by solving the following relationships for n:

$w = 1.96\ \sigma_{\bar{X}}^2$ where $\sigma_{\bar{X}}^2$ is given by the equation above.

The summations over the sectors for calculating $\sigma_{\bar{X}}^2$ are determined for a given n value as shown in Table B-16 ($n = 117$ used in table).

The number of flights to be sampled, n, was found by setting an approximate value initially and determining the width, w, then adjusting the value of n until the appropriate value of w was obtained. In the table, $\sigma_{\bar{X}}^2$ is evaluated for $n = 117$ and the resulting value of w is 0.0200 or 2.00%. Samples sizes for three widths of the 95% confidence intervals—±2%, ±3%, and ±4%—were found to be as shown in Table B-17.

Table B-16. Calculation of standard deviation of sample mean for cluster sampling with flights stratified by sector and a 50% sample of passengers on selected flights.

								Calculate $\sigma_{\bar{X}}^2$ for $n = 117$		
Sector of Flight	**Departing Flights**		**Est. Avg. % at Curb, p_i**	**Pass. on Each Flight, M_i**	**Sampled on Each Flight**		**SD Between Flights, σ_{ci}**	**Between Cluster**	**Within Cluster**	**Between + Within**
	Total, N_i	**$W_i = N_i / N$**			**% f**	**# m_i**		**$(1 - n/N) / n$ $(N_i / N)\ \sigma_{ci}^2$**	**$(1 / N_i)\ (1 - f)$ $p_i(1 - p_i) /$ $(m_i - 1)$**	**Total**
Short-Haul Dom.	405	0.6639	0.40	50	50%	25	0.100	0.0000459	0.0000123	0.0000582
Long-Haul Dom.	136	0.2230	0.60	120	50%	60	0.100	0.0000154	0.0000150	0.0000304
International	69	0.1131	0.90	170	50%	85	0.100	0.0000078	0.0000078	0.0000156
Total	**610**	**1.0000**	**0.59**							**$\sigma_{\bar{X}}^2 = 0.0001041$**
										$w = 1.96\ \sigma_{\bar{X}} =$ 0.0200

Table B-17. Sample number of flights for cluster sampling with flights stratified by sector and a 50% sample of passengers on selected flights surveyed for 95% confidence interval widths ±2%, ±3%, and ±4%.

95% C.I. Mean ± *w*	95% C.I. ± *w* *w* as % of mean	Sample *n* (flights)
2.00%	3.40%	117
3.00%	5.09%	47
4.00%	6.79%	26

The numbers of flights in each sector and estimated number of passengers (based on average numbers of passengers per flight in that sector) are as shown in Table B-18.

The surveying of only a 50% sample of passengers on each flight resulted in an increase in the number of flights to be surveyed from 83 to 117 for the ±2% accuracy case. However, since only 50% of passengers on these flights are to be surveyed, the total number of passengers decreased from 6,560 to 4,615. For surveys conducted in the departure lounge, it is almost impossible to survey all passengers on a flight due to reasons given in Chapter 5 of the guidebook. In practice it may be possible to obtain complete responses from 50% of passengers, in which case the number of flights to be surveyed based on the 50% passenger sample should be used.

It is evident that the total number of passengers that need to be surveyed can be reduced by reducing the percentage of passengers sampled on each flight, but the number of flights surveyed increases. Several other cases were examined using this example:

- If 75% of passengers on each of the selected flights were to be surveyed, a sample of 92 flights and 5,580 passengers would be required.
- If 30% of passengers on each of the selected flights were to be surveyed, a sample of 268 flights and 6,360 passengers would be required.

The optimal balance for a particular survey will depend on the variation in responses between and within flights, and on the relative costs of surveying passengers and flights, which vary from survey to survey.

Another important consideration with interview surveys in gate lounges, discussed in Chapter 5 of the guidebook, is the limitation on the number of interviews that each interviewer can complete in the time window between when passengers start to arrive in the gate lounge and the start of flight boarding. As a practical matter, this limits the number of passengers who can be surveyed on a given flight.

Again note that the results here reflect the assumptions regarding variation considered in this example and will vary in other situations.

Table B-18. Sample sizes by sector for cluster sampling with flights stratified by sector and a 50% sample of passengers on selected flights surveyed for 95% confidence interval widths ±2%, ±3%, and ±4%.

Sector of Flight	C.I. Width ± 2%		C.I. Width ± 3%		C.I. Width ± 4%	
	Flights	Pass.	Flights	Pass.	Flights	Pass.
Short-Haul Domestic	78	1,950	31	775	17	425
Long-Haul Domestic	26	1,560	11	660	6	360
International	13	1,105	5	425	3	255
Total	**117**	**4,615**	**47**	**1,860**	**26**	**1,040**

APPENDIX C

Material and Equipment Checklists for Air Passenger Intercept Surveys

Office Supplies

Pens
Pencils
Erasers
Pencil Sharpeners
Notebooks or Notepaper
Staplers
Scissors
Rubber Bands
Paper Clips
Printer Paper
Clipboards (for paper surveys)
Bags to carry survey forms (for paper surveys)
Uniforms (shirts, aprons, other identifying attire)
Name Tags
ID Badges

Electronics

PDAs or other Electronic Data Collection Devices if needed (for electronic surveys)
Chargers
Secure Digital (SD) Cards (additional memory for PDAs or other devices)
Batteries
Laptops for Office Staff
Flash Drives
Printer
Two-Way Radios and Charging Cords
Cell Phones and Charging Cords
Power Strips (for overnight charging)

Paperwork

Intercept Survey Training Manuals
Copies of Questionnaires (printed copies of electronic survey questions)
Show Cards
Site Location Maps

Airport Authorization Letters
Client Contact Information (phone numbers)
Flight Schedules
Interviewing Schedules
Daily Flight (or Intercept Survey Location) Sampling Plans
Backup Flight Sampling Plan (if originally selected flights are cancelled or extensively delayed)
Time Sheets
Sign-In and Sign-Out Sheets
Equipment Sign-Out and Sign-In Sheets
Interviewer Results Forms
Overtime Forms
Expense Reimbursement Forms
Nightly Inventory Forms
Employee Scheduling and Availability Information
Employee Contact Information
Employment Agency or Field Service Contact Information

Other Logistics

Location of FedEx or UPS Drop Boxes
Location of Copy Service
Transit Tickets or Passes
Parking Passes
Car Rental Information
Air Travel Information (if field staff are not local)
Hotel Arrangements
Driving Directions
Cash for Per Diems
Cash for Unexpected Expenses
On-Site Training Room
On-Site Pre-Test Debriefing Room
On-Site Project Office (centrally located, sufficient space)
On-Site Internet Access (downloading and transmitting data)

APPENDIX D

Sample Training Agenda

NAME OF SURVEY SPONSOR

NAME OF AIRPORT

20XX AIR PASSENGER SURVEY

INTERVIEWER TRAINING SESSION

AGENDA FOR DAY ONE

9:00 Introductions
Welcome
Purpose of Survey
Role and Importance of Field Staff
Team Hierarchy, Where to Go with Questions
Time Frame
Schedules and Compensation
Incentive Structure
Airport Terminology

9:15 Tour of Airport

10:15 Break

10:30 Expectations and Standards
Behavior On and Off the Job
Interactions with Passengers
What to Do if You Get Asked for Information

Pacing

- Move Quickly to Next Person – Be on the Move
- Use a Positive Assumption
- Use Positive Body Language
- Smile

Quality of Work – The Importance of Completeness and Accuracy

Attire and Grooming

Challenging Situations

Communications, Staying in Touch and How to Get Help

12:00 Lunch

1:00 Review of Key Interviewing Practices and Procedures

Confidentiality

Basic Rules: Dos and Don'ts

Responses to Resisters and Questioners

Handling Open-Ended Questions

Handling "Other"

2:00 Sample Selection

What Is a Sample?

Importance of How People Are Selected

Survey Sample and Shadow Sample

How to Read the Schedule

Selecting the Next Person at Security Screening

Start Point and Counting in Boarding Areas

What to Do When There Are No Passengers There

What to Do When Time Is Over

2:45 Break

3:00 Questionnaire Review

Structure

Questions

Key Considerations

4:00 Use of Handheld Devices

Why Are We Doing This?

Checking In and Checking Out

Turning On and Off

Moving from One Question to the Next

Recording Answers

Moving from One Complete to the Next

PDA Tricks

- Tap Lightly
- Ask as You Enter
- Use a Mid-Sentence Tap

NAME OF SURVEY SPONSOR

NAME OF AIRPORT

20XX AIR PASSENGER SURVEY

INTERVIEWER TRAINING SESSION

AGENDA FOR DAY TWO

9:00 Review of Key Points from Day One
9:45 Review of Concepts that Appear to Have Been Unclear
10:15 Break
10:30 Questions: Be Armed for Success
11:00 Practice: Interview Each Other
12:00 Lunch
1:00 Continue Practice
2:00 Practice in Terminals with Supervisors
4:00 Debriefing and Reminders
5:00 Training Concludes

APPENDIX E

High-Speed Scanning Technology

This appendix describes the use of high-speed scanning for data entry from paper forms. This technology represents, in some ways, the leading edge of survey forms handling, and the techniques and tools described here are still being developed and improved. For the latest information in this area, the reader is directed to the Internet for further research.

Data Entry by Scanning

The process of scanning forms as a data entry method has been around since the days of punch-cards and early development of technology for school standard testing. Students would complete a form consisting of columns of multiple choice answers and signify their response by darkening the appropriate box or oval.

Things have come a long way since then.

The old structured format of a fixed pattern of boxes or ovals that can be filled in has been replaced with free-form capabilities, and the scanning speeds and hardware have improved to allow thousands of forms to be scanned—both sides—in a matter of hours.

The following sections describe each of the components of this high-speed scanning system. There may be differences in available products and services, but the main principles will still apply.

Hardware

The first component is the scanner itself. These are not ordinary office scanners, but special purpose scanners that are designed for high volumes of work.

The hardware includes a hopper for thousands of completed forms.

Each form is fed into the scanner, where a scanning pass takes one second or less. The page is then reversed and the other side is scanned.

The scanned images are then processed.

Software

The software that comes with these systems provides the user with the ability to program the areas of the forms to be scanned and information on what to with the results. There is a certain degree of character recognition built into the software. The requirements for legibility and well-formed letters can be quite high.

For questions with tick-box answers, the process is relatively straightforward and also relatively lenient as to whether a box is ticked or not.

For written responses, the optical character recognition (OCR) software can be quite crude. Depending on the particular service or system being used, those completing the forms may need to be trained on how to enter each letter and number. Sloppiness at the time of the interview translates into reduced productivity in converting the data into an electronic file.

Interview surveys with many free-form entries and time constraints or respondent self-completed surveys are not recommended for such a process due to the inherent sloppiness of the responses.

Scan Design Process

Perhaps the longest part of the process is the scan design. This step only takes place after the survey form has been finalized. The software is then used to designate each question on the form, where the responses are, and what each tick box means. In this manner, each question and each response is linked to an entry in the resulting database.

This process can take several hours and must be thoroughly tested.

Purchase or Rent

It is possible to buy the hardware and software or purchase such services from a local agency. A recent search on the Internet revealed a number of businesses that offer high-speed scanning and data entry services. Careful research would be necessary to match the capabilities of different vendors with the requirements of the survey.

Purchasing of the hardware and software should be considered if large volumes of surveys are done on a frequent basis. This equipment is relatively expensive and the cost would most likely not be justifiable over a single survey project.

APPENDIX F

Sample Questionnaires for Passenger Surveys

This appendix contains sample questionnaires from a range of recent air passenger surveys, including one intercept interview survey and four surveys performed using self-completed forms.

Metropolitan Transportation Commission 2006 Airline Passenger Survey

The first sample questionnaire was developed for the 2006 Airline Passenger Survey undertaken at Oakland International Airport and San Francisco International Airport by the Metropolitan Transportation Commission, the metropolitan planning organization responsible for transportation planning for the San Francisco Bay Area. The survey was performed as an interview survey of selected passengers in two locations: airline gate lounges or as passengers exited security screening. Passengers were sampled with the intent of only interviewing one respondent per air party. The survey questions were programmed into hand-held Personal Digital Assistant (PDA) units.

The survey was performed in two waves between August 23 and October 8, 2006. The survey yielded just over 8,200 responses from ground originating air parties, just under 3,600 at Oakland International Airport and just over 4,600 at San Francisco International Airport. More details of the survey are reported in:

JD Franz Research, Inc., *Metropolitan Transportation Commission 2006 Airline Passenger Survey: Oakland International Airport and San Francisco International Airport,* Final Report, Prepared for the Metropolitan Transportation Commission, Oakland, Calif., January 2008.

Atlanta International Airport 2005 Passenger Survey

The second sample questionnaire was developed for the 2005 peak week air passenger survey at Hartsfield–Jackson Atlanta International Airport. The survey used a self-completed questionnaire that was distributed to passengers waiting in the airline gate lounges for selected flights. The completed questionnaires were collected before or as passengers boarded the flight, although postage-paid envelopes were available so that the survey form could be returned by mail if passengers were not able to complete it before boarding the flight. The questionnaire was designed as a tri-fold form, both to facilitate respondents writing on it while holding it and to allow it to be mailed back. The introduction to the survey and the sequence of questions on the panels appear in the correct order when the questionnaire is folded.

Boston Logan 2007 Air Passenger Ground Access Survey

The third sample questionnaire was developed for the 2007 Air Passenger Ground Access Survey undertaken at Boston Logan International Airport by the Massachusetts Port Authority (Massport). The survey used a self-completed questionnaire that was distributed to passengers waiting in the airline gate lounges for selected flights. The completed questionnaires were collected before or as passengers boarded the flight, although the survey form was designed so that it could be returned by mail if passengers were not able to complete it before boarding the flight. The questionnaire was designed as a tri-fold form, both to facilitate respondents writing on it while holding it and to allow it to be mailed back. The introduction to the survey and the sequence of questions on the panels appear in the correct order when the questionnaire is folded.

The survey was conducted over a two-week period from Monday, April 23 to Sunday, May 5, 2007. A total of 255 flights were surveyed, yielding just over 10,000 survey responses. More details of the survey are reported in:

Vanasse Hangen Brustlin, Inc., *Boston-Logan International Airport 2007 Environmental Data Report,* Report EOEA #3247, Prepared for the Massachusetts Port Authority, East Boston, Mass., September 2008.

Roanoke Regional Airport 2005 Passenger Survey

The fourth sample questionnaire was developed for an air passenger survey at Roanoke Regional Airport in Virginia undertaken in 2005 as part of an airport master plan study. The survey used a self-completed questionnaire that was distributed to passengers waiting in the airline gate lounges for selected flights.

2007 Washington–Baltimore Regional Air Passenger Survey

The fifth sample questionnaire is one of three developed for the 2007 Washington–Baltimore Regional Air Passenger Survey that was undertaken by the Metropolitan Washington Council of Governments at Ronald Reagan Washington National Airport, Washington Dulles International Airport, and Baltimore/Washington International Thurgood Marshall Airport (BWI). The sample questionnaire shown was designed for use at BWI. Similar questionnaires were designed for use at National and Dulles Airports. The survey questionnaires were distributed to passengers waiting in the airline gate lounges for selected flights for self-completion. The completed questionnaires were collected before or as passengers boarded the flight, although postage-paid envelopes were available so that the survey form could be returned by mail if passengers were not able to complete it before boarding the flight. The questionnaire was designed as a tri-fold form, both to facilitate respondents writing on it while holding it and to allow it to be mailed back. The introduction to the survey and the sequence of questions on the panels appear in the correct order when the questionnaire is folded.

The survey was conducted over a two-week period from Sunday, October 7 to Saturday, October 20, 2007, with a few additional flights surveyed during the following week. Survey responses were obtained from approximately 19,000 passengers. More details of the survey are reported in:

Mohammed, A., *2007 Washington-Baltimore Regional Air Passenger Survey,* Metropolitan Washington Council of Governments, Washington, D.C., September 2008.

METROPOLITAN TRANSPORTATION COMMISSION

SAN FRANCISCO INTERNATIONAL AIRPORT

OAKLAND INTERNATIONAL AIRPORT

SURVEY OF AIR PASSENGERS

(FINAL VERSION)

QA. INTERVIEWER: Please enter the location where this interview is taking place.

OAKLAND INTERNATIONAL AIRPORT
SAN FRANCISCO INTERNATIONAL AIRPORT

QB. INTERVIEWER: Please enter the terminal where this interview is taking place.

Oakland

TERMINAL 1
TERMINAL 2

San Francisco

TERMINAL 1/B
TERMINAL 1/C
TERMINAL 3/E
TERMINAL 3/F (MAIN PIER)
TERMINAL 3/F (GATES 73/74)
TERMINAL 3/F (GATE 75)
INTERNATIONAL TERMINAL A
INTERNATIONAL TERMINAL G

QC. INTERVIEWER: Where is this interview taking place?

GATE (ASK QD)
SECURITY SCREENING (ASK QE)
IF GATE, ASK:

QD. INTERVIEWER: Please enter the gate where this interview is taking place.

IF SECURITY SCREENING, ASK:

QE. INTERVIEWER: Please enter the security screening location where this interview is taking place.

Oakland

TERMINAL 1
TERMINAL 2

San Francisco

TERMINAL 1/B
TERMINAL 1/C
TERMINAL 3/E
TERMINAL 3/F (MAIN PIER)
TERMINAL 3/F (GATES 73/74)
TERMINAL 3/F (GATE 75)
INTERNATIONAL TERMINAL/A
INTERNATIONAL TERMINAL/G

QF. INTERVIEWER: Please enter your interviewer ID number. ___ ___ ___ ___

Good (morning) (afternoon) (evening). My name is YOUR FULL NAME, and we are doing a brief survey of passengers for NAME OF AIRPORT. I need less than ten minutes of your time. Would you please take this short survey?

YES
NO – NO TIME
NO – NO/OTHER REASON
LANGUAGE BARRIER

QG. Did your airline ask you to be at the gate in the next 20 minutes, or do you have more time than that?

NEXT 20 MINUTES (ASK QH)
MORE TIME (SKIP TO Q1)

IF NEXT 20 MINUTES, ASK:

QH. May I accompany you to the gate and conduct the interview there if there is enough time?

YES - CONTINUE WITH Q1
NO - THANK AND TERMINATE

1. First, what airline are you flying on today? _____

2. And what is your flight number? (ASK FOR BOARDING PASS OR TICKET IF NOT SURE)
_____

3. Including yourself, how many people are in your travel party today? (By travel party, I mean all of the people who are traveling together with you **on the same flight** today.)

4. And how many of these are children under the age of 18?

5. Did you fly into this airport today solely for the purpose of connecting with another flight, or did you get here by ground transport?

FLEW IN - CONNECTOR (CONTINUE)
GROUND TRANSPORTATION (SKIP TO Q8)

IF FLEW IN (CONNECTOR), ASK:

6. What airline did you take to get here?

7. And what was that flight number? ASK FOR BOARDING PASS OR TICKET IF NOT SURE.

THANK AND TERMINATE.

IF USED GROUND TRANSPORTATION, ASK:

8. What is your final airport destination for today's trip?

9. And what is the main purpose of your trip? SHOW CARD OR READ IF NEEDED.

CONVENTION OR CONFERENCE
OTHER TYPE OF BUSINESS TRIP
VISIT FRIENDS OR RELATIVES
VACATION
TRAVEL TO OR FROM SCHOOL
WEDDING OR FUNERAL
PERSONAL OR FAMILY EMERGENCY
SOME OTHER PURPOSE
RECORD OTHER PURPOSE.

10. How many people came into the terminal with you today just to see you or other members of your travel party off? (INCLUDE NON-FLYING PARENTS.)

11. At which of the types of places shown on this card did you start your trip to the airport today? SHOW CARD OR READ IF NEEDED.

YOUR OWN HOME (ASK Q18A)
SOMEONE ELSE'S HOME (ASK Q18A)
A PLACE OF BUSINESS (ASK Q18A)
A HOTEL, MOTEL, INN, BED & BREAKFAST (ASK Q13)
A RESTAURANT (ASK Q14)
A CONVENTION CENTER (ASK Q15)
A SCHOOL, COLLEGE, OR UNIVERSITY (ASK Q16)
A TOURIST ATTRACTION (ASK Q17)
SOMEWHERE ELSE (ASK Q17)

12. And what city or town was that in? _____

IF NOT ON LIST, SKIP TO Q18A.

IF HOTEL/MOTEL/INN/B&B, ASK:

13. And what was the name of that _____?

IF NOT ON LIST ENTER NAME IN OTHER

IF RESTAURANT, ASK:

14. And what was the name of that restaurant?

SKIP TO Q18A.

IF CONVENTION CENTER, ASK:

15. And what convention center was that?

IF NOT ON LIST ENTER NAME IN OTHER, SKIP TO Q18A.

IF SCHOOL, COLLEGE, OR UNIVERSITY, ASK:

16. And what is the name of that (school) (college) (university)?

IF NOT ON LIST ENTER NAME IN OTHER, SKIP TO Q18A.

IF ATTRACTION OR OTHER PLACE, ASK:

17**.** And what was the name of that (attraction) (place)? IF NOT FOUND ON LIST, ENTER NAME IN OTHER, GO TO Q18A.

IF HOME OR BUSINESS LOCATION, ASK:

18A. What is the ZIP code of that (residence)?

18B. Could you please tell me the street address there? ASK FOR HELPFUL DOCUMENTS IF NEEDED. PROBE FOR STREET SPELLING.

IF REFUSED ADDRESS, ASK:

19. Then could you please give me the block number? (Such as the 100 block, the 1000 block, and so forth.)

IF REFUSED BLOCK, SAY:

20. Then could you just give me the nearest intersection—that is, the nearest street and the nearest cross-street?

21. What time did you leave that place? ___ ___ : ___ ___ AM PM

22. And what time did you arrive inside the terminal? ___ ___ : ___ ___ AM PM

23. How did you get to the airport today?

OAKLAND:

PRIVATE CAR/VEHICLE (SKIP TO Q27)
AC TRANSIT (PUBLIC TRANSIT) BUS (SKIP TO Q37)
AC TRANSIT FROM AMTRAK (SKIP TO Q33)
AC TRANSIT FROM BART (SKIP TO Q31)
AIRBART FROM AMTRAK (SKIP TO Q33)
AIRBART FROM BART (SKIP TO Q31)
CHARTERED BUS OR VAN SERVING YOUR TRAVEL PARTY ONLY (SKIP TO Q38)

HOTEL/MOTEL COURTESY SHUTTLE (SKIP TO Q24)
LIMOUSINE SERVING YOUR PARTY ALONE (SKIP TO Q38)
RENTAL CAR (SKIP TO Q27)
SCHEDULED AIRPORT BUS: NAME: _____ (SKIP TO Q35)
SHARED RIDE VAN SERVING MORE THAN ONE PARTY (SKIP TO Q38)
TAXI/CAB (SKIP TO Q38)
SOMETHING ELSE: _____ (SKIP TO Q38)
DON'T KNOW (**THANK AND TERMINATE**)
REFUSED (**THANK AND TERMINATE**)

SAN FRANCISCO

PRIVATE CAR/VEHICLE (SKIP TO Q27)
BART (SKIP TO Q31)
BART FROM CALTRAIN (SKIP TO Q33)
CHARTERED BUS OR VAN SERVING YOUR TRAVEL PARTY ONLY (SKIP TO Q38)
HOTEL/MOTEL COURTESY SHUTTLE (SKIP TO Q24)
LIMOUSINE SERVING YOUR PARTY ALONE (SKIP TO Q38)
RENTAL CAR (SKIP TO Q27)
SAMTRANS (PUBLIC TRANSIT) BUS (SKIP TO Q37)
SCHEDULED AIRPORT BUS: NAME: _____ (SKIP TO Q35)
SHARED RIDE VAN SERVING MORE THAN ONE PARTY: NAME _____ (SKIP TO Q38)
TAXI/CAB (SKIP TO Q38)
SOMETHING ELSE: _____ (SKIP TO Q38)
DON'T KNOW (**THANK AND TERMINATE**)
REFUSED (**THANK AND TERMINATE**)

IF HOTEL/MOTEL SHUTTLE, ASK:

24. Did you stay overnight at that hotel, or did you visit the hotel only for the purpose of getting to the airport?

    STAYED OVERNIGHT (SKIP TO Q38)
    ONLY VISITED TO GET TO AIRPORT (CONTINUE)

    IF SOLELY TO GET TO AIRPORT, ASK:

    25. Did you park at the hotel, or did you get there some other way?

        PARKED (CONTINUE)
        OTHER WAY (SKIP TO Q38)
        VOLUNTEERED PARKED NEAR HOTEL (CONTINUE)
        DON'T KNOW (SKIP TO Q38)
        REFUSED (SKIP TO Q38)

        IF PARKED AT HOTEL OR VOLUNTEERED PARKED NEAR HOTEL, ASK:

        26. Were any passengers dropped off at the curb in front of the terminal before the car was parked?

            SKIP TO Q38.

IF PRIVATE VEHICLE OR RENTAL VEHICLE ASK:

27. Were any passengers dropped off at the curb in front of the terminal (before returning the rental car)?

YES (CONTINUE)
NO (SKIP TO Q38)
DON'T KNOW (SKIP TO Q38)
REFUSED (SKIP TO Q38)

28. And was the vehicle driven away without being parked, parked for a while and then driven away, or parked for the duration of your trip?

DRIVEN AWAY (SKIP TO Q38)
PARKED AND THEN DRIVEN AWAY (CONTINUE)
PARKED FOR DURATION OF TRIP (CONTINUE)

IF PARKED, ASK:

29. At what location was the vehicle parked?

OAKLAND

HOURLY/SHORT-TERM LOT AT THE AIRPORT
DAILY/LONG-TERM LOT (A OR B) AT THE AIRPORT
ECONOMY LOT AT THE AIRPORT
VALET PARKING AT THE AIRPORT
OFF-AIRPORT LOT
HOTEL/MOTEL PARKING LOT
AIRPORT EMPLOYEE LOT
OTHER: _____

SAN FRANCISCO

DOMESTIC TERMINAL GARAGE AT THE AIRPORT
INTERNATIONAL TERMINAL GARAGE AT THE AIRPORT
LONG-TERM GARAGE AT THE AIRPORT
VALET PARKING AT THE AIRPORT
OFF-AIRPORT LOT OR GARAGE: _____
HOTEL/MOTEL PARKING LOT OR GARAGE
AIRPORT EMPLOYEE LOT
OTHER: _____

30. And how long (was it) (will it be) parked there?

LESS THAN A DAY: ____ ____ HOURS
DAYS: ___ ___ ROUND TO NEAREST NUMBER OF DAYS

SKIP TO Q38.

IF BART OR AIRBART FROM BART, ASK:

31. At what station did you begin your trip on BART?

LIST OF STATIONS.

32. And how did you get to that station? ACCEPT MULTIPLE RESPONSES. (IF BART, RETURN TO QUESTION 31 AND ASK, "What I am looking for is the very first station where you got on BART for your trip to the airport today.")

WALKED
DROVE AND PARKED
DROPPED OFF
TAXI/CAB
AMTRAK (SKIP TO Q33)
BART
CALTRAIN (SKIP TO Q33)
OTHER PUBLIC TRANSIT
OTHER: _____

SKIP TO Q38.

IF AMTRAK/CALTRAIN/AIRBART FROM AMTRAK, SAY (IN Q23):

33. At what station did you begin your trip on (Amtrak) (Caltrain)?

LIST OF STATIONS.

34. And how did you get to that station? ACCEPT MULTIPLE RESPONSES. (IF AMTRAK OR CALTRAIN, RETURN TO QUESTION 33 AND ASK, “What I am looking for is the very first station where you got on (AMTRAK)(CALTRAIN) for your trip to the airport today.”)

WALKED
DROVE AND PARKED
DROPPED OFF
TAXI/CAB
AMTRAK
BART
CALTRAIN
OTHER PUBLIC TRANSIT
OTHER: _____

SKIP TO Q38.

IF SCHEDULED AIRPORT BUS, SAY:

35. Where did you begin your trip on the airport bus?

LIST OF LOCATIONS

36. And how did you get to that location? ACCEPT MULTIPLE RESPONSES.

WALKED
DROVE AND PARKED
DROPPED OFF
TAXI/CAB

OTHER PUBLIC TRANSIT: _____
OTHER: _____

SKIP TO Q38.

IF PUBLIC BUS (AC TRANSIT, SAMTRANS), SAY:

37. How did you get to the stop where you first got on the (AC Transit) (SamTrans) bus? ACCEPT MULTIPLE RESPONSES.

WALKED
DROVE AND PARKED
DROPPED OFF
TAXI/CAB
BART
CALTRAIN
OTHER PUBLIC TRANSIT: _____
OTHER: _____

38. What were the **most important** sources of information you used to decide how to get to the airport today? SHOW CARD. CODE UP TO FIRST THREE SOURCES.

AIRPORT WEB SITE
OTHER WEB SITE (And what was that Web site?): _____
AIRPORT INFORMATION BROCHURE, DISPLAY, OR PHONE NUMBER
TRAVEL AGENT
TRAVEL GUIDE (And what was that travel guide?): _____
HOTEL STAFF
511 TRANSIT INFORMATION (PHONE 511, 817-1717, OR 511.ORG)
511 HIGHWAY TRAFFIC INFORMATION (PHONE 511, 817-1717, OR 511.ORG)
OTHER HIGHWAY TRAFFIC INFORMATION (RADIO, TELEVISION, NEWSPAPER)
PUBLIC OR PRIVATE TRANSPORTATION OPERATOR BROCHURE, DISPLAY, OR PHONE NUMBER
FAMILY/FRIENDS/BUSINESS ASSOCIATES
OTHER: _____
NONE/ALREADY FAMILIAR WITH

39. And what are the **main reasons** you decided to get to the airport the way you did? CODE UP TO FIRST THREE REASONS.

COMFORT
CONVENIENCE (PROBE FOR REASON)
DEPENDABILITY
LUGGAGE (AMOUNT)
NO PRIVATE VEHICLE AVAILABLE
NO PUBLIC TRANSIT AVAILABLE
NUMBER OF PEOPLE IN TRAVEL PARTY
PARKING CONSIDERATIONS
PRICE/COST
RETURN RENTAL CAR

SAFETY OR SECURITY CONCERNS
SOMEONE ELSE DECIDED
TRAVEL TIME/TIME
OTHER: _____

ASK Q40 IF MORE THAN ONE PERSON IN TRAVEL PARTY:

40. Including yourself, how many people in your travel party came to the airport in the same vehicle as you? (IF NEEDED: By travel party, I mean all of the people who are traveling together with you on the same flight today.)

ASK Q41 IF ONE PERSON IN TRAVEL PARTY (Q3) OR IN VEHICLE (Q40):

41. How many pieces of luggage did you check today? RANGE CHECK FOR >3.

ASK Q42 IF MORE THAN ONE PERSON IN Q40:

42. How many total pieces of luggage did these people check - that is, the people who arrived here in the same vehicle? RANGE CHECK FOR >3/PERSON.

ASK Q43 OF CONVENTION/CONFERENCE/BUSINESS/OTHER PURPOSE TRAVELERS ONLY.

43. Will any of the cost of your trip to the airport (including parking) be reimbursed by your employer, by a client, or by some other organization? (BEING REIMBURSED BY FAMILY, FRIENDS, OR COLLEAGUES DOES NOT COUNT.)

YES
NO
NOT SURE

44. Are you a resident of this area who is **starting** an air trip here today, or are you a visitor from another area who is taking an air trip to **get home or travel to some other destination?**

RESIDENT (CONTINUE)
VISITOR (SKIP TO Q49)
DON'T KNOW/REFUSED—THANK AND TERMINATE

ASK Q45 THROUGH Q48 OF RESIDENTS. VISITORS SKIP TO Q49.

45. How many nights will you be away from home on this trip?

46. And what airport will you fly back into?

OAKLAND (CONTINUE)
SACRAMENTO (CONTINUE)
SAN FRANCISCO (CONTINUE)
SAN JOSE (CONTINUE)
OTHER: _____ (CONTINUE)
NOT SURE YET (SKIP TO Q53)
NOT RETURNING BY AIR (SKIP TO Q53)

ASK Q47 AND 48 IF RETURNING BY AIR.

47. About what time will your return flight arrive? ____ ____ : ____ ____ AM PM (LOOK AT TICKET IF UNSURE)

48. How are you planning to get to your local destination when you get back? ACCEPT MULTIPLE RESPONSES.

PICKED UP BY SOMEONE IN A PRIVATE VEHICLE
PRIVATE VEHICLE PARKED AT AIRPORT OR NEARBY
AIRBART SHUTTLE BUS
BART
CHARTERED BUS OR VAN
HOTEL/MOTEL COURTESY SHUTTLE
LIMOUSINE
PUBLIC TRANSIT BUS (AC TRANSIT, MUNI, SAMTRANS, VTA, ETC.)
PUBLIC TRANSIT LIGHT RAIL (MUNI, VTA)
RENTAL CAR
SCHEDULED AIRPORT BUS
SHARED RIDE VAN
TAXI/CAB
TRAIN (CALTRAIN, AMTRAK)
OTHER: _____
NOT SURE

SKIP TO Q53.

49. What day did you arrive in the Bay Area? CALENDAR IS DISPLAYED.

MONTH ___ ___
DATE ___ ___

50. And what airport did you fly into?

OAKLAND (CONTINUE)
SACRAMENTO (CONTINUE)
SAN FRANCISCO (CONTINUE)
SAN JOSE (CONTINUE)
DON'T RECALL (SKIP TO Q53)
OTHER: _____ (CONTINUE)
DID NOT ARRIVE BY AIR (SKIP TO Q53)

ASK Q51 AND Q52 IF ARRIVED BY AIR.

51. About what time did your flight arrive? (LOOK AT TICKET)

____ ____ : ____ ____ AM PM

52. And how did you get from the airport to your local destination? ACCEPT MULTIPLE RESPONSES.

PICKED UP BY SOMEONE IN A PRIVATE VEHICLE
PRIVATE VEHICLE PARKED AT AIRPORT OR NEARBY
RENTAL CAR
AIRBART SHUTTLE BUS
BART

CHARTERED BUS OR VAN
HOTEL/MOTEL COURTESY SHUTTLE
LIMOUSINE
PUBLIC TRANSIT BUS (AC TRANSIT, MUNI, SAMTRANS, VTA, ETC.)
PUBLIC TRANSIT LIGHT RAIL (MUNI, VTA)
SCHEDULED AIRPORT BUS
SHARED RIDE VAN
TAXI/CAB
TRAIN (CALTRAIN, AMTRAK)
OTHER: _____
NOT SURE

CONTINUE HERE WITH ALL RESPONDENTS.

53. In the past twelve months, including this trip, how many times have you flown out of _____ Airport? How about _____ Airport?

Oakland
Sacramento
San Francisco
San Jose

Now just a couple of questions about you for classification purposes …

ASK Q54 THROUGH Q57 OF VISITORS ONLY.

54. First, do you live in the United States?

YES (CONTINUE)
NO (SKIP TO Q57)
DON'T KNOW/REFUSED (SKIP TO Q60)

IF YES, ASK:

55A. And what is the ZIP code where you live?

55B. What city or town do you live in?

IF ZIP CODE UNKNOWN, ASK:

56. What state do you live in?

SKIP TO Q60.

IF NO, ASK:

57. What country do you live in?

ASK Q58 AND Q59 ONLY OF RESIDENTS WHO DID NOT COME FROM HOME AND ALREADY PROVIDED ZIP CODE/CITY OR TOWN.

58. First, what is the ZIP code where you live? RANGE CHECK FOR NORTHERN CALIFORNIA.

59. And what city or town do you live in?

CONTINUE HERE WITH ALL RESPONDENTS.

60. Including yourself, how many people live in your household? RANGE CHECK FOR 10+.

IF MORE THAN ONE, ASK:

61. And how many of these are children under the age of 18?

62. Which letter on this card corresponds to the total annual income of your entire household last year before taxes? SHOW CARD. ASK FOREIGNERS TO ESTIMATE INCOME IN U.S. DOLLARS.

A. UNDER $25,000
B. $25,000 - $49,999
C. $50,000 - $74,999
D. $75,000 - $99,999
E. $100,000 - $149,999
F. $150,000 - $199,999
G. $200,000 - $299,999
H. $300,000 AND OVER
I. DON'T KNOW
J. REFUSED
ANSWER GIVEN IN ANOTHER CURRENCY

63. Now just in case my supervisor needs to verify something from this interview, could I please have your name or initials and phone number or email address?

NAME OR INITIALS: _____

PHONE: (_____) _____

EMAIL ADDRESS: _____

64. RECORD GENDER

MALE
FEMALE

If you are a **RESIDENT** of the area, please answer Questions 19-20 concerning your return trip.

If you are a **VISITOR** to the area, please answer Questions 21-22.

19. When you return to Atlanta, how will you leave the Airport? *(check one)*

- ☐ Personal Car
- ☐ Rental car
- ☐ Taxi
- ☐ MARTA
- ☐ Limo/executive sedan
- ☐ C-TRAN
- ☐ Hotel courtesy vehicle
- ☐ Commercial shuttle
- ☐ Charter bus
- ☐ Other *(specify)*____________________

20. When you return to Atlanta, will anyone meet you at this Airport?

- ☐ No
- ☐ Yes ▸▸ How many?________*(number of meeters)*
  - ▸▸ Where will they meet you?
    - ☐ Baggage Claim ☐ Gate ☐ Curb
    - ☐ Other (specify)____________________
    - ☐ Exit from people mover trains into Main Terminal ("yellow line")

21. When you arrived at Hartsfield-Jackson Atlanta International Airport, how did you leave the Airport? *(check one)*

- ☐ Personal Car
- ☐ Rental car
- ☐ Taxi
- ☐ MARTA
- ☐ Limo/Executive sedan
- ☐ C-TRAN
- ☐ Hotel courtesy vehicle
- ☐ Commercial shuttle
- ☐ Charter bus
- ☐ Other *(specify)*____________________

22. When you arrived in Atlanta, did anyone meet you at this Airport?

- ☐ No
- ☐ Yes ▸▸ How many?_________*(number of meeters)*
  - ▸▸ Where did they meet you?
    - ☐ Baggage Claim ☐ Gate ☐ Curb
    - ☐ Exit from people mover trains into Main Terminal ("yellow line")
    - ☐ Other (specify)____________________

PLEASE USE THE BACK OF THIS QUESTIONNAIRE FOR YOUR COMMENTS. THANK YOU FOR YOUR HELP.

COMMENTS:

For Surveyor Use Only

☐Resident Airline:__________________

☐Visitor Flight #:__________________

☐Connect/Through

Survey Represents_________passengers (#)

Hartsfield-Jackson
Atlanta International Airport

2005 PASSENGER SURVEY

The City of Atlanta, in cooperation with the airlines serving Hartsfield-Jackson Atlanta International Airport, is conducting a user survey. Your answers to this questionnaire will help the Airport improve its facilities and plan for the future. No personal identification is required. A survey representative will collect your completed questionnaire before you board your aircraft, or you may ask for a postage-paid envelope in which to return your form. For more information, please contact Shelley Lamar at the Department of Aviation at (404) 530-5676. **THANK YOU.**

1. *Including you*, how many people are in <u>your immediate travel party</u> *(i.e., family, friends, and/or business associates)*?

*Number of People:*_____

2. *Including yours*, how many questionnaires are being completed by people in your <u>immediate travel party</u>?

*Number of Questionnaires:*_____

3. Is your immediate travel party associated with a <u>larger travel group</u> *(tour group, sports team, church group, etc.)*?

☐ No ☐ Yes ⏩ How many are in your travel group?_____

⏩ What is the name/nature of your travel group?

_____

4. What is (or was) the <u>MAIN</u> purpose of your trip?

☐ Business (Non-military) ☐ Military
☐ Convention/Conference ☐ Travel to/from School
☐ Vacation/Pleasure ☐ Personal
☐ Visit Friends/Family
☐ Other *(specify)*_____

5. <u>From Atlanta</u>, where are you flying today *(final stop)*?
(If returning to Atlanta later today, consider the 1-way portion of your trip.)

_____
(airport/city) *(state/province)* *(country)*

6. How many nights will you be (or were you) away on this trip?(Enter "0" if returning same day.)

Number of Nights: _____

7a. Which amenities did you use at Hartsfield-Jackson Atlanta International Airport today? *(check all that apply)*

☐ Fast food restaurant ☐ Sit-down restaurant/bar
☐ Newsstand/Giftshop ☐ Bank/ATM
☐ Shoeshine ☐ Airline club
☐ Duty-free shop ☐ Currency exchange
☐ Snack food/coffee counter *(e.g. pretzel, ice cream)*
☐ Specialty retail *(e.g., book store)*
☐ Business services *(fax, Internet)*
☐ Post Office ☐ Other*(specify)*_____

7b. While at this Airport, have you or anyone in your party used (or will use) a:

Cell Phone	Laptop	MP3 / iPod
☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

8. Are you CONNECTING (i.e. changing planes) <u>in Atlanta</u>?

☐ No
☐ Yes, I am connecting <u>in Atlanta</u>

If you checked "<u>NO</u>" in Question #8, please complete the entire survey. If you checked "<u>YES</u>" in Question #8, please STOP here and return form to the survey representative.

9. Where did you start your GROUND TRIP today to Hartsfield-Jackson Atlanta International Airport?

☐ Your home ☐ Someone else's home
☐ A place of business *(specify)*_____
☐ A hotel/motel *(name)*_____
☐ Other *(specify)*_____

10. Where is the place you checked in Question #9?

⏩ City/State:_____Zip Code:_____

⏩ Building/Intersection/Street:_____

_____

11. Where do you live?

☐ Same as Question #10
☐ Another location *(please specify):*

_____
(city) *(state/province)* *(country)*

12. What time did you arrive at Hartsfield-Jackson Atlanta International Airport today?

_____:_____ AM/PM *(please circle one)*

13. How did you travel to Hartsfield-Jackson Atlanta International Airport today?

☐ Personal Car ☐ Rental car
☐ Taxi ☐ MARTA
☐ Limo/Executive sedan ☐ C-TRAN (public bus)
☐ Hotel courtesy vehicle ☐ Commercial shuttle
☐ Charter bus
☐ Other *(specify)*_____

14. If you came by either <u>personal car</u> OR <u>rental car</u>:

⏩ How many people (**including you**) were in the car?

*Number of People:*_____

⏩ How many of these people are traveling by **air today**?

*Number of Air Passengers:*_____

15. If you came by either <u>personal car</u> OR <u>rental car</u>:

Was the car driven (*please check one*):
☐ To the curb, then off-airport
☐ To the curb, then to a parking facility or rental car return
☐ Directly to a parking facility or rental car return

Was the car parked?
☐ No
☐ Yes ⏩ Please indicate the lot that was used:

☐ Hourly Lot ☐ Daily Lot ☐ Gold Lot
☐ West Economy ☐ South Economy ☐ North Econ.
☐ Airport Park-ride Lot ☐ Off-airport Lot

⏩ How long will the car be (or *was the car*) parked?

☐ 0-2 *HOURS* ☐ 3-6 *HOURS* ☐ 7-24 *HOURS*
☐ 1-3 *DAYS* ☐ 4-6 *DAYS* ☐ 7+ *DAYS*

16. Did any well-wishers come to this Airport to see you off?

☐ No
☐ Yes ⏩ How many?_____ (*well-wishers*)

⏩ How far did they accompany you?
☐ Dropped me/us at curb ☐ Ticket counter
☐ Gate ☐ Security
☐ Other_____

17. How many bags did your <u>immediate travel party</u> CHECK and/or CARRY ON?

Number of Checked *Bags:*_____
Number of Carry-on *Items:*_____
Total Items: _____

18. How did you check in for this flight and, if you checked bags, where were they checked?

Check-in Location	Passengers	Bags
On-line	☐	☐
Curb with Skycap	☐	☐
Self-serve Kiosk at Ticket Counter	☐	☐
With Agent at Ticket Counter	☐	☐
Airline Club	☐	☐
At or Near Airport MARTA Station (Delta & AirTran Only)	☐	☐
Other _____	☐	☐

CONTINUED ✈

Finally, about yourself (for classification purposes only)

19. Where is **your home?**

_____ City or town _____ State or country Zip code, if in USA

20. In the last 12 months, how many times have you flown out of each of the following airports, including today?

	Number of flights primarily for business	*Number of flights primarily for leisure*
Logan Airport	_____	_____
Manchester (New Hampshire)	_____	_____
T.F. Green (Providence, RI)	_____	_____
Hanscom Field (Bedford, MA)	_____	_____
Bradley (Hartford/Springfield)	_____	_____

21. Are there any cities **outside the U.S.** not presently served non-stop from Logan to which you would like to see new non-stop service added?

❑ **yes** ❑ **no**

↳ Which city or cities? _____

↳ How many times per year would you use this service? _____

22. In total, counting all children and adults including yourself, how many people live in your household? ☐

23. How many automobiles are available to be used by members of your household? ☐

24. Are you . . . ❑ male? ❑ female?

25. Which of the following categories best describes your age?

❑ Under 25 ❑ 35-44 ❑ 55-64
❑ 25-34 ❑ 45-54 ❑ 65 and over

26. What was the **total combined income** (before taxes) for everyone living in your household for the year 2006? *(Check one only)*

❑ under $30,000 ❑ $90,000 to under $120,000
❑ $30,000 to under $60,000 ❑ $120,000 to under $150,000
❑ $60,000 to under $90,000 ❑ $150,000 or more

Thank you very much for your help. Please hand your completed questionnaire to the survey staff before boarding, or mail it back to us postage-free from anywhere in the United States.

Open out ➡

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT NO. 129 FITCHBURG MA
POSTAGE WILL BE PAID BY ADDRESSEE

RESEARCH RESULTS
PO BOX 2085
FITCHBURG MA 01420-9874

Please tape here

massport

www.massport.com
1-800-23-LOGAN

Logan International Airport
Air Passenger Ground Access Survey, 2007

Please read the instruction sheet provided before completing the survey.

About your trip to the airport for this flight

1. **Which flight are you taking** (or were you taking when given this form)?

_____ airline _____ flight no. on ❑ April ❑ May _____, 2007 date

For the Boston area transportation agencies to improve ground travel options to the airport, it is very important for us to know *exactly* where passengers start their trips to get to the airport. Please **give as much detail as you are able**. The information will be kept confidential.

2. **From what address** did you start your ground trip **today** to come to the airport for this flight?

_____
Building, firm, or specific location name, if applicable (e.g., landmark, company, hotel, institution, etc.)

_____ Street address, with number _____ Name of nearest cross street

_____ City or town _____ State ☐☐ Zip Code

3. Is the place where you started your trip to the airport . . . *(Check one only)*

❑ your own home? ❑ a hotel or motel?
❑ someone else's home? ❑ a school or college?
❑ a place of business? ❑ other: _____

4. **At approximately what time** did you . . .

leave the above starting point? ☐☐ : ☐☐ hour mins. ❑ A.M. ❑ P.M.

arrive inside this airport terminal? ☐☐ : ☐☐ hour mins. ❑ A.M. ❑ P.M.

continue inside ➡

5. How did you arrive at the airport **today**? *(Check **one only** to show the form of transport you used to reach the airport or nearby parking or rental car facilities)*

- ❑ **private vehicle** (car, van, SUV, motorcycle, etc.)
- ❑ **rental vehicle**
  - ↳ *which company?* _____

→ *go to* ***question 6***

- ❑ **MBTA subway** (Blue Line to Airport Station)
  - ↳ *at what station did you **begin** your trip?* _____
- ❑ **MBTA Silver Line bus**
  - ↳ *where did you board the Silver Line bus?*
    - ❑ South Station ❑ World Trade Center
    - ❑ Courthouse ❑ Silver Line Way
- ❑ **other MBTA bus**
- ❑ **Logan Express bus** from (*check one*)
  - ↳ ❑ Braintree ❑ Framingham ❑ Woburn ❑ Peabody
- ❑ **other scheduled bus service**
  - ↳ *which operator?* _____
- ❑ **charter bus**
- ❑ **airport water shuttle/water taxi**

→ *skip to* ***question 8***

- ❑ **taxicab**
- ❑ **courtesy shuttle** (hotel, school, hospital, etc.)
- ❑ **van or limo** running on a fixed route and schedule
- ❑ **van or limo** that picked me up by reservation

→ *skip to* ***question 9***

- ❑ **other** (*specify:* _____)
  If you're not sure which box to check, write name of carrier here

→ *skip to* ***question 10***

6. If you came by a private or rental vehicle, were you or any passengers dropped off **at the curb** near a terminal entrance?

❑ **yes** ❑ **no**

↳ Including you, how many persons were dropped off? (*write in*) _____

7. If you came by private vehicle, was it . . . *(Check one only)*

- ❑ driven away from the airport by someone **without being parked**?
- ❑ **parked** in the **Central Parking Garage** at the airport?
- ❑ **parked** in the **Terminal B Garage** at the airport?
- ❑ **parked** in an **Economy Parking lot** at the airport?
- ❑ **parked** in a lot or garage **off the airport grounds**?

For **how long** do you expect it to be parked? *(Check one only)*

- ❑ 1 hour or less
- ❑ between 1 and 2 hours
- ❑ between 2 and 4 hours
- ❑ between 4 and 7 hours
- ❑ between 7 and 24 hours
- ❑ longer: _____ days

open and continue inside →

8. If you came to the airport by subway, bus, or water shuttle, **how did you get to the place where you boarded** that vehicle? *(Check all that apply)*

- ❑ walked
- ❑ drove and parked
- ❑ dropped off by private vehicle
- ❑ taxicab
- ❑ subway
- ❑ commuter rail
- ❑ bus
- ❑ other: _____

9. If you came to the airport by taxi, shuttle, van, or limo, how many passengers in total were in the vehicle when it arrived at the airport?

Total number of passengers: _____ ❑ I don't remember

If a van or limo, what was the name of the service? _____

10. For what proportion of your trips to fly from Logan have you used the Silver Line since it first opened in June of 2005?

- ❑ over 75%
- ❑ 50% - 75%
- ❑ 25% - 49%
- ❑ Less than 25%
- ❑ none

↳ What mode did you *most often* use before June of 2005? (*Check one only*)

- ❑ private vehicle
- ❑ rental vehicle
- ❑ taxicab
- ❑ van or limo on a fixed schedule
- ❑ van or limo going door-to-door
- ❑ courtesy shuttle
- ❑ water shuttle/water taxi
- ❑ MBTA subway
- ❑ MBTA bus
- ❑ Logan Express (*check one*)
  - ❑ Braintree ❑ Framingham ❑ Woburn ❑ Peabody
- ❑ other scheduled bus
- ❑ other: _____

11. If the means of travel you used to get to the airport today were *not available*, how would you have arrived at the airport instead?

- ❑ private vehicle
- ❑ rental vehicle
- ❑ taxicab
- ❑ van or limo on a fixed schedule
- ❑ van or limo going door-to-door
- ❑ courtesy shuttle
- ❑ water shuttle/water taxi
- ❑ MBTA subway
- ❑ MBTA Silver Line bus
- ❑ other MBTA bus
- ❑ Logan Express (*check one*)
  - ❑ Braintree ❑ Framingham ❑ Woburn ❑ Peabody
- ❑ other scheduled bus
- ❑ other: _____

12. Will your ground transportation to the airport or your parking cost **be reimbursed** by your employer or other organization? *(Don't count payment by a friend or relative.)*

- ❑ **yes**, some or all of the costs will be paid back to me
- ❑ **no**, my costs will not be reimbursed

13. How many people have come into the terminal just to see you (and other members of your travel party) off?

Enter the number (if none, enter zero): _____

About your air travel today

14. Is your air travel today primarily **part of a business trip?**

❑ **yes** ❑ **no**

15. What will be your **final destination airport** on today's air trip?

_____ (airport) _____ (U.S. state or foreign country)

16. In total, how many people **in your personal travel party** came to the airport in the same vehicle and are traveling on the same flight with you? (***Don't forget to count yourself.*** *If none in a category, enter "0"*)

number of people aged 17 or under: _____

number of people aged 18 or over, **including you**: _____

How many of the people aged 18 or over are filling out a questionnaire of their own, **including you?** _____

17. In total, how many **pieces of luggage** are all the people you counted in Question 16 taking on this flight? (*If none, enter zero*)

total number of pieces of luggage *checked*: _____

total number of *carry-on* pieces: _____

18. Is Logan Airport at **the "home" end of your air trip?**

❑ yes

↳ When will you return to Logan?

- ❑ today
- ❑ tomorrow
- ☐☐ days from now

What time of day will your return flight arrive at Logan?

☐☐ (hour) : ☐☐ (mins.) ❑ A.M. ❑ P.M.

How do you expect to travel from the airport when you return? (*Check all that apply*)

- ❑ picked up by someone else
- ❑ private vehicle parked at airport
- ❑ rental vehicle
- ❑ taxicab
- ❑ courtesy shuttle
- ❑ van/limo on fixed route/schedule
- ❑ van/limo picking me up by request
- ❑ subway
- ❑ MBTA Silver Line bus
- ❑ Logan Express bus
- ❑ other scheduled bus
- ❑ charter bus
- ❑ water shuttle/water taxi
- ❑ some other way, or not sure

❑ no

↳ When did you arrive at Logan?

- ❑ today
- ❑ yesterday
- ☐☐ days ago

What time of day did your flight arrive at Logan Airport?

☐☐ (hour) : ☐☐ (mins.) ❑ A.M. ❑ P.M.

How did you travel from the airport when you arrived? (*Check all that apply*)

- ❑ picked up by someone else
- ❑ private vehicle parked at airport
- ❑ rental vehicle
- ❑ taxicab
- ❑ courtesy shuttle
- ❑ van/limo on fixed route/schedule
- ❑ van/limo picking me up by request
- ❑ subway
- ❑ MBTA Silver Line bus
- ❑ Logan Express bus
- ❑ other scheduled bus
- ❑ charter bus
- ❑ water shuttle/water taxi
- ❑ some other way, or not sure

fold in and continue →

ROANOKE REGIONAL AIRPORT 2005 PASSENGER SURVEY

The Roanoke Regional Airport Commission is updating the master plan for the Airport. By taking a few moments to complete this questionnaire, you will help us plan for the Airport's future. No identification is required. Thank you for your help.

1. Including you, how many people are in your immediate travel party *(i.e., family, friends, and/or business associates)*?

_____ *(number of people)*

2. Where did you begin your ground trip for this flight to Roanoke Regional Airport today?

☐ Your home ☐ Someone else's home
☐ A place of business ☐ A hotel/motel
☐ Other *(specify)*_____

3. What is the location of the place checked in Question #2?

Zip Code:_____City/State:_____

OR Building/Intersection/Address:_____

_____

4. Where is your home?

☐ Same as Question #3
☐ Another location *(please specify):*

_____
(city/county) (state/province) (country) (postal code)

5. How did you travel to Roanoke Regional Airport today?

☐ Personal/Company car ☐ Taxi
☐ Rental car ☐ Limousine/Executive sedan
☐ Hotel courtesy vehicle ☐ Smart Way bus (Public Transit)
☐ Other *(specify)*_____

6. If you came by either personal/company car OR rental car:

✈ Including you, how many **air passengers** were in the car?

_____ *(number of air passengers)*

✈ Was the car driven (*please check one*):
☐ To the curb, then off-airport
☐ To the curb, then to a parking facility or rental car return
☐ Directly to a parking facility or rental car return

✈ If the car was parked, where is/was the car parked?
☐ Short Term (Hourly) ☐ Long Term ☐ Rental Car Lot

✈ If the car was parked, how long was it (*will it be*) parked?
☐ Less than 1 hour ☐ 5-24 hours
☐ 1-4 hours ☐ More than 24 hours

7. At what time did you arrive at Roanoke Regional Airport today?

_____:_____ **AM / PM** *(please circle one.)*

8. Did any well-wishers come to the Airport to see you off?

☐ No
☐ Yes ⏩How many?_____ (*well-wishers*)
⏩Where did you say goodbye?
☐ Curb ☐ Ticket counter ☐ Security
☐ Gate ☐ Other_____

9. How many carry-ons and checked bags is your immediate travel party taking on this flight?

_____ Carry ons *(Enter '0' if none.)*

_____ Checked bags *(Enter '0' if none.)*

10. Where did YOU check in for this flight AND, if applicable, where did you check your BAGS?

Check-in Location	Passengers	Bags
On-line	☐	☐
Self-serve kiosk at ticket counter	☐	☐
Agent at ticket counter	☐	☐
Other _____ *(specify)*	☐	_____ *(specify)* ☐

11. Which amenities did (or will) you visit at Roanoke Regional Airport today? *(Check all that apply.)*

☐ Restaurant ☐ Bar/lounge ☐ Snack bar
☐ Vending machine ☐ News/gift shop ☐ Shoeshine
☐ ATM ☐Other *(specify)* _____

12. List any amenities you looked for but could not find:

a. _____
b. _____
c. _____

13. What is (or was) the MAIN purpose of your trip (*Check one*)?

☐ Business ☐ Convention/Conference
☐ Vacation/Pleasure ☐ Personal
☐ Visit Friends/Family ☐ Travel to/from School
☐ Other *(specify)*_____

14. From Roanoke, where are you flying today (*final stop*)?
(If returning to Roanoke later today, consider the 1-way portion of your trip.)

_____
(airport/city) (state/province) (country)

15. How many nights will you be (or were you) away on this trip?

_____ Nights *(Enter '0' if you are returning the same day.)*

16. If you are a resident of the area, how many people will come into the Airport terminal to meet you when you return from this trip?

_____ People will meet me/us *(Enter '0' if no one will meet you.)*

17. If you were visiting the area, how many people came into the Airport terminal to meet you when you arrived on this trip?

_____ People met me/us *(Enter '0' if no one met you.)*

18. Please select the most important reason for choosing Roanoke Regional Airport for this flight today?

☐ Closest airport ☐ Most convenient flight times
☐ Least expensive airfare ☐ Airport amenities
☐ Other *(specify)*_____

19. Which other airports did you consider for this flight today?

☐ Greensboro (Piedmont Triad Int'l) ☐ Charlotte Douglas Int'l
☐ Raleigh/Durham Int'l ☐ Richmond Int'l I
☐ Lynchburg Regional ☐ Washington Dulles Int'l
☐ Wash. Reagan Nat'l ☐ Tri-Cities Reg'l
☐ Other *(specify)*_____

PLEASE USE THE BACK OF THIS QUESTIONNAIRE FOR YOUR COMMENTS. THANK YOU FOR YOUR HELP.

C. ABOUT YOUR AIRPORT CHOICE

1. Please rank the three most important reasons for choosing Ronald Reagan Washington National Airport for your flight today.
(Please write #1, #2 or #3 in the appropriate spaces.)

_____ Closest airport
_____ Easy road access
_____ Convenient limo, bus, or rail service
_____ Good parking facilities
_____ More convenient flight times
_____ Less expensive airfare
_____ Only airport with nonstop flights
_____ Only airport that serves market
_____ Frequent flyer specific airline
_____ Other
(Specify) _____

2. If you could have arranged the airline schedule for your trip today, which airport would you have PREFERRED to use ? *(Please circle ONE answer)*

a. Baltimore/Washington International Thurgood Marshall
b. Washington Dulles International
c. Ronald Reagan Washington National
d. No preference.

3. Please indicate which other airport(s) you considered using today. *(Please circle ALL answers that apply.)*

a. Baltimore/Washington International Thurgood Marshall
b. Washington Dulles International
c. Other airport
(Specify) _____
d. Did not consider another airport

4. During the last twelve months, how many flights did you make from each of the following airports ? *(Please write a number in the appropriate spaces. Count today's trip as one flight.)*

_____ Baltimore/Washington International Thurgood Marshall
_____ Washington Dulles International
_____ Ronald Reagan Washington National

D. ABOUT YOURSELF

1. Please indicate the location of your current residence:

_____
City/County State Zip Code Country

2. How many people live in your household ?

_____ People *(Enter '1' if you live alone.)*

3. Please circle your age bracket:

a. 18 or younger
b. 19–24
c. 25-34
d. 35–49
e. 50-64
f. 65 or older

4. Please circle the answer that approximates the TOTAL household annual income of all persons in your HOUSEHOLD:

a. Less than $15,000
b. $15,000-24,999
c. $25,000-44,999
d. $45,000-79,999
e. $80,000-119,999
f. $120,000-159,999
g. $160,000-199,999
h. $200,000 or more

If you were visiting the Washington-Baltimore area Please answer Questions #5 and #6, then proceed directly to section E.

5. How many nights did you stay in the area ?

_____ Nights *(Enter '0' if you are leaving the same day you arrived.)*

6. Approximately how much did you spend PER DAY while you were in the area ? *(Include expenses which are meals, hotels, rental cars, etc. Do not include airfare. Please circle ONE answer.)*

a. Less than $100
b. $100-199
c. $200-299
d. $300-399
e. $400-499
f. $500-749
g. $750-999
h. $1,000 or more

7. How many nights will you spend away on this trip ?

_____ Nights *(Enter '0' if you are returning today.)*

8. How many vehicles are usually available for use at your residence ?

_____ Vehicles *(Enter '0' if no vehicles are available.)*

E. PLEASE WRITE ANY COMMENTS YOU MAY WISH TO BRING TO OUR ATTENTION BELOW

Again, Thanks For Your Help!

D –

2007 WASHINGTON–BALTIMORE REGIONAL AIR PASSENGER SURVEY

TO DETERMINE LOCAL AIRPORT NEEDS

DCA

This survey is being conducted by:
Metropolitan Washington Council of Governments
Metropolitan Washington Airports Authority
Maryland Aviation Administration
in cooperation with the airlines serving the region's airports.

This survey concerns your trip today.
Please complete this form, even if you have received a form on other days.

All answers are confidential.
Personal identification is not required.
Thank you for your cooperation.

A. ABOUT YOUR TRIP TODAY

1. How did you get to Ronald Reagan Washington National Airport for this trip ?
(Please circle ONE answer.)

a. I came to this airport by GROUND TRANSPORTATION *(e.g. auto, taxi, Metro, etc.)*
(Please proceed directly to QUESTION #2.)

b. I was on this flight when it arrived at this airport.
(STOP. That is all the information we need.)

c. I made a connection at this airport from a DOMESTIC FLIGHT with _____ Airlines. *(Please fill in the name of the airline and STOP. That is all we need to know.)*

d. I made a connection at this airport from an INTERNATIONAL FLIGHT with _____ Airlines *(Please fill in the name of the airline and STOP. That is all we need to know.)*

If you arrived at this airport by GROUND TRANSPORTATION, please complete the rest of this survey.

2. What is the destination of your trip today ?

_____ _____
Airport City

_____ _____
State/Province Country

3. What type of trip is this ?
(Please circle the answer for the main purpose of your travel).

a. Business related to the federal government *(Including military)*
b. Business related to state or local government
c. Business that is not related to government
d. Vacation
e. Personal or family affairs
f. Student or school related
g. Other purpose
(Specify) _____

4. How did you purchase your ticket for this trip?
(Please circle ONE answer)

a. Ticket Counter
b. Internet
c. Telephone
d. Travel Agent
e. Corporate Office

B. ABOUT YOUR GROUND TRIP TO RONALD REAGAN WASHINGTON NATIONAL AIRPORT:

1. Where did you start your ground trip to Ronald Reagan Washington National Airport ?
(Please circle ONE answer.)

a. Private residence
b. Hotel/Motel
c. My regular place of employment
d. Another place of business
e. Other _____ (Specify)

2. What is the address of the place above ?
(If you prefer to provide a less specific geographic location, please indicate the nearest intersection, or building name.)

_____
Street Number | Street Name | City Quadrant (e.g. SW, NE)

_____
City | State | Zip Code

3. What time did you begin your trip to the airport today? *(Enter time and circle AM or PM)*

_____ : _____ AM PM

4. What time did you arrive at the airport today ?
(Enter time and circle AM or PM)

_____ : _____ AM PM

5. Did any member of your household, friends, or business associates travel to the airport with you ?

a. No
b. Yes
   1. How many ? _____
   2. Of this group, how many came to board a plane?_____

6. How many checked-in bags on this flight are yours ? *(Enter '0' if no bags were checked.)*_____

7. What was your primary means of transportation to this airport?
(Please circle ONE answer)

a. Private Car
b. Rented Car
c. Taxi
d. Airport bus/van/limo
e. Other (Specify) _____
f. Metrorail (National)
g. Amtrak/MARC (BWI)
h. Light Rail (BWI)
i. Hotel/Motel courtesy bus

8. If you arrived in a private vehicle (excluding rental cars):

a. Were you dropped off at terminal curbside ?

Yes _____ No _____

b. Where was that vehicle parked (either directly or after dropping you off) ?

1. It was not parked
2. Short term/hourly - parking lot.
3. Long term/daily parking garage
4. Long term/satellite parking lot.

For How Long

a. For a few hours or less
b. Until you return from this trip.

APPENDIX G

Sample Questionnaires for Groundside Surveys

Forms for Toronto Pearson International Airport Groundside Survey 2005

The forms in this appendix have been included with the permission of the Greater Toronto Airports Authority. They include observation and interview forms for the vehicle/passenger survey used during the 2005 Groundside Survey. The observation forms are provided here for completeness, although observation surveys at airports are not within the scope of this guidebook.

Each form was accompanied by a page of notes. These notes were affixed to the back of each clipboard for handy reference by the interviewer/surveyor.

Table G-1 lists the groundside area associated with each form.

Table G-1. Groundside interview forms and locations.

Form Designation	Associated Area
CI—Curbside interview CA—Curbside activity	All curb areas including taxi queues, bus stops, and public areas, both arrivals and departures
PI1—Parking interview at the ticket spitter	Entrance to the parking lots of Terminal 2 (demolished since 2005) and Terminal 3
PI2—Parking interview for "pay on foot" machines	The two main payment machine areas at Terminal 1
RI—Rental car interview	Drop-off and pick-up areas
II—Inter-terminal bus interview	Shuttle bus service between terminals

Source: Cripwell, J.P., *Survey Design Report, 2005 Ground Transportation Survey*, Toronto Pearson International Airport, June 2005.

GTAA

Greater Toronto Airports Authority
Curbside Interviews

													C	I
1. Interviewer Initials				2. Station No.					3. Interview No.					
4. Date	2	0	0	5	0	6			5. Time (24h clock)	H	H	M	M	

6. Type of Vehicle

1-Private Vehicle		6-Local Bus (TTC, MT)		9-Remote Parking		13-Other Coach	
2-Taxi		7-Pacific Western Bus - Downtown		10 – Rental Courtesy		14-Truck	
3-Limo		8-Hotel Courtesy		12-Out of Town Service – Small		15-Other	
5-TTC Route 192							

7. No. of occupants (including the driver)

We are conducting an interview survey of the groundside facilities today at Pearson International Airport. Please help us by answering a few short questions about your trip to the airport today. This information will be used for statistical purposes only.

8. Have you been interviewed during this trip to the airport today?
Yes or No (If Yes then the interview is complete.)

9. Where did you begin your vehicle trip to the airport today?

Postal Code
Address, Municipality
Intersection, Municipality
Landmark, Hotel
Municipality

10. What type of establishment is at this location?

1-Residence		3-Hotel/Motel	
2-Business		4-Other	

11. What is the main purpose of your trip to the airport today?

1-To meet an air passenger (Go to A)		5-Dropping bags for a later flight (Go to B)	
2-To send-off an air passenger (Go to B)		6-Business at the airport (Survey complete)	
3-You will be an air passenger (Go to B)		7-Sightseeing (Survey complete)	
4-You were an air passenger (Go to A)		8-Other Specify_____ (Survey complete)	

A **Arriving Air Passengers**	**B** **Departing Air Passengers**
12. Did you also park at the airport before coming to the curb? Yes/No	12. Will you also park at the airport? Yes/No
13. How many air passengers will leave the airport in this vehicle?	13. How many air passengers came to the airport in this vehicle?
14. How many bags did you check?	14. How many bags will you check?
15. At what city or airport did this air journey begin?	15. At what city or airport will this air journey end?
16. Which airline was used?	16. Which airline will be used?
17. What time did the flight arrive?	17. What time will the flight depart?
18. Are the air passengers returning home?	18. Are the air passengers leaving from home?

19. What was/is the main purpose of this air journey?

1-Business		3-Personal Business	
2-Pleasure		4-Other: Specify	

20. How many days were you away, or will you be away?

21. Survey Result

C-Complete		I-Incomplete		L-Language		R-Refusal	

22. Comments:

Greater Toronto Airports Authority
Curbside Activity Survey

Observer Initials | Station | Section | Date 2 0 0 5 0 6 | Page C A

Time In (24 hr. clock)	Vehicle Type	Lane	A	Load/ Unload	Bags	Time Out (24 hr. clock)	B	Remarks Codes	Comments
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			
H H M M S S						H H M M S S			

1	Car, including minivans	6	Transit bus – TTC, MT	11	Inter-Terminal Bus
2	Taxi	7	Pacific Western – Downtown Bus Only	12	Small Out-of-Town Bus Services
3	Limo	8	Hotel Minibus & Courtesy Vehicles	13	Coach
4	Rental Cars – Do Not Use	9	Remote Parking Minibus & Courtesy Vehicles	14	Truck – delivery
5	TTC Route 192 Only	10	Rental Courtesy Vehicles	15	Other

1	Driver went into terminal	5	Delivery or service vehicle
2	Told to leave by Traffic Control	6	Interviewed
3	Unloaded at one point, loaded at another	7	Outside Zone
4	Asked information	8	Given a ticket

A – No. of occupants as the vehicle stops or number getting off a bus

B – No. of occupants as the vehicle leaves or number getting on a bus

GTAA

Greater Toronto Airports Authority
Terminal 1 Parking Interviews

P I 1

1. Interviewer Initials				2. Station No.					3. Interview No.			P	I	1	
4. Date	2	0	0	5	0	6			5. Time (24h clock)	H	H	M	M		

6. Type of Vehicle

1- Private Vehicle	X

7. Parking Ticket Number | | | : | | | | | | | | | | |

We are conducting an interview survey of the groundside facilities today at Pearson International Airport. Please help us by answering a few short questions about your trip to the airport today. This information will be used for statistical purposes only.

8. Have you been interviewed during this trip to the airport today? Yes or No (Y/N) (If Yes then the interview is complete.)

9. No. of occupants (including the driver)

10. What is the main purpose of your trip to the airport today?

1-To meet an air passenger (Go to A)		5–Dropping off bags for later flight (Go to B)	
2-To send-off an air passenger (Go to B)		6-Business at the airport (Survey complete)	
		7-Sightseeing (Survey complete)	
4-You were an air passenger (Go to A)		8-Other Specify_____ (Survey complete)	

A **Arriving Air Passengers**	**B** **Departing Air Passengers**
11. Will you also use the curb area to pick up your passengers today? Yes/No/Don't Know	11. Did you also use the curb area to drop passengers before parking? Yes/No
12. How many air passengers will leave the airport in this vehicle?	12. How many air passengers came to the airport in this vehicle?
13. How many bags were checked	13. How many bags did they check?
14. At what city or airport did this air journey begin?	14. At what city or airport will their air journey end?
15. Which airline is being used?	15. Which airline was used?
16. What time did the flight arrive?	16. What time will the flight depart?
17. Where will you end your vehicle trip from the airport today? Postal Code, Address, Municipality, Intersection, Municipality, Landmark, Hotel Municipality	17. Where did you begin your vehicle trip to the airport today?

18. What type of establishment is at this location?

1-Residence		3-Hotel/Motel	
2-Business		4-Other	

19. Are the air passengers returning home?	19. Are the air passengers leaving from home?

20. What was/is the main purpose of this air journey?

1-Business		3-Personal Business	
2-Pleasure		4-Other: Specify	

21. How many days were you away, or will you be away?

22. Would you use a Curbside Valet Parking Service, if offered?

23. Survey Result

C-Complete		I-Incomplete		L-Language		R-Refusal	

Comments:

GTAA

Greater Toronto Airports Authority
Terminals 2 and 3 Parking Lot Interviews

P I 2

1. Interviewer Initials				2. Station No.						3. Interview No.										
4. Date	2	0	0	5	0	6			5. Time (24h clock)							H	H	M	M	

6. Type of Vehicle

1-Private Vehicle	X

7. Parking Ticket No.

8. No. of occupants (including the driver)

We are conducting an interview survey of the groundside facilities today at Pearson International Airport. Please help us by answering a few short questions about your trip to the airport today. This information will be used for statistical purposes only.

9. Have you been interviewed during this trip to the airport today?
Yes or No (If Yes then the interview is complete.)

10. Where did you begin your vehicle trip to the airport today?

Postal Code
Address, Municipality
Intersection, Municipality
Landmark, Hotel
Municipality

11. What type of establishment is at this location?

1-Residence		3-Hotel/Motel	
2-Business		4-Other	

12. What is the main purpose of your trip to the airport today?

1-To meet an air passenger (Go to A)		5-Dropping bags for a later flight (Go to B)	
2-To send-off an air passenger (Go to B)		6-Business at the airport (Survey complete)	
3-You will be an air passenger (Go to B)		7-Sightseeing (Survey complete)	
		8-Other Specify_____ (Survey complete)	

A **Arriving Air Passengers**	**B** **Departing Air Passengers**
13. Will you also use the curb area to pick up your passengers today? Yes/No/Don't Know	13. Did you also use the curb area to drop passengers before parking? Yes/No
14. How many air passengers will leave the airport in this vehicle?	14. How many air passengers came to the airport in this vehicle?
15. How many bags did they check?	15. How many bags will you check?
16. At what city or airport did this air journey begin?	16. At what city or airport will this air journey end?
17. Which airline was used?	17. Which airline will be used?
18. What time will the flight arrive?	18. What time will the flight depart?
19. Are the air passengers returning home?	19. Are the air passengers leaving from home?

20. What was/is the main purpose of this air journey?

1-Business		3-Personal Business	
2-Pleasure		4-Other: Specify The	

21. How many days were you away, or will you be away?

22. Would you use a Curbside Valet Parking Service, if offered?

23. Survey Result

C-Complete		I-Incomplete		L-Language		R-Refusal	

Comments:

GTAA

Greater Toronto Airports Authority
Rental Parking Interviews

													R	I
1. Interviewer Initials				2. Station No.						3. Interview No.				
4. Date	2	0	0	5	0	6			5. Time (24h clock)	H	H	M	M	

6. Type of Vehicle

4-Rental		10-Courtesy Vehicle	

7. No. of occupants (including the driver)

We are conducting an interview survey of the groundside facilities today at Pearson International Airport. Please help us by answering a few short questions about your trip to the airport today. This information will be used for statistical purposes only.

8. Have you been interviewed during this trip to the airport today?
Yes or No (If Yes then the interview is complete.)

9. What is the main purpose of your trip to the airport today?

3-Dropping off rental - you will be an air passenger (Go to B)	
4-Picking up rental - you were an air passenger (Go to A)	
5-Dropping off rental – you will not be an air passenger (interview complete)	
6-Picking up rental – you were not an air passenger (interview complete)	

A **Arriving Air Passengers**	**B** **Departing Air Passengers**
10. How many bags did you check?	10. How many bags will you check?
11. At what city or airport did this air journey begin?	11. At what city or airport will this air journey end?
12. Which airline was used?	12. Which airline will be used?
13. What time did the flight arrive?	13. What time will the flight depart?
14. Where will your vehicle trip end today?	14. Where did your vehicle trip start today?

Postal Code
Address, Municipality
Intersection, Municipality
Landmark, Hotel
Municipality

15. What type of establishment is at this location?

1-Residence		3-Hotel/Motel	
2-Business		4-Other	

16. What was/is the main purpose of this air journey?

1-Business		3-Personal Business	
2-Pleasure		4-Other: Specify The	

17. How many days were you away, or will you be away?

18. Survey Result

C-Complete		I-Incomplete		L-Language		R-Refusal	

Comments:

GTAA

Greater Toronto Airports Authority
Inter-Terminal Bus Interviews

														I	I
1. Interviewer Initials				2. Station No.						3. Interview No.					
4. Date	2	0	0	5	0	6			5. Time (24 h clock)			H	H	M	M

6. Type of Vehicle

11-Inter-Terminal Bus	X

We are conducting an interview survey of the groundside facilities today at Pearson International Airport. Please help us by answering a few short questions about your trip through the airport today. This information will be used for statistical purposes only.

7. Have you been interviewed during this trip to the airport today?
Yes or No (If Yes then the interview is complete.)

8. Including yourself, how many air passengers are there in your party?

9. Boarding Terminal (1,2,3)

10. Disembarking Terminal (1,2,3)

11. What is the main purpose for using the Inter-Terminal Shuttle at the airport today?

1-Connecting air passenger (Complete A and B)	
2-Transfer from arrival terminal to parked vehicle (Complete A Only)	
3-Parked a vehicle and transferring to departure terminal (Complete B Only)	
4-Other	

A **Arrival at Pearson Airport**	**B** **Departure from Pearson Airport**
12. How many bags did you check?	
13. Are the bags with you on the bus? (Y/N)	
14. At what city or airport did this air journey begin?	17. At what city or airport will this air journey end?
15. Which airline was used?	18. Which airline will be used?
16. What time did the flight arrive?	19. What time will the flight depart?

20. What was/is the main purpose of this air journey?

1-Business		3-Personal Business	
2-Pleasure		4-Other: Specify	

21. How many days were you away, or will you be away?

If passengers are connecting the interview is complete.
If passengers are transferring to or from a parking lot then proceed with the final questions.

22. Where did/will your vehicle trip start/end today?

Postal Code
Address, Municipality
Intersection, Municipality
Landmark, Hotel
Municipality

23. What type of establishment is at this location?

1-Residence		3-Hotel/Motel	
2-Business		4-Other	

24. Survey Result

C-Complete		I-Incomplete		L-Language		R-Refusal	

Comments:

GTAA

Greater Toronto Airport Groundside Authority

Check List for Supervisors

Supervisor		Team		Date		
1) Start Shift Report for the day						
2) Check with Drake for changes to personnel for the day						
3) Enter team list on Shift Report, ready for sign-in						
4) Vests ready for team pick-up						
5) Get a supply of envelopes						
a. Team members to complete one on sign-in						
6) Pack bag for the day.						
a. Pencils						
b. Sharpener						
c. Forms – given team composition						
d. Extra Clipboard						
e. Cell phone						
f. Comment cards						
g. Team member envelopes						
7) Update Surveyor Evaluation Forms from previous day's work						
8) Brief team members on new or changed protocols						
9) First part of team to go with assigned Survey Management Team member to start survey – perhaps 10 minutes prior to shift start.						
10) If all members signed-in then take second part of team to start survey.						
11) If members missing.						
a. Inform Drake						
b. Await instructions on incoming new team member.						
c. Adjust team assignments to compensate.						
d. Take remainder of team to start survey.						
e. Standby surveyor will be brought to you – on site.						

GTAA

Greater Toronto Airport Groundside Authority
Supervisor Shift Report - Groundside

Name		Team		Date	
Terminal		Coverage Area			

Surveyors: Interviewers, Observers and Relief

Type	Required	Actual	Type	Required	Actual
CA			PI1		
CA-Relief			PI2		
CI			RI		
			II		

Reasons for difference, if any

Team Member Check In and Check Out

Name	Type	Time In	Time Out	Hours Billed	Interviews or CA Forms	Vest Returned	Initials

Team Totals

Type	Estimated	Actual	Assignment	Estimated	Actual
CA			PI2		
CI			RI		
PI1			II		

Relief schedule comments, interviewers and observers

Survey Form Issues

Survey Conduct Issues

Survey Team Issues

Comments from Travellers

Other Comments, Suggestions

Signature:

Greater Toronto Airports Authority
Surveyor Evaluation Form

Supervisor:_____
Date:_____

Surveyor Name:_____

- Completes all relevant survey header information – initials, numbers, station, and date
- Chooses respondents accordingly – finding new vehicles and groups as quickly as possible after completing an interview
- Conveys invitation for the survey in a complete and cordial fashion
- Corresponds with interviewees politely
- Considers appropriateness of answers and probes for further completeness or clarification and where necessary gives examples.
- Has thorough knowledge of the questionnaire
- Is able to switch between interview types
- Has thorough knowledge of the terminal and sectors
- Punctuality
- Attendance

APPENDIX H

Sample Questionnaires for Employee Surveys

This appendix contains two sample questionnaires from recent airport employee surveys. The first questionnaire is focused mainly on employee use of airport concessions and is based on employee surveys performed by Jacobs Consultancy at various airports.

The second questionnaire was developed for an airport employee commute survey performed in 2007 at Boston Logan International Airport by the Massachusetts Port Authority (Massport). The survey questionnaires were distributed in several ways. The primary distribution was through a contact person at each employer with employees based at the airport, who distributed the surveys internally by various means. Surveys were also handed out on airport express bus and parking shuttle bus services used by employees. The survey yielded just under 1,700 responses, for a response rate of about 18% of the survey forms distributed. More details of the survey are reported in:

Vanasse Hangen Brustlin, Inc., *Boston-Logan International Airport 2007 Environmental Data Report,* Report EOEA #3247, Prepared for the Massachusetts Port Authority, East Boston, Mass., September 2008.

XXX INTERNATIONAL AIRPORT

EMPLOYEE SURVEY

Hello, we are undertaking a survey for the XXX International Airport to obtain customer input to the terminal modernization plan. Your responses will help us to plan the facilities, shops & services for the terminal re-development at the airport.

Please provide information about your employment and use of the concessions

A1. Do you work full time or part-time at the airport?
- 1 [ ] Full-time
- 2 [ ] Part time

A2. Who do you work for at the airport?
- 1 [ ] Airport / Security
- 2 [ ] Airline
- 3 [ ] Other

A3. Where do you mostly work? **(Check 1 box)**
- 1 [ ] In the terminal
- 2 [ ] In an office within the terminal
- 3 [ ] In an office outside the terminal
- 4 [ ] On the ramp
- 5 [ ] In a remote facility (i.e., hanger)
- 6 [ ] On board a plane
- 8 [ ] Outside front of terminal

[] Other **[SPECIFY]** _____

B1. How often do you bring your own meal to work?
[WRITE IN NUMBER] _____ times per week

B2. How often do you visit and how much do you spend on average at the restaurants and shops at the airport:

(Select most appropriate time frame – day, week OR month – and input frequency & amount)

Restaurants: (including coffee shops, kiosks, etc)		
	_____ visits per **day**	$_____ per day
OR	_____ visits per **week**	$_____ per week
OR	_____ visits per **month**	$_____ per month
Retail Shops: (books, magazines, gifts, clothes, etc.)		
	_____ visits per **day**	$_____ per day
OR	_____ visits per **week**	$_____ per week
OR	_____ visits per **month**	$_____ per month

B3. If you don't use the food & beverage concessions at the airport, what are your reasons for not doing so? **(Check All applicable answers)**
- 1 [ ] Poor selection of restaurant/food outlets
- 2 [ ] Poor selection of food offered
- 3 [ ] No seats/tables available
- 4 [ ] Lines for service usually too long
- 5 [ ] Facilities are dirty
- 6 [ ] Prices are too high
- 7 [ ] Restaurants/outlets often closed
- 8 [ ] Don't have time
- 9 [ ] Prefer to bring my own food with me

[ ] Other **[SPECIFY]** _____

STORE PREFERENCES

C1. Which types of food service do you prefer? **(Check 1 box)**
- 1 [ ] Combination of national and local brands
- 2 [ ] Mainly national brands
- 3 [ ] Mainly local/regional brands
- 4 [ ] No preference

C2. What types of retail stores would you prefer? **(Check all applicable answers)**
- 1 [ ] Nationally owned stores
- 2 [ ] Regionally known or owned stores
- 3 [ ] Specialty shops
- 4 [ ] No preference

Below is a general list of store products and services. Please read this list and indicate which of these stores you would visit if they were available at the airport.

D. **Convenience Products**
- 1 ◯ Business/office supplies
- 2 ◯ Greeting Cards
- 3 ◯ Books/Magazines/ Newspapers
- 4 ◯ Personal Care Items
- 5 ◯ Any Other Suggestions: _____

E. **Items for Gifts or Personal Use**
- 1 ◯ Cosmetics/Soap/Gifts
- 2 ◯ Candy/Chocolates
- 3 ◯ Arts and Crafts
- 4 ◯ Wine/Liquor
- 5 ◯ Tapes/Compact Discs
- 6 ◯ Gift Food/Local Food
- 7 ◯ Entertainment retail
- 8 ◯ Toys/Games/ Stuffed Animals
- 9 ◯ Golf/Tennis/Sporting Goods
- 10 ◯ Jewelry
- 11 ◯ China/Pottery
- 12 ◯ Watches
- 13 ◯ Electronics Shop
- 14 ◯ Local Theme Shop
- 15 ◯ Museum Shop
- 16 Other Suggestions: _____

F. **Apparel and Accessories**
- 1 ◯ Women's Stockings, Socks, Scarves, Shoes
- 2 ◯ Women's Clothing
- 3 ◯ Men's Clothing
- 4 ◯ Men's Ties, Belts, Shoes and Socks
- 5 ◯ Children's /Infants Clothing

6 ◯ Luggage, Handbags, Leather Goods
7 ◯ Sports Clothing
8 ◯ Jeans
9 ◯ Other Suggestions:

_____ _____

G. **Convenience & Personal Services**

1 ◯ Post Office
2 ◯ Business Centre with Fax and Photocopy
3 ◯ Courier (FedEx, UPS, etc)
4 ◯ Shoe Shine
5 ◯ Barber Shop/Hair Salon
6 ◯ Florist
7 ◯ Automated teller machines
8 ◯ Lottery Ticket Sales
9 ◯ 1-Hour Photo Developing
10 ◯ Pharmacy / Drug Store
11 ◯ Massage therapy
12 ◯ Health Club/Spas
13 ◯ Any Other Suggestions:

_____

H. **Travel Services**

1 ◯ Automobile Service Station
2 ◯ Travel Agent
3 ◯ Baggage Lockers/ Storage
4 ◯ Travel Insurance
5 ◯ Courtesy Telephone
6 ◯ Hotel Information
7 ◯ Tourism Information
8 ◯ Concierge Service
9 ◯ Other Suggestions:

_____

I. **Leisure Services**

1 ◯ Arcade/Game Room
2 ◯ Children's Play Area
3 ◯ Internet Kiosks
4 ◯ TV/Video Monitors
5 ◯ Chapel/Meditation Room
6 ◯ Other Suggestions:

_____

J. **Food & Beverage – Type of Service**

1 ◯ Fast Food/Food Court
2 ◯ Full (Table) Service Restaurant
3 ◯ Cafe (limited service restaurant)
4 ◯ Cafeteria (Self Service)
5 ◯ Cocktail bar, lounge, pub
6 ◯ Specialty food served at kiosk or cart

K. **Food Services - Type of Food**

1 ◯ Pizza
2 ◯ Salads
3 ◯ Deli - Sandwiches
4 ◯ Chinese
5 ◯ Health Food
6 ◯ Coffee/Donuts
7 ◯ Italian Food/Pasta
8 ◯ Chicken
9 ◯ Hamburgers/ Hot dogs
10 ◯ Tex-Mex
11 ◯ Fish & Chips
12 ◯ Seafood
13 ◯ Steak / Ribs
14 ◯ Soup
15 ◯ Baked goods/pastry
16 ◯ Ice Cream/Frozen Yoghurt
17 ◯ Pretzels Popcorn
18 ◯ Juice/Fruit
18 ◯ Specialty Coffee (expresso, cappuccino, etc.)
20 ◯ Other suggestions:

_____

Please indicate which stores you would likely visit if they were present at the airport

M. **Apparel**

1 ◯ Banana Republic
2 ◯ Victoria Secret
3 ◯ Tie Rack
4 ◯ Chanel
5 ◯ Louis Vuitton
6 ◯ Mont Blanc
7 ◯ Brooks Brothers
8 ◯ Sunglass Hut
9 ◯ Wilson's Leather
10 ◯ Leather Care
11 ◯ Bon Voyage Luggage
12 ◯ US Open Golf House
13 ◯ PGA Tour Shop
14 ◯ Tony Bahama
15 ◯ Airport Wireless palmOne
16 ◯ Other(s):

N. **Books and Records**

1 ◯ Barnes & Noble
2 ◯ Books A Million
3 ◯ Hudson Booksellers
4 ◯ WH Smith
5 ◯ Music World
6 ◯ Sam Goody
7 ◯ Other suggestions:

_____

O. **Beauty**

1 ◯ The Body Shop
2 ◯ Bath & Body Works
3 ◯ Clinique / Estee Lauder
4 ◯ Perfumania
5 ◯ Other suggestions:

_____

Please indicate which restaurants you would likely visit if they were present at the airport

1 ◯ Starbucks
2 ◯ Seattle's Best
3 ◯ Krispy Kreame
4 ◯ Samuel Adam's Brewhouse
5 ◯ Subway
6 ◯ Arby's
7 ◯ Au Bon Pain
8 ◯ McDonald's
9 ◯ Burger King
10 ◯ Wendy's
11 ◯ Krystal (burgers)
12 ◯ KFC
13 ◯ Church's Chicken
14 ◯ Chick-Fil-A
15 ◯ Taco Bell
16 ◯ Chili's
17 ◯ Pizza Hut
18 ◯ Domino's
19 ◯ Papa John's
20 ◯ Quizno's
21 ◯ Golden Rule BBC+Grill
22 ◯ Milo's Southwest Grill
23 ◯ Applebee's
24 ◯ Ruby Tuesday
25 ◯ Zoe's Kitchen
26 ◯ TGI Fridays
27 ◯ Sbarro, The Italian Eatery
28 ◯ Waffle House
29 ◯ Ben & Jerry's
30 ◯ Dairy Queen
31 ◯ Baskin/Robbins 31 Flavors
32 ◯ Marble Slab Creamery
33 ◯ Godiva Chocolatier
34 ◯ Candy Express
35 ◯ Other suggestions:

Q1. **We would like you to rate your experience on each of the following items?**
A "5" (very satisfied) is the *highest rating* you may give. A "1" (very dissatisfied) is the *lowest rating* you may give. You may circle any number in between.
[CIRLCE ONE NUMBER FOR EACH ITEM.]

	Very Dissatisfied				Very Satisfied	Didn't Use
Transportation						
Access roads to airport	1	2	3	4	5	[ ]
Adequate public transportation service	1	2	3	4	5	[ ]
Parking Factors						
Convenience/walking distance of parking to terminal	1	2	3	4	5	[ ]
Directional signs in/out of parking lot	1	2	3	4	5	[ ]
Security in parking lots	1	2	3	4	5	[ ]
Space availability	1	2	3	4	5	[ ]
Cost of airport parking	1	2	3	4	5	[ ]
Security Check Point Staff						
Time to pass through security screening	1	2	3	4	5	[ ]
Thoroughness of screening/inspecting	1	2	3	4	5	[ ]
Professional attitude of security staff	1	2	3	4	5	[ ]
The Terminal Building						
Cleanliness of terminal	1	2	3	4	5	[ ]
Cleanliness of washrooms	1	2	3	4	5	[ ]
Availability of washrooms	1	2	3	4	5	[ ]
Directional signage in terminal	1	2	3	4	5	[ ]
Adequate, visible security / feeling safe in terminal	1	2	3	4	5	[ ]
Courteous and helpful personal assistance (info centre staff, other airport employees)	1	2	3	4	5	[ ]
Food & Beverage Facilities						
Selection of food & beverage facilities	1	2	3	4	5	[ ]
Quality of food & beverages	1	2	3	4	5	[ ]
Speed of service at food outlets/restaurant	1	2	3	4	5	[ ]
Cleanliness/appearance of food outlets/restaurant	1	2	3	4	5	[ ]
Quality of service	1	2	3	4	5	[ ]
Value for your money	1	2	3	4	5	[ ]
Retail Shops						
Variety of retail/gift shops	1	2	3	4	5	[ ]
Quality of retail merchandise	1	2	3	4	5	[ ]
Quality of service	1	2	3	4	5	[ ]
Appearance/cleanliness of stores/shops	1	2	3	4	5	[ ]
Value for money	1	2	3	4	5	[ ]

BMX4 Emp Questn

3

Please utilize the space below to provide any suggestions/ comments regarding the above information:

_____

_____

_____

_____

R1. **Please provide any additional comments/ suggestions about your experience at XXX Airport and how we can improve our services?:**

_____

_____

_____

_____

_____

_____

_____

The following questions are for statistical purposes.

S1. To which age group do you belong?

1 [ ] 15 to 24 years
2 [ ] 25 to 34 years
3 [ ] 35 to 44 years
4 [ ] 45 to 54 years
5 [ ] 55 to 64 years
6 [ ] 65 or more

S2. Which of these best describe your annual household income before taxes in US dollars?

1 [ ] Under $25,000
2 [ ] $25,000 - $50,000
3 [ ] $50,000 - $100,000
4 [ ] Over $100,000

S3. Please record your gender:

1 [ ] Male
2 [ ] Female

Your responses to this survey are anonymous, confidential, and will be used only for transportation planning purposes.

14. **WHICH COMPANY IS YOUR EMPLOYER AT LOGAN?**

15. **WHERE AT LOGAN IS YOUR MAIN WORKPLACE?** *(Check all that apply)*

- ☐ Terminals / Tower
- ☐ South Cargo Area (including Hyatt)
- ☐ North Cargo/Hangar Area *(e.g., along Prescott St., N. Service Rd.)*
- ☐ Other *(please specify)*:
- ☐ Logan Office Center
- ☐ Southwest Service Area (rental car area)
- ☐ North Service Area

16. **WHICH OF THE FOLLOWING BEST DESCRIBES YOUR EMPLOYMENT?** ☐ Permanent full-time ☐ Permanent part-time ☐ Temporary full-time ☐ Temporary part-time

17. **ARE YOU A MEMBER OF A FLIGHT CREW?** ☐ Yes ☐ No

18. **ARE YOU?** ☐ Male ☐ Female

19. **AGE:** ☐ Under 18 ☐ 18 to 24 ☐ 25 to 34 ☐ 35 to 44 ☐ 45 to 54 ☐ 55 to 64 ☐ 65 or over

20. **ANNUAL FAMILY/HOUSEHOLD COMBINED INCOME RANGE:**

☐ $30,000 or under ☐ $30,001 to $50,000 ☐ $50,001 to $75,000
☐ $75,001 to $100,000 ☐ $100,001 to $125,000 ☐ more than $125,000 per year

21. **Any comments about your commute to Logan?**

Optional:

The Logan Transportation Management Association (Logan TMA) may be able to help you find other employees with whom to carpool. If you would like to receive a computer-generated list of other interested Logan employees who share your work hours and your commute, please fill in this section (or contact the Logan TMA at 617-561-1613):

Name: _____

Phone: (_____) _____-_____ Email: _____

Thank you for participating in this survey!

LOGAN AIRPORT 2007 EMPLOYEE COMMUTE SURVEY

March 2007

To all employees at Logan Airport:
This survey is being distributed to all current Logan Airport employees. Your comments are important! Please take the time to give us your feedback.

Why you have been given this questionnaire:
This airport-wide employee travel behavior information will be used to improve commuter services. The survey also helps Massport meet its environmental commitments.

How to return completed questionnaires:
Please return the completed form to the collection box/envelope at your work site, or the Logan TMA office at lower level Terminal C, or the Massport office at the Logan Office Center at One Harborside Drive, Suite 200-S (attention: Economic Planning & Development Dept.) by **Monday, March 19.**

Should you have any questions regarding the survey:
Please contact Tyler Cyr at 617-568-3527 or *TCyr@massport.com*.

We appreciate your participation.

Sincerely,

Ed Freni
Director of Aviation
Logan International Airport

Today's date: / / 2007

1. **HOME TOWN:** **State:** **Zip Code:**

2. **DO YOU HAVE A DRIVER'S LICENSE?** ☐ Yes ☐ No

3. a. **DO YOU OWN A VEHICLE?** ☐ Yes ☐ No

OR...

b. **HAVE ACCESS TO A VEHICLE FOR COMMUTING PURPOSES?** ☐ Any time ☐ Sometimes ☐ No

4. **ON YOUR TYPICAL (most common) COMMUTE DAY, DESCRIBE HOW YOU USUALLY TRAVEL TO LOGAN AIRPORT?** *(CHECK ALL THE MODES THAT APPLY FOR THAT COMMUTE)*

Private Vehicle (to Logan or Chelsea Parking Garage):
- ☐ Drive alone
- ☐ Get dropped off by someone who doesn't work at Logan
- ☐ Carpool/vanpool with other Logan employees
  - → How many people are typically in the carpool (including yourself)? _____

Private Vehicle (part way):
- ☐ Drive to another mode of transportation (i.e. park-and-ride) *(check mode below)*
- ☐ Get dropped off at another mode of transportation (i.e. kiss-and-ride) *(check mode below)*
- ☐ Carpool/vanpool not destined to Logan *(check below the mode used for the remainder of your trip)*

MBTA (the "T"):
- Commuter Rail to: ☐ North Station *OR* ☐ South Station
- ☐ Subway (Blue, Orange, Green, and/or Red lines)
- ☐ Silver Line → Prior to the Silver Line service (summer 2005), what was your method of commuting to Logan?
  - ☐ Same as now
  - ☐ Drove/carpool
  - ☐ Blue Line / Subway / Commuter Rail
  - ☐ Other: _____
  - ☐ I did not work at Logan
  - ☐ Logan Express

Bus Route:
☐ 120 ☐ 171 ☐ 448 ☐ 449 ☐ 459 ☐ Other: _____

Logan Express Bus:
- ☐ Braintree
- ☐ Peabody
- ☐ Framingham
- ☐ Woburn

Other Scheduled Bus Service:
- ☐ Logan Direct (P & B)
- ☐ Peter Pan / Bonanza
- ☐ Other *(specify)*:
- ☐ C & J Trailways
- ☐ Concord Trailways

Other Modes:
- ☐ Boat/Water Taxi
- ☐ Taxicab
- ☐ Other *(specify)*: _____
- ☐ Bicycle all the way
- ☐ Bicycle part way
- ☐ Walk all the way
- ☐ Walk part way

5. **If you complete your trip using a Massport shuttle bus, which routes do you typically use?** *(circle all that apply)* 11 22 33 44 55 66 77 88 LOC

6. **IF YOU DRIVE TO LOGAN AIRPORT, WHERE DO YOU USUALLY PARK?**
- ☐ Employer's parking area near my place of work
- ☐ Elsewhere *on* airport: _____
- ☐ Massport's Chelsea garage
- ☐ Elsewhere *off* airport: _____

7. **FOR EACH OF YOUR LAST FIVE DAILY COMMUTES, WHAT WAS YOUR MAIN MODE OF TRANSPORT?**

	Private Vehicle, Drive Alone	Carpool or Dropped Off	Logan Express or Other Scheduled Bus	Silver Line Bus	Commuter Rail and/or Subway	MBTA Bus	Water Taxi/ Ferry	Taxi	Bicycle or Walk
a. Latest trip	☐	☐	☐	☐	☐	☐	☐	☐	☐
b. 1 trip before	☐	☐	☐	☐	☐	☐	☐	☐	☐
c. 2 trips before	☐	☐	☐	☐	☐	☐	☐	☐	☐
d. 3 trips before	☐	☐	☐	☐	☐	☐	☐	☐	☐
e. 4 trips before	☐	☐	☐	☐	☐	☐	☐	☐	☐

8. **DID THE I-90 CONNECTOR/TED WILLIAMS TUNNEL CLOSURE** ***(July 2006-January 2007)*** **CHANGE YOUR METHOD (MODE) OF COMMUTING TO LOGAN?**
- ☐ No
- ☐ Yes, temporarily → What was your commute mode **during** the closure? _____
- ☐ Yes, permanently → What was your commute mode **before** the closure? _____

9. **ESTIMATE YOUR MONTHLY COMMUTE EXPENSES:**

	Paid by YOU	Paid by EMPLOYER
a. Parking:	$ _____	$ _____
b. Tolls:	$ _____	$ _____
c. Bus, subway, rail, boat fares or passes:	$ _____	$ _____
d. Other expenses: *(specify)*	$ _____	$ _____

10. **ON YOUR TYPICAL WORK DAY, WHAT TIME DO YOU USUALLY ARRIVE AT YOUR LOGAN WORKSITE AND WHAT TIME DO YOU LEAVE WORK?**

Arrival Time _____ ☐ AM ☐ PM **Departure Time** _____ ☐ AM ☐ PM

11. **HOW OFTEN DOES YOUR WORK SHIFT CHANGE?** ☐ Never OR _____ time(s) a year

12. **ABOUT HOW OFTEN DO YOU WORK OVERTIME?** ☐ Never OR _____ day(s) per month

13. **DURING THE WORK DAY HOW OFTEN DO YOU LEAVE LOGAN (for non-commuting purposes)?**

a. ____ times EACH WEEK, on average, for **work-related** reasons
For these trips, what kind of transport do you use?
☐ Business Vehicle ☐ Personal Vehicle ☐ Public Transit ☐ Other: _____

b. ____ times EACH WEEK, on average, for **personal** reasons
For these trips, what kind of transport do you use?
☐ Business Vehicle ☐ Personal Vehicle ☐ Public Transit ☐ Other: _____

(continued)

APPENDIX I

Sample Questionnaire for Tenant Surveys

AIRPORT TENANT QUESTIONNAIRE
(Confidential when completed)

This survey is part of a study to assess the economic impact of the XXX Airport. The study is a means of measuring the airport's activity, importance and purpose and identifying economic linkages between the aviation industry and other sectors of the economy.

The results of this study will be used to communicate the airport's role in benefiting the region to the public and to policy and decision makers.

The survey also collects information on the effectiveness of the airport's communication with tenants. This information will be used to help the airport improve its communication channels.

We ask that you complete this survey by _____. Instructions for returning the survey are on the last page.

Your responses will be held in strict confidence and results of the survey will only be released in aggregate form where responses from individual companies cannot be identified. Individual responses will not be released to the Airport, or any other party, without your written consent.

So that the results fully capture the true size of the airport's economic base, it is important that the entire airport community participates. Your time and effort are greatly appreciated.

If you have any questions, please call _____ at ___ ____ ____.

AIRPORT TENANT QUESTIONNAIRE
(Confidential when completed)

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1. General Information

Business / Organization Name:		
Address:		
Contact Person (name, title):		
Phone Number:	**Fax Number:**	
Email Address:	**Web Page:**	
Physical location of business:	❑ on airport (physically located at airport)	❑ off-airport (within the xxxx Region)
Type of Business: (If you are involved in more than one type of business, please choose the one that you feel makes the greatest economic contribution to the XXX Airport)	❑ Air Carrier - Scheduled ❑ Air Carrier – Charter/air taxi ❑ Air Cargo / Courier ❑ Airport Operations ❑ Freight Forwarder / Customs Broker ❑ Ground Transportation (taxi / limo / public transport / public parking)	❑ Accommodation ❑ Corporate Aviation ❑ Private Aviation ❑ Flight School / Club ❑ Airport Commercial Services ❑ Aircraft / Aviation Services ❑ OTHER: _____

How long have you been a tenant at the airport?	❑ < 1 year	❑ 1-3 years	❑ 3-5 years
	❑ 5-10 years	❑ >10 years	
What airport committees does your organization participate in?	❑ Airport Operators	❑ OSH	❑ Security
	❑ Other (specify)	❑ Other (specify)	❑ Other (specify)

AIRPORT TENANT QUESTIONNAIRE
(Confidential when completed)

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2. Employment

Your figures for both payroll and contract employees should include all employees at the XXX Airport, plus any additional employees based in the xxx region whose jobs are directly related to air transportation.

Total Number of Payroll Employees: ▪ Permanent ▪ Part-time ▪ Seasonal ▪ TOTAL	On Airport _____ _____ _____ _____	Off-Airport _____ _____ _____ _____
Average Number of Weeks Worked per Year by:	Part-Time Employees	Seasonal Employees
Average Weekly Hours of Work per Employee:	Part-Time	Seasonal
Does your firm contract out any services?	❑ No ❑ Yes (please specify functions):	
Number of Employees on Contract (versus payroll):		
Total Annual Hours of Contract Work:		

3. Financials

The figures you provide in the following section are strictly confidential and will only be used in aggregate form to determine the economic impact of the XXX Airport. For the purposes of this study, it is important that the figures you provide are as accurate and current as possible.

Please indicate if the figures you provide are consolidated with operations at other airports. If this is the case, please indicate the percentage of the total which is attributable to the XXX Airport.

Most Recent Fiscal Year Ending (date):		
Are the financial figures provided for the XXX Airport only? ❑ Yes ❑ No If NO, what % is attributable to operations at the XXX Airport? _____ %		
Gross Sales:	$	
Gross Wages (excl. benefits)	$	
Taxes Paid	Corporate $	Property $
Value of Capital Assets Located at XXX Airport (land, buildings, aircraft, etc.)	$	
Capital Improvements During Past Fiscal Year	Value $	Description:

AIRPORT TENANT QUESTIONNAIRE
(Confidential when completed)

---

4. Importance of Airport to Your Operations

a. What would happen to your business if the XXX Airport was closed? [This is a hypothetical question but one that helps us get to the true value of the airport operation]. What percentage (%) of your employee base and revenues would be lost?

_____
_____
_____
_____

b. If there is anything else that you would like to add which you feel may be useful to the economic impact study such as recommendations for improving service or airport facilities, please add comments below.

_____
_____
_____
_____

5. **Air Operators** (only complete this section if your organization operates aircraft at the Airport)

Please provide the following information on the aircraft you operate and base at XXX Airport

Aircraft Make / Model	Fixed/Rotary Wing	No. Based at XXX Airport

Where do you see your business' growth occurring, particularly in relation to XXX Airport over the next five years? (sectors, destinations, types of service, aircraft used, levels of growth etc)	
What are the three biggest impacts of XXX Airport on your business?	1.
	2.
	3.
Please indicate any new or planned orders for aircraft within the next five years. How many of these may be used on routes out of XXX Airport?	

AIRPORT TENANT QUESTIONNAIRE
(Confidential when completed)

6. Effectiveness of Airport's Communication with Tenants

Please rate the overall quality of the Airport's communication with your organization. *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Poor Good Excellent
Please rate the overall quantity/frequency of the Airport's communication with your organization. *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Not Enough Just Right Too Much
Please rate the Airport's communication with you on a day-to-day basis regarding operational issues. *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Poor Good Excellent
Please rate the Airport's communication with you on strategic issues (e.g., airport redevelopment and its impact on your organization) *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Poor Good Excellent
How often do you check the Airport's website? *[check one]*	❑ Never ❑ Monthly ❑ Weekly ❑ Daily
Please rate your ability to contact the appropriate XXX Airport representative when you need to *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Poor Good Excellent
Please rate the timeliness of the Airport's response to your inquiries *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Poor Good Excellent
Please rate the quality of the Airport's response to your inquiries *[circle number]*	0 1 2 3 4 5 6 7 8 9 10 Poor Good Excellent

7. General

How could the XXX Airport better serve you as a tenant/user?

_____

_____

THANK YOU FOR YOUR PARTICIPATION.

Please return complete questions to: _____

APPENDIX J

Sample Questionnaire for Area Residents Surveys

AREA RESIDENTS QUESTIONNAIRE

Introduction

Hello, my name is _____ with (_____market research firm). We are calling to hear your opinions regarding the future of the XXXXX Airport. Your responses will be kept confidential and combined with other responses when reporting the results.

Airport Usage
Firstly, we would like to ask you about your recent travel by air.

Q1. In the last 12 months, how many trips did you make departing from XXXXX Airport, for leisure or non-business purposes? _____ times

Q2. And how many trips did you make departing from the Airport for business purposes? _____ times

Q3. How many times in the past year have you picked up or dropped off someone at XXXXX Airport, or visited the Airport for any other reason? _____ times

When was the last flight you took from XXXXX Airport: Month ____ Year _____ or Never_____

IF MORE THAN 12 MONTHS AGO, Please GO TO Question 11

IF WITHIN THE PAST 12 MONTHS, please answer the following questions for that flight:

Q4. Including yourself, how many travelers were in your group with the same itinerary and ticket? _____

Q5. What was the final destination airport for your trip? (record airport name or airport code) _____

Q6 What airline did you fly with? _____

Q7. How many connecting flights did you take to reach your destination? _____
(enter 0 for stops without a plane change)

Q8. From what source did you purchase your airline ticket(s) for that flight?

Airline Call Centre	□1	Airline Website	□4
Travel Agent	□2	Don't know	□5
Travel Website (e.g. Expedia)	□3	Other (Please Specify):_____	

Q9. Were you travelling for?

Business purposes	□1
Personal reasons	□2
Both Business & Personal	□3

Q10. **If part or all** of your trip was for 'Personal reasons', what was the purpose of your trip? (check all that apply)

Visit Friends/Relatives □1
Vacation □2
Other (Please Specify):_____

Q11. In the past **12 months** have you started/ended an airline trip to/from the xxxxxx Region at an airport **other than XXXXX** Airport? Yes □1 No □2

If 'No': Go to Question 12

If 'Yes': a) How many times did you travel by car, bus or train to/from the xxxxxx Region in order to catch a flight at another airport in the past 12 months: _____

b) For the five most recent of these flights please record the following:

	Airport	Airline	Final Destination	Reason for Airport Choice (check all that apply)			
				Better Fare	Nonstop Flight	Better Schedule	Other (Specify)
1				□	□	□	
2				□	□	□	
3				□	□	□	
4				□	□	□	
5				□	□	□	

Attitudes and Perceptions of XXXXX Airport

Q12. Using a scale of 1 to 5, where 1 means "extremely dissatisfied" and 5 means "extremely satisfied,":

How satisfied or dissatisfied are you with XXXXX Airport overall?

Extremely Dissatisfied				Extremely Satisfied	Not Applicable	Don't Know
1	2	3	4	5	NA	DK

Q13. Why did you give that rating?

_____

_____

Now, where 1 means "strongly disagree" and 5 means "strongly agree," please indicate your level of agreement with the following statements:

	Strongly Disagree 1	2	3	4	Strongly Agree 5	Not App. NA	Don't Know DK
Q14. XXXXX Airport is among the best airports in the United States.	1	2	3	4	5	NA	DK
Q15. Airplane noise reduces the quality of life in my neighborhood.	1	2	3	4	5	NA	DK
Q16. The Airport should do more to protect the environment.	1	2	3	4	5	NA	DK
Q17. Flights out of the Airport allow me to easily travel when and where I want to go.	1	2	3	4	5	NA	DK
Q18. The Airport is important to the region's economy.	1	2	3	4	5	NA	DK
Q19. Protecting the natural environment is more important than accommodating airport growth.	1	2	3	4	5	NA	DK
Q20. The light rail service is a convenient way for me to travel to and from the Airport.	1	2	3	4	5	NA	DK

Understanding Key Impacts

As the region grows, the impact of the Airport on adjacent neighborhoods increases. We'd like to ask you to consider the following trade-offs between accommodating growth and protecting neighborhood liveability.

Sustainability is an important part of planning for the future. We define sustainability as: meeting the Region's air transportation needs, without compromising the quality-of-life for future generations. Using a scale of 1 to 5, where 1 means "Strongly Oppose" and 5 means "Strongly Favor," please indicate how much you favor or oppose the following options:

	Strongly Oppose 1	2	3	4	Strongly Favor 5	Not App. NA	Don't Know DK
Q21. Requiring airport fleet vehicles, taxis, and rental cars operating out of the Airport to be hybrids, high gas mileage, or use alternative fuel by 2020.	1	2	3	4	5	NA	DK
Q22. Reduce number of pick-up and drop-off trips by encouraging greater use of mass transit, and on-site parking.	1	2	3	4	5	NA	DK
Q23. Require all future terminal renovations and expansions to be certified as energy efficient and environmentally friendly even if it costs travelers more to fly.	1	2	3	4	5	NA	DK
Q24. Pay an airport surcharge to fly at peak times of the day, such as early morning and late afternoon, in order to reduce congestion in—and around—the airport.	1	2	3	4	5	NA	DK
Q25. Enhance public transit to the Airport by increasing access to light rail service and adding bus service.	1	2	3	4	5	NA	DK

Q26. We'd like to get a sense of the amount, if any, you would be willing to pay, per-round-trip-ticket, to help reduce the environmental or carbon impact of your flight. Would you pay nothing, $5, $10, $15, or more than $15?

Nothing	□1
$5	□2
$10	□3
$15	□4
More than $15	□5
Don't know / Depends / Refused	□6

Q27. On a 1 to 10 scale, where 10 means protecting the neighborhoods' liveability and 1 means protecting the airport's ability to support the region's economic vitality, what number between 1 and 10 would reflect your view?

_____

Q28. On a 1 to 10 scale, where 10 means protecting the neighborhoods' liveability and 1 means protecting your air travel options, what number between 1 and 10 would reflect your view?

_____

How willing or unwilling would you be to accept the following trade-offs in order to reduce community and neighborhood impacts, using a scale of 1 to 5, where 1 means "not at all willing" and 5 means "very willing?"

	Not at all Willing 1	2	3	4	Very Willing 5	Not App. NA	Don't Know DK
Q29. Decrease my use of <u>next day delivery service</u> in order to reduce cargo flights over the neighborhoods and delivery trucks around the airport.	1	2	3	4	5	NA	DK
Q30. Decrease my travel to reduce the overall demand for travel and environmental impact.	1	2	3	4	5	NA	DK

Q31. Finally, when thinking about the future of XXXXX Airport, what issues would you like to see addressed?

_____

_____

Demographics

I'd like to finish up with a few demographic questions, for classification purposes:

Q32. Which of the following categories describes your age?

Under 21	□1
22 - 35	□2
36 - 45	□3
46 - 55	□4
56 - 65	□5
Over 75	□6
Refused	□9

Q33. What is the last grade in school you had the opportunity to complete?

Student	□1
High School Diploma	□2
Some College	□3
4-Year Degree	□4
Graduate/Post Graduate	□5
Refused	□9

Q34. Which of the following categories describes your total annual household income?

Under $20,000	□1
$20,000 - $39,999	□2
$40,000 - $59,999	□3
$60,000 - $79,000	□4
$80,000 - $99,000	□5
$100,000 - $119,000	□6
$120,000 - $149,000	□7
$150,000 or more	□8
Refused	□9

Q35. How many years have you lived at your current residence?

Under 5 years	□1
5-9 years	□2
10-14 years	□3
Over 15 years	□4
Refused	□9

Q36. What is the Zip code of where you live _____

Those are all the questions I have. Thank you for your time and opinions.

Q37. Record Gender:

Male	□1
Female	□2

APPENDIX K

Sample Questionnaire for Roadside Driver Cargo Surveys

The forms in this appendix have been included with the permission of the Greater Toronto Airports Authority. They represent observation and interview forms for the air cargo truck survey used during the 2005 Groundside Survey. The observation forms are provided here for completeness, although observation surveys at airports are not within the scope of this guidebook.

Each form is accompanied by a page of notes. These notes were affixed to the back of each clipboard for handy reference by the interviewer/surveyor.

GTAA

Greater Toronto Airports Authority
Cargo Area Driver Interview Survey

																C	G	3
1. Observer Initials				2. Station						4. Interview No.								
3. Date	2	0	0	5	0	6			5. Time (24hr)	H	H	M	M					
6. Vehicle Type									7. Inbound/Outbound									
8. Trucking Company Name																		

We are conducting a survey of the cargo facilities today at Pearson International Airport. Please help us by answering a few short questions about your trip to the airport today. This information will be used for statistical purposes only.

9. For which cargo operator did or will you load?		10. Freight Forwarder?	
11. For which cargo operator did or will you unload?		12. Freight Forwarder?	
13. What was the origin of this trip?			
14. Where was your last pick up before coming here?			
15. What is the final destination of this trip?			
16. Where will be your next delivery after leaving here?			

17. What type of trip is this?

1-Part of peddle run		3-Line haul	
2-Start/End of peddle run			

18. If this is a peddle run: what other stops did/will you make on this trip, including other airport cargo facilities?

19. Which major highways did you use to get to this cargo facility? (Select all that apply.)

1-401 Eastbound		5-403/410		9-404/DVP	
2-401 Westbound		6-QEW			
3-427 Northbound		7-407 Eastbound			
4-427 Southbound		8-407 Westbound			

20. Which main arterials did you use to get to this cargo facility? (Select all that apply.)

1-Dixie Rd.		6-Convair Dr.			
2-Derry Rd.		7-Renforth Dr.			
3-Airport Rd.		8-Carlingview Dr.			
4-Britannia Rd. E		9-Silver Dart Dr.			
5-Courtneypark Dr.		10-Other			

Approximately how full is your vehicle?	21. By weight	%	22. By Volume	%	
23. Does/Did this trip include crossing into or from the United States? (Y/N)					

24. If yes, what border crossing did you use? (one only)

1-Queenston-Lewiston, Niagara Falls		4-Thousand Islands Bridge		7-Ambassador Bridge, Windsor	
2-Rainbow Bridge, Niagara Falls		5-Hwy 16 Prescott		8-Detroit-Windsor Tunnel, Windsor	
3-Peace Bridge, Fort Erie		6-Hwy 138, Cornwall		9-Bluewater Bridge, Sarnia	
				10-Other Specify	

25. Is this a scheduled trip? (Y/N)	
26. If this is a scheduled trip how often is it made? Number of times per day /week /month.	
27. If this is not a scheduled trip, approximately how often do you carry air cargo to or from Pearson?	

28. Survey Result

C-Complete		I-Incomplete		R-Refusal	

29. Comments

1	Car	4	Straight truck (double rear axle)
2	Van or light truck	5	Tractor-trailer
3	Cube Van (no swivel)	6	Flatbed
		7	Other

Cargo Area Driver Interview Survey

CG3 Notes

8. Trucking Company Name – Most obvious name from side of truck

9. Loading company, airline or freight forwarder where load taken on. Indicate freight forwarder in question 10 with Y.

11. Same as 9 but for unloading operation. Freight forwarder indicated in question 12.

13. Origin, or first staring point today.

14. Last stop before coming to the airport.

15. Final destination of the trip, or last stop of the day.

16. Next stop after the airport stop.

17. Trip type, line haul, one load, one unload, no intermediate stops: or peddle run with multiple stops. Use answer 2 if this is either the start or end point of a peddle run.

18. Other stops in a peddle run. This need not be exhaustive, get as many as reasonable.

19. Major highways, restrict answers to multi-lane divided highways, see 20 for arterials. Add other highways as necessary, eg. I-81 in New York State.

20. Major arterials in the immediate vicinity of the airport, tick all that are mentioned. Write in others as specified.

21. and 22. Are for approximate load. Specify either percent by weight or percent by volume which ever is applicable, or mentioned by the driver. If driver just says “Full”, leave 21 blank and put 100% in 22.

23. US bound origins or destinations, yes or no.

24. If yes to 23, specify border crossing point. Most popular and nearest are listed. Write in any other one that is mentioned.

25. Regular scheduled trip, if yes specify frequency and units in 26.

27. If not scheduled, specify frequency and units (day, week, month).

28. If all questions answered, code Complete, if driver refuses code Refusal (form to be submitted), if driver quits part way through code Incomplete.

29. Specify any other comments here.

Greater Toronto Airports Authority
Cargo Area Activity Survey

C G 1

Observer Initials ☐☐☐ Station ☐☐☐ Date 2 0 0 5 0 6 ☐☐ Page ☐☐

Dock	Time In (24 hr)	Type	Tractor	Time Out (24 hr)
	H H M M			H H M M

Dock	Time In (24 hr)	Type	Tractor	Time Out (24 hr)
	H H M M			H H M M

1 Car 2 Van or light truck 3 Cube Van 4 Straight truck (double rear axle) 5 Tractor-trailer 6 Flat bed 7 Other

Cargo Area Activity Survey - Notes

Dock – Number near the door

Time In – Time the truck stops at dock

Type – From list

Tractor – Enter 1 if tractor leaves a trailer at the dock, otherwise leave blank

Time out – Time the truck leaves the dock

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
HMCRP	Hazardous Materials Cooperative Research Program
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
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: 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