INTEGRATING AIRPORT ACCESS PLANNING WITH THE METROPOLITAN SURFACE TRANSPORTATION PLAN

By

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To my wife, Sharon; daughter, Beth; and son, John, who understand my passion for learning and achievement
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This research was focused on the development of an improved planning process to evaluate an airport’s off-site intermodal surface transportation access needs utilizing a procedure compatible with the Metropolitan Planning Organization’s (MPO) surface transportation planning methodology. Enhancing intermodal planning procedure is consistent with transportation policy, increases the effectiveness of modal coordination and is designed to improve modal connectivity and transportation systems linkage to the global economy. To accomplish this research objective, Florida’s 20 urban commercial service airports and their MPO partners’ intermodal planning process were reviewed to select the best region in the state for a detailed examination. For this study, the Jacksonville airport and MPO was selected to analyze in greater detail for compatibility, adopted methodology, shared documentation, data consistency and availability, level of coordination and adopted policy goals. This process examined the current planning and coordination practice utilized by both agencies to enhance intermodal connectivity and improve the compatibility of the agencies’ adopted plans. Each organization is required by federal and state law to coordinate development of their respective plans. Even with extensive coordination, there is no technical tool or procedure to validate if this
coordination actually achieves its objectives. To better ensure desired outcomes, this research collected reference data to validate need, examine current practice and data, examine alternatives for process improvement and support development of a common procedure for application in Florida. This planning process will be refined and tested utilizing the Jacksonville Urban Area as a case study. The Jacksonville International Airport’s (JAX) adopted long-range master plan served as the primary source for airport data, land-use development and forecast activity levels. The North Florida Transportation Planning Organization’s (NFTPO) planning process and urban models were utilized to establish current surface transportation planning procedures and to evaluate acceptable alternatives for improving the planning outcomes utilizing airport data inputs. Airport documents were analyzed to locate the most appropriate data for use in representing the facilities’ operational characteristics in the surface transportation model for trip generation, origin/destination and mode split. Airport data tables were prepared to replace existing generic model files. This airport output will serve as an input to be utilized within the North Florida MPO’s Special Generator model routine. Airport data representing the facilities’ unique existing operations and adopted long-range master development plan was compiled for all on-site land-uses. Using industry-accepted procedures, the aviation data was transformed into MPO usable input files for use in the model to support transportation plan development. The results provide a more reliable means to represent the airport in the urban surface transportation model and resultant long-range transportation plan. The inclusion of airport specific data in development of the MPO’s surface plan approval process will help assure both adopted
plans are compatible, mutually supportive and advance intermodal airport access planning for both agencies.
CHAPTER 1
INTRODUCTION

Background

The United States is becoming more and more urbanized increasing from 70% urban in 1970 to slightly more than 82% by 2015 (The World Bank, 2016). Cities are growing together, becoming economically and politically powerful Megaregions (Regional Plan Association, 2015). These large metropolitan population centers become even more powerful as their agglomeration economies self-perpetuate more growth and expansion (Florida, 2012), creating a whole new set of opportunities and challenges. All urban economic centers depend on efficient transportation systems to more cost effectively move people, products and ideas across a larger and larger geography for economic survival (Glaeser, 2010). As transportation increased the productivity of industries, the metropolitan areas attract people and goods, spreading population and productive capacities into broader areas. In turn, the increases in quantitative and qualitative movements of people and goods intensify the demand for complex and improved transportation systems, such as roads, highways, airports, rail lines and seaports (Dilger 2015; Eberts 2000). The historic and current impact and value of each mode can be traced in the structure and function of the urban land-use it shapes, also impacting its pace of development. In the 18th century, cities grew up around seaports; by the 19th century, development was dominated by railroads; the 20th century has been dominated by automobiles and highways; and, many experts feel the 21st century will be all about the influence of the airport. In major U.S. urban centers, the role and value of the urban airport is unquestioned. Today many researchers and economists believe this
In order to sustain and grow the economic value of the transportation system in a synergistic fashion, federal, state and local governments have adopted various transportation policies beginning as early as 1910s to guide their successful implementation. Through the 1980s, those policies focused more on the primary purpose of transportation – moving people and goods efficiently – and invested mostly in adding modal capacity, especially for highways systems (US DOT 2006; Eberts 2000). However, since the early 1990s, increasing demands for improved urban transportation infrastructure, coupled with declining funding options, placed greater pressures upon urban modal systems planning to ensure optimum, well-coordinated outcomes for the total transportation system. This condition motivated policy makers to consider subsequent initiatives to further change the urban transportation planning process from one with a focus on modal capacity building to a more diverse systems approach that would consider more and more diverse alternatives, such as public transit, intermodal systems, energy efficiency, bicycle and pedestrian mobility, safety, the environment and freight to ensure optimum performance of the overall transportation system (Dilger 2015). From a planning perspective, seamless intermodal connectivity is crucial to provide optimum mobility and mode choice for the efficient movement of both people and goods. This efficient transfer is essential to maintain a competitive and vibrant local economy in today’s global business environment (Alstadt, Weisbrod, & Cutler, The Relationship of Transportation Access and Connectivity to Local Economic Outcomes: A Statistical Analysis, 2012). Providing growing influence will transform the immediate urban environment into an Aerotropolis (Kasarda, 2016).
improved intermodal connectivity to the urban airports greatly increases accessibility to a broader market, which in turn stimulates knowledge-based post-industrial economies’ increased activity, resulting in greater regional wealth and productivity (Florida, 2012).

Federal transportation policy, from the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) through to the adoption of the current legislation Fixing America’s Surface Transportation (FAST) Act of 2015, has progressively moved toward a stronger emphasis on development of a seamlessly interconnected intermodal system. Congress enacted the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 with emphasis on the importance of the intermodal (or multimodal) transportation systems connectivity and compatibility to the success of the nation’s social and economic well-being. The ISTEA was seen as a means to achieve national goals for economic recovery, energy and environmental conservation and social equity with its focus on system efficiency over capacity and modal integration of highways, transit, aviation and marine systems (Dilger 2015; Shoup 1997). As transportation planning evolved to include more modes and more diverse participants, the needs for new transportation legislation was identified, resulting in the passage of the Transportation Equity Act for the 21st Century (TEA-21) in 1998. As urban areas grew in size, political power and economic importance, TEA-21 updated the requirements of metropolitan planning process to place even greater emphasis on new planning factors, including improved mobility of people and freight, improved modal connectivity for all modes, improved system management and a focus on maintaining and maximizing the value of the existing transportation system (FHWA, 2015). Building on the previous acts, the Safe, Accountable, Flexible, and Efficient Transportation
Equity Act: A legacy for Users (SAFETEA-LU) expanded programs for safety, congestion reduction, improved freight movements, increased intermodal connectivity and environmental protection (FHWA 2005; Dilger 2015).

In 2012, Moving Ahead for Progress in the 21st Century Act (MAP-21) was passed as a major reconstruction of federal surface transportation programs implemented under previous legislation, placing greater emphasis on outcome performance measures. The MAP-21 placed renewed emphasis on streamlining the national surface transportation program, making it more performance based and aligning outcomes with national transportation goals to increase intermodal systems’ efficiency and effectiveness in support of the nation’s continued economic growth. This act also specifically addressed the need for improved planning coordination between ports, airports and their highway connections serving the region (USDOT, 2015).

Metropolitan transportation planning policy and guidelines were updated with the passage of Fixing America’s Surface Transportation ACT (FAST Act) (FHWA, 2016a). This act generally continues the broader program requirements defined under the previous transportation legislation and are directed and funded through agencies (Federal Highway Administration-FHWA, Federal Transit Administration-FTA) aligned with the highway trust fund and with implementing surface modes, predominately highways and rubber-tired transit. Expanded general requirements in the law now specify the process for developing the transportation plan and TIP to include consideration for all modes with greater detail on specific outcomes to ensure compatible modal planning goals (FHWA, 2016a).
In the previous policy provisions, airports are identified as having a special role in stimulating continued economic growth and diversity by providing the region it serves an essential global linkage for business and tourist travel, supporting movements of high-value air cargo, serving as a major employment center for business logistics and transportation related jobs and creating a tremendous positive regional economic impact (FAA, 2015). In 2012, aviation-related economic activities generated $1.5 trillion and supported 11.8 million jobs with $459.4 billion in earnings (FAA, 2015d). The number of air passengers using U.S. airports grew from 767.2 million in 2004 to 895.5 million in 2015, and around 23.6 million tons of air freight was enplaned through U.S. airports in 2015 (BTS, 2016). As aviation-related economic activities supported by increased air passengers, air cargo, employment and other supporting aviation uses has expanded over time, the demand for passenger cars, trucks and commercial service vehicles accessing the airport has increased proportionately. This growth has in turn made ground access to airports become an essential critical link in the regional transportation network development (GAO, 2015). Aviation and ground transportation modes are interdependent, and neither can serve the connectivity or mobility needs of their customers without the other. This is even more critical for urban airports and the interconnected urban surface transportation system supporting it because congestions and consequent negative economic and social effects are very apparent in urban areas, as well as along transportation access corridors already experiencing traffic congestion, delay and safety concerns.

For the airport to continue to be successful in supporting the regions’ global economic connectivity increase, coordination between aviation and surface planning
programs is required to reduce access time and cost and to ensure long-range modal development compatibility. For that, transportation planning requirements have evolved to place a special emphasis on the need to accomplish coordinated planning and development of access to ports, rail intermodal facilities and airports, linking them to the regional, state and national highway transportation system. ISTEA redefined relationships between MPOs and state and local governments by enhancing the role of MPOs in the transportation planning process. ISTEA increased MPOs’ funding; granted more local control over the planning and programming of projects; required transportation planning agencies to evaluate other modes; placed an emphasis on improved intermodal integration, connectivity and compatibility; and added representatives from other modes as active participants in the MPO planning process (Research and Innovative Technology Administration, 2016). SAFETEA-LU required MPOs to coordinate or consult with planning officials who are responsible for other planning activities such as planned growth, economic development, environmental protection, airport operations, and freight movements (FHWA, 2005b). The MAP-21 required each MPO to establish performance targets that are to be coordinated with the relevant state and public transportation providers to ensure consistency to the maximum extent practicable. In addition, MPOs were mandated to include officials from public transportation systems in their planning and decision making process (FHWA, 2013). The FAST Act added public ports and private transportation providers into the planning process and required MPOs to consult with officials from other types of interrelated planning activities, such as local land-use and environmental regulatory agencies (FHWA, 2016b).
These federal surface transportation policies have delegated legislative authority for providing surface connectivity to the MPOs, and required airports to be subjected to strict coordination and plan consistency determinations by the agency. This is complemented by FAA and state DOT policies, directing the participation of MPOs in the development of state aviation system plans as well as preparation of the airports’ master development plans. The federal surface transportation programs also allow for funding systems’ alternatives when other modal improvements create a better cost/benefit than funding more traditional highway access alternatives (FHWA, 2012). Airports have a positive impact for advancing airport-related access projects because MPO planning policy sets priority for projects that: 1) support economic vitality for the metropolitan area by improving global competitiveness, productivity and efficiency; 2) increases the accessibility and mobility of people and freight movements; 3) enhances the integration and connectivity of the transportation system across and between modes; and, 4) enhances travel and tourism (FHWA, 2016). This initiative would allow access consideration and funding options to include various forms of highway or transit access improvements to the airport. With these changes, airports now have equal standing on the MPO by providing airport representatives equal powers and duties with other designated officials in the construct and approval of MPO plans. Additional criteria impacting the airport is the provision for on-site airport roadways and other major infrastructure programs included in the airports Capital Improvement Program (CIP) to be coordinated with the MPOs air quality conformity determination process prior to implementation (Gosling G., 2008).
This is a key point in the legislation for Florida and its airports since a rapidly growing population, economically vital tourism and air cargo are integrally linked to the state’s continued economic success. In July 2015, Florida’s population grew to reach 20.27 million residents and was approximately 92% urban (Bureau of Economic and Business Research, 2015). Florida’s population is projected to exceed 27.22 million by 2045, placing even greater demands on the state’s infrastructure, quality of life and its fragile environment. In addition, during this same period Florida had over 97 million annual tourists visit the state and over 50 million of these visitors came by air transportation (Florida Department of Transportation, 2015). This rapid growth compounds urban congestion with Florida’s urban areas already ranking as some of the worst congested in the country (Federal Highway Administration, 2015). Growing congestion decreases productivity and limits a region’s global competitiveness, necessitating the implementation of a more creative system’s approach to address this challenge. Shrinking transportation resources also dictates that all modes work cooperatively to solve their joint transportation challenge in the most cost-effective and efficient manner.

**Problem Statement**

In order to support legislative policies and to aide in achieving their goals, the U.S. Department of Transportation (USDOT), Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) provide more specific and extensive guidelines to states and MPOs in accordance with U.S. Code: Title 49 - Transportation and U.S. Code: Title 23 – Highways. States prepare state modal plans, which are required to be consistent with national modal plans and also with the foundation for adoption of a state Transportation Plan and policy. To ensure modal consistency MPOs
have designated roles in the preparation and coordination of state modal plans as well as individual mode development plans, MPOs are also required to adopt a 20-year transportation plan for the urban area consistent with policy and within its five-year capital improvement program (CIP) establish multi-modal funding priorities aligned with enhancing intermodal connectivity (i.e. improving access to ports and airports) and the overall transportation systems operational performance (FHWA, 2015). These federal guidelines mandate MPOs to ensure that surface transportation planning processes include extensive modal coordination and that results in an adopted surface transportation plan are compatible with and ensures improved intermodal connectivity (FHWA, 1995). Federal provisions required the MPO structure to include officials of public agencies who administer or operate major modes of transportation in the metropolitan area, such as airports. The 23 CFR 450.206(a) (4) also required the MPO plan to develop freight and passenger options to meet the needs of all modes and their connections within the planning area.

Federal legislation sets requirements for airport operational licensing and, through rule development, backs the promulgation of Federal Aviation Administration (FAA) policy and procedures to guide aviation development in the U.S. The 2012 adoption of the FAA Modernization and Reform Act continued federal funding for aviation and placed renewed emphasis on streamlining airport development, the environmental review process and decentralizing more authority to FAA regional and state programs to improve direct coordination with local airport sponsors (US Government, 2015). Implementation of policy is directed through compliance with FAA regulations and advisory circulars. Provisions directly applicable to airport access are
listed in FAA regulations for planning and grant assurances and in Advisory Circulars (AC) for development of Airport Master Plans (AMPs) (FAA, 2015).

Airports are required to prepare a comprehensive 20-year master plan, including a section focused on defining the airport’s existing and future ground access, circulation and parking requirements both on- and off-site (FAA, 2015). Prior to adoption, this plan is to be coordinated with the local government for future land-use consistency and with the regional-metropolitan transportation planning organization (MPO) to support their planning process for development of a compatible intermodal access plan off-site (FAA, 2015). The AMP is to be developed consistent with other agency programs and also remain consistent with adopted state and federal aviation plans (FAA, 2015). All major access needs are to be coordinated with the MPO for inclusion in their intermediate and long-range plans and funding within their Capital Improvement Programs (CIP). Since airport funds are limited to on-site applications, airport staff are appointed as designated members of MPO Technical Advisory Committees and participate regularly in MPO meetings and functions to ensure the airport’s off-site access, air quality conformity and freight planning requirements are addressed in the adopted plan. Other noted changes in both the aviation and surface transportation legislation included restructuring and simplification of the project delivery process and granting more local flexibility and control of the CIP to local MPO’s, further supporting the need for greater airport involvement in these organizations.

The airport’s agenda is framed by agencies like the FAA that are tied to implementing policies and funding objectives of the aviation trust fund and advancing the aviation program, which is predominately focused on airport airside development.
Successful planning processes typically follow the money for plan formulation and project implementation. Even though all federal transportation agencies are under the direction of the U.S. Department of Transportation (USDOT), legislative mandates and agency project requirements are driven through the modal agencies. This independent agenda and noticeable divide is also maintained as states promulgate their own state transportation laws to implement federal and state transportation programs. While coordination and development compatibility requirements are generally dictated at both levels of government, the guidelines often do not have the same level of priority, include a clear definition for the objectives of modal coordination or define penalties for non-compliance as with individual modal planning programs. This often creates independent planning agendas that may complicate or unintentionally create barriers for the development of compatible plans and implementing projects to enhance seamless intermodal connectivity and compatible long-term modal development within the urban area.

Off-airport surface access requirements for the airport are required to be addressed in the AMP but to a lesser extent are compared to on-airport circulation requirements that are clearly defined within the guidelines and listed even as low priorities for receiving federal aviation trust funding. Also noted is the airport sponsor’s obligation to coordinate with the state DOT, local and state agencies, as well as the MPO. Achieving transportation plan consistency is a critical first step in assuring compatibility with other planning processes. The AMP requirements address coordination to document compliance for aviation activity forecasts; land-use; security;
air, noise and environmental compliance; surface intermodal transportation plan consistency; and public involvement (FAA, 2015).

Even though legislative requirements still focus on ensuring MPO plans remain consistent with other adopted state and federal modal plans and programs, there are little detailed guidelines, audit processes or penalties to ensure compliance. This is compounded by the fact that MPO, local land-use planning agencies and airport authorities (FAA, 2015) all have independent, yet interrelated, planning processes that are bound by legal and policy requirements to ensure compatibility. The complexity of these independent agency guidelines, policies and planning practices often creates a different technical culture and language that is either unknown or has a slightly different meaning to the other agency. Schedules, funding limitations, technical complexity and political objectives often push these independent agencies to develop and adopt long- and short-range plans that may not ensure all projects are truly compatible or mutually supportive of the other agencies’ activities and objectives. This potential for inconsistency can compound urban congestion problems, reduce global connectively and the associated economic value of the transportation system and negatively impact the mobility of people and goods (US Code, 2015).

Today there is a general lack of mutual understanding between modal agencies even though agency coordination occurs at various levels. MPOs currently have little understanding of how they can evaluate the urban airports’ activity and off-site access needs, or how they can incorporate the AMP into the MPOs’ adopted long-range transportation plan for the region. Currently MPO models rely on land-use and demographic data provided by local governments to generate trips, network
assignments, mode split and planned growth needs. Typically the airport is addressed in this format as an industrial land-use, an employment center and a trip attractant. While current model input data works well to simulate travel demands of tradition urban land-use and development, it is very ineffective in representing the airports’ unique operational characteristics within the model structure. Both MPOs and airports need a clear understanding of the data and programs needed to support inclusion of required airport access improvements into both organizations’ adopted plans to ensure a compatible result.

MPOs are also facing technical challenges of their own in both the travel demand modeling capacity and the resources to improve their modeling capability. Some MPOs are already attempting to update travel forecast techniques as the conventional four-step models are unable to address the increasing complexities of transportation issues. However, most MPOs lack the resources to improve their modeling capacity to meet with the increasing complexity of urban transportation systems and a growing set of new transportation requirements. MPOs especially suffer from lack of quality data needed to reflect current travel patterns in metropolitan areas and support development of their long-range transportation plans to be more objective and credible (GAO, 2009). Airports are one of the essential land-uses that need further research. For the urban transportation models to work appropriately, airport data is needed to represent its unique travel behaviors for originating and visiting passengers, their broader market reach and their diversity of on-site activities and schedules. Since a standard trip classification, such as home-based non-work trips in regular regional travel models, is not able to address air passenger trips or some of the other airport activities, a number
of MPOs consider airports as a special generator and develop sub-models to better reflect these facilities’ needs in the surface network. The special-generator sub-models used in conventional four-step travel models, while a step in the right direction, are not currently able to accurately estimate the diverse trip activities associated with airports (Gosling, 2005). These sub-models currently do not include data or analysis of airport activities that could result in more precise trip generation, distribution and mode choice for the airport based on its specific operational requirements for proper model estimation (Cambridge Systematics, Inc. et al., 2012).

MPOs and airports in Florida have experienced the same limitation in their planning practices. In Florida, the passage of HB599 was completed to update state policy for conformance with federal transportation legislation and to provide additional policy guidance to the Florida Department of Transportation (FDOT) and MPOs. While many policy issues were addressed, relevant additions or renewed emphasis was placed on intermodal connectors, freight and the development of performance measures used to evaluate the success of transportation investments. The new Freight Mobility and Trade Plan, updates to the Strategic Intermodal Systems Plan (SIS) and the new Intermodal Development Plan all are directed to place special emphasis on improving access to airports, seaports, spaceports, passenger terminals and rail terminals. Performance measures are used to set priorities for expansion of facilities that improve the movement of people or goods between Florida regions or provide improved connections to other markets in the U.S. or other countries, which results in Florida’s enhanced economic competitiveness (Florida Senate, 2012). This will give Florida’s airports competitive standing when dealing with other modes and agencies or
when it attempts to obtain project funding since the state’s economy is so heavily dependent on airports. The total annual economic impact of airports in Florida, when considering on-airport activities, tenants and visitors, are responsible for $116 billion in annual economic output and over 1 million jobs (FDOT, 2014).

Florida airports are required by the FAA and FDOT to develop and operate in compliance with an approved AMP, as defined in AC150/5070-6B (FAA, 2015). The AC identifies airport access, on-site circulation and parking as some of its key facility requirements to support continued airport operations and future growth needs. Development of the AMP is coordinated with and approved in Florida by the FAA, FDOT and local governments and/or authority sponsors. In addition, when the airport is located within the boundaries of a federally designated metropolitan area, the preparation of the AMP, including the airport’s short- and long-range development program and related access needs, are required to be coordinated with the surface transportation planning program or MPO, and the county Comprehensive Plan and its Transportation Element. Aviation funds are limited to on-airport use, and planning coordination is intended to assist the surface transportation modes in planning and development of off-site connections to the airport consistent with local planning policy and funding objectives (FAA, 2000).

Over the past 10 years, numerous access studies have been completed by airports and associated research agencies. Most of these studies have addressed the site specific access needs of a single airport or provided a focus on large hub airport access needs in great detail, especially for transit or rail, while at the same time these studies have recognized the industries’ limitation of not having a data set or model
interface to work within the surface transportation model that would provide a better, long-term representation of the airport’s needs. Airport sponsored research developed to address off-site access has provided a wealth of new knowledge, defining the unique operation characteristics of the airport and its trip characteristics. But the obvious step of providing a method to utilize this data within the MPO off-site access planning process has not been developed. This is an essential missing component of the research because funding for the off-site airport access projects are planned and budgeted through the MPO planning process, not the airport. Even though research into how best to address airport access is very limited to non-existent for the surface transportation planning model applications, whatever model application is developed needs to work within the planning structure of the responsible funding agency. The airport-sponsored access model, if developed, would not likely be an acceptable substitute for the MPO model unless the airport also planned to fund the off-airport access project, which institutionally is very unlikely (FAA, 2000).

With these limitations, little success has been achieved in including adopted airport master plans, or their supporting data, into the MPO surface transportation planning process even though significant efforts have been made to improve modal planning coordination. Today both modal planning processes remain largely independent with little, if any, cross utilization of technical planning data to support the plan outcomes of the other mode. Improved compatibility helps both surface and air transport by improving the efficiency of the total transportation system (Jin, Wang, & McAnally, 2004). An improved, more collaborative modal planning process needs to be defined to address and fix this critical transportation planning problem.
Statement of Purpose

This research aims to define a potential planning procedure to effectively integrate airport access planning into the metropolitan surface transportation planning process. The new planning framework seeks to utilize more precise airport data to more accurately reflect the airports access needs as well as to ensure compatible planning results for urban airports and the metropolitan surface transportation system. In pursuing its research objective, this study seeks to address the following questions: (1) What factors within the current transportation planning framework hamper coordination of joint airport access and surface transportation planning efforts in metropolitan areas; (2) What planning framework could be developed to provide an improved integrated planning procedure for MPOs and their airport partners; (3) What existing airport resources and data can be shared with the MPO to better reflect the airports off-site access needs; (4) How can existing airport data be operationalized for use in metropolitan transportation planning models; and, (5) If successful, can the new planning framework be applied to MPOs and urban airports across the U.S. while at the same time providing a unique, site-specific representation of each individual airport?

This study first examines planning procedures utilized by the local aviation and urban surface transportation planning professionals to evaluate the access and mobility needs of the urban airport located within the metropolitan planning area boundaries. This study reviews the four-step model, which has been widely used as the conventional travel forecasting procedure since the Bureau of Public Road (BPR) adopted it in the 1960s to support the Continuing, Comprehensive and Cooperative (3C) transportation planning process requirements. This study also examines the activity-based model to which many MPOs are adopting or considering for transition. The
activity-based model is considered to provide a better representation of today’s more
diverse travel patterns as well as improved forecasting of future travel demands,
allowing more informed decisions in preparation of the transportation plan. In reviewing
these transportation models, this study primarily focuses on the four modules within the
four-step model. These are trip generation, trip distribution, mode choice and network
assignment, all of which were selected due to the similarity of data needs between both
models. It also discusses how airports are modeled in the surface planning models and
what limitations must be addressed in development of the new planning framework.

Secondly, this study seeks to define a common planning procedure to improve
the efficiency and effectiveness of integrating off-site airport access planning into the
surface transportation planning process. This study attempts to provide an alternative
planning framework to improve the airport’s representation within the MPOs’ forecast
models, producing satisfactory and usable outcomes for both modal partners. In the
current MPO planning process, airports are generally characterized as industrial land-
uses and employment centers. Airport trips are assigned to the airport as an attractant
zone and most often analyzed using either regular regional travel, such as home-based
non-work trips. Occasionally the MPO may utilize a special generator sub-model to
generate passengers’ or/and employees’ trips to and from the airport zone in the model,
but these are assigned using traditional regional travel purposes. This process could be
improved by modeling airport-related trips separately from general regional travel
patterns, and then integrating with other trips as a separate function.

In addition, this study seeks to define the most applicable and available
resources and data currently available at airports for use in off-site access planning. It
then attempts to define the best method to operationalize this existing airport data by identifying a simple but professionally acceptable methodology to transform the airport data into a format suitable for use in surface transportation analysis models. Among modeling elements, quality data collection is often the most important function because inaccurate or out-of-date data may produce inappropriate forecasts, producing poor planning and decision-making results. Under current transportation planning processes, the lack of data (or inaccurate data) has been identified as the major obstacle by urban surface transportation planning professionals for developing accurate airport access plans. Therefore the processes of data identification, selection and application methodologies are critical for the airport to ensure reliability in travel demand forecasting within MPO models. It is also essential for planning agencies to reduce data acquisition time and costs so the joint planning framework will strive to use existing data and keep the methodology as simple as possible to satisfactorily achieve the desired results.

This study then evaluates the effectiveness of the proposed planning framework by applying the newly acquired airport data to local MPOs’ transportation models. In order to empirically test the potential planning process and applicability of airport data, this study utilizes the transportation forecast models used by the North Florida Transportation Planning Organization (NFTPO) and airport data collected from the Jacksonville International Airport (JIA) in Jacksonville, Florida. The NFTPO has historically used the four-step model to assist in preparing its long-range plan. Staff has extensive experience working with the four-step model and has recently adopted and is nearing completion of its conversion to the activity base model for its plan preparation.
Being able to work with both models and experienced staff in one location is a major advantage. The agency has developed the Northeast Regional Planning Model - Activity Based (NERPM-AB), which includes a set of travel demand routines to predict household and personal travel choices at a parcel-level on a minute-by-minute basis. The resultant data and travel choices are utilized by the model to assign the predicted travel demand to roadway and transit networks to produce estimates of network performance. The NETPM-AB has enhanced model features to analyze different activity types using detailed land-use information and is expected to provide more accurate travel patterns and characteristics to and from the airport. In addition to shifting to a more advanced travel model, the NFTPO has made the decision to expand its model application outside of the tradition MPO boundaries for more regional coverage, which will benefit from the airport data and has already taken an aggressive position by placing members of other local transportation agencies, including JIA on its policy board (NFTPO, 2016). JIA is a medium-hub commercial service airport serving approximately 5.5 million passengers and 145 million pounds of air cargo in 2015 (JIA, 2016). The airport has a large service area with a very small leakage of passengers to other competing airports. JIA is located within the TPO planning boundaries and depends on highways for 100% of both access and egress trips to and from the airport. The airport is also a Development of Regional Impact (DRI) and must work under a restrictive development order that requires extensive annual reporting and concurrency traffic monitoring on the adjoining highway network, which will be of value in testing the planning framework’s accuracy. These extensive positive factors make this location ideal to test the potential planning framework.
Once this study confirms the effectiveness and efficiency of the potential planning framework’s application and use of airport data, this study attempts to validate whether collection and operationalization of airport data could be generalized to airports across the U.S. by comparing JIA data with the airport activity data from the Southwest Florida International Airport (SFIA) in Fort Myers, Florida. SFIA is also a medium-hub commercial service airport with a large service area and is within the boundaries of an MPO. In 2015, SFIA served nearly 8.4 million passengers and 32.2 million pounds of air cargo (SFIA, 2016). If similar data can be obtained for SFIA, the framework will be shared with the MPO to examine its value in application and use in their model. This comparison is expected to provide valuable insight for the use of the planning framework and airport data to other airports. This data and information obtained from the literature review will be utilized to examine the need for different levels of application for the planning framework based upon the size and location of the airport.

**Scope of Research**

This study consists of an abstract and six chapters including: (1) Introduction; (2) Literature Review; (3) Methodology; (4) Findings and Results; (5) Discussions and Policy Implications; and (6) Conclusion and Recommendations. Chapter 1 presents background information of the federal legislative efforts to integrate the airport access and metropolitan transportation plans, a problem statement, a statement of purpose and the scope of research proposed. In Chapter 2, this study reviews previous studies, research and federal policy focusing on the evolution intermodal transportation systems planning and related agency guidelines.

Chapter 3 provides a theoretical framework and proposed methodology to improve the integration of airport access and metropolitan transportation planning. This
study examines current metropolitan transportation planning processes focusing on data needs and uses for both the conventional four-step model and activity-based model to support development of a new potential planning framework to promote greater collaborative planning efforts between MPOs and their airport partners. It then explores available resources and data available from airports, such as defining different characteristics and operational uses for airport property, air passenger counts, employment, air cargo, general/corporate aviation activities, military and non-aviation development for potential application in assessing the airports off-site access needs. It also attempts to identify the best data and methods to collect existing and future airport data. Once collected, the research will develop a professionally acceptable methodology to transform the airport data input into an acceptable format for use within the MPO transportation model to accurately display airport access corridors and needed improvements.

This study provides analysis results for input-output models developed from airport data and transformed for use in transportation models in Chapter 4. This section describes a comparison of the existing model data for the airport and proposed new airport data, expected value and preliminary results from both the four-step and activity-based models used by the NFTPO. The results of the analysis are expected to validate whether the joint agency planning framework can effectively utilize airport data collection and operationalization methods to successfully integrate airport access planning into the metropolitan transportation plan. Then this study compares JIA data to SFIA data and local MPO models to test whether similar airport data and processes can be generalized across airports in the U.S. In the next chapter, this study discusses
findings and policy implications. For that, this study focuses on what improvements are provided by the new planning framework, what potential limitations are in using the new planning process and what actions may be necessary to address and resolve these concerns. This study presents concluding remarks and research that needs to be addressed in future studies. The recommendations emphasize key points and critical needs to focus future studies.
CHAPTER 2
REVIEW OF RESEARCH LITERATURE

Studies on the Significance of the Airport Ground Access System

Early research documented the critically important role of the surface transportation system in supporting the efficient operation of the airport (Initiatives, 1980). Existing research highlights the value of improved intermodal connectivity, plan compatibility and the value of coordination to improve the overall transportation systems’ function. This need is increasing since basic infrastructure expansion has not kept pace with economic growth, placing even higher demands on existing facilities. New investments in airports and other transportation facilities to improve systems’ performance can erode quickly without a stronger public agency commitment to intermodalism and promoting the most efficient use for each mode. The private sector has embraced logistics to manage the movement of both people and goods through the intermodal transportation system as the most cost effective way to remain competitive in the global economy (Goetz & Vowles, 2007). Businesses already recognize that access and connectivity are key factors in a positive economic outcome. Past research has documented the positive effect of changing access to markets and connections to intermodal transfer terminals and their impact on economic growth (Alstadt, Weisbrod, & Cutler, 2011).

Federal Guidelines and Directives for the Intermodal Transportation System

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provided a clear definition of agency management responsibilities under federal law. This law promoted a joint FAA and FHWA project entitled “Intermodal Ground Access to Airports: A Planning Guide” that provided guidelines, techniques and data for planners,
engineers and airport staff for ground-access planning in compliance with current laws, policies and procedures (USDOT, Research and Technology Administration, 1995). The main purpose was to aide aviation and surface transportation practitioners in building partnerships to strengthen the planning process for joint airport access project planning (USDOT, Research and Technology Administration, 1995). The guide provided a comprehensive set of information to educate a wide variety of users on the airport ground access planning process, policy issues, problem definition, performance measures and case studies for best practices (USDOT Research and Innovative Technology Office, 2016). This document was to be developed in several volumes and was planned for wide distribution, but it was not advanced beyond a partial volume one by the joint agency task force and the effort was terminated prior to completion. As a result, guidelines were never developed to define how airport data could be utilized by the MPO or how MPO data could be utilized by the airport.

A collaborative, joint-agency planning process is required to define off-site airport access needs for inclusion within the urban surface transportation. MPOs are mandated by ISTEA to have primary responsibility for planning and programming activities for off-site airport access within the MPO boundaries and to coordinate with the state for broader regional coverage. The MPO utilizes its transportation management systems to better define, assess needs and evaluate implementation alternatives. The Congestion Management System (CMS) and Intermodal Management System (IMS) both address specific applications relevant to the airport access project. The CMS uses demand management strategies to reduce the use of single occupant vehicles in favor of public transit to reduce congestion. The IMS uses state and federal plans and policies to
promote development of a seamlessly interconnected transportation system by improving linkages between modes. The IMS focuses on intermodal project needs, such as airport access, where modal linkages require planning for aviation development to become more integrated within the planning for surface transportation modes. Once identified, the surface airport access project included in the urban transportation plan is to follow guidelines similar to other projects contained within the plan (USDOT, Research and Technology Administration, 1995). Continuing modal segregation in the planning process will not likely produce a compatible planning outcome for either mode.

Intermodal connectivity continued to be a major issue and prompted the Airports Council International – North America (ACI-NA) to conduct a survey for 253 commercial service and general aviation airports in the U.S. in 1994 to define critical issues and capital needs associated with airport access. The survey documented that 73% of airports surveyed experienced high levels of passenger congestion and delays due to airport access and on-site roadways, compared to only 20% experiencing delays from airside/airfield capacity restraints. The results of this survey became the major impetus for a subsequent research effort to define better planning methods to define airport trip generation (Ruhl & Trnavskis, 1998). Key conclusions from this research include: a) trip generation and mode split estimating procedures are critical in predicting accurate airport traffic volumes; b) airport trip generation is the sum of trips generated by discreet land-uses on-site; c) for commercial service airport terminals a statically significant relationship exists between vehicle trip ends and number of origin-destination (O/D) passengers; d) predicting mode split requires site-specific data but noted as the O/D volume increases the percentage of automobiles declines; e) traffic volume
characteristics from vehicles accessing passenger terminals follow the characteristics of
enplaning and deplaning passengers; and, f) trip generation and mode split for
passenger terminals vary significantly based upon size (small, medium and large hubs),
but each level can have a wide range based upon local mode split characteristics (Ruhl
& Trnavskis, 1998).

Intermodal guidelines and directives are not limited to surface modal agencies.
The FAA promulgated several documents aimed at providing guidance to the aviation
community and others to clearly define what were perceived to be airports’ roles and
obligations in coordinating surface access planning. Bulletin 1: Best Practices-Surface
Access to Airports (FAA, 2000) was issued and updated periodically primarily for FAA
offices to provide consistent direction to airport sponsors. This FAA document and
related supporting policy documents clearly dictated the limited use of “airport revenues”
to items “directly and substantially related to the air transportation of passengers.” While
the FAA did agree that on-site roadways and certain transit facilities exclusively serving
the air passenger and owned and operated by the airport could be eligible for funding,
off-site access project development and funding is defined as the primary responsibility
of other agencies. After extensive coordination with the FHWA, FTA, state DOTs, MPOs
and Regional Planning Commissions, the FAA provided additional expanded guidelines
directed to the airport sponsor to define their roles in off-site access planning.
Recognizing the significant demand and interdependence the airport placed upon local
highways and transit systems, urban airports were to become active participants in
MPO activities related to the surface access and land-use needs of the airport.
Participation by the airport sponsor was initially focused on educating public officials of
the airport’s value and its role in the overall transportation system. The goal, however, is to ensure that the adopted MPO plans accommodate the surface access, land-use and air quality requirements of the airport. Outside of urban areas, the airport sponsor is to coordinate these activities with the state DOTs. As project needs were defined, airport/MPO coordination establishes each agency’s responsibility for planning, including data and analysis needed to justify the project and move it toward compatible implementation (FAA, 2000).

**Airport Access in Airport Planning**

Integrating modal and land-use planning within the urban environment has been the subject of substantial research (Ward, Massey, Feldpausch, & Puchacz, 2010). This research has resulted in significant progress with integrating local land-use, supporting demographics and related mobility objectives within the individual transportation mode development plans (FHWA, 2014). However, modal planning practice and coordination between the modes, especially aviation and surface transportation planning, do not have consistent guidelines to evaluate proper intermodal access or service requirements common to both modes. In fact, off-airport access planning is often a low priority for airports and MPOs, possibly due to the lack of a cost-benefit model for evaluating intermodal projects and the current structure of modal funding for airports and surface transportation. Separate federal legislation and supporting trust funds for surface transportation and aviation provide little incentive for these organizations to develop a comprehensive intermodal planning process for airport access (Horowitz, 2003).

On-site airport roadways are exclusively within the domain of the airport, although they are usually a low priority for aviation funding and almost always are
exclusively a sponsor obligation for local funding and development. These internal roadways provide essential access to many different on-site land-uses, serve a wide variety of vehicle types and, because of their unique operating requirements, cannot be adequately addressed by traditional Highway Capacity Manual (HCM) techniques or models that have been adapted over the years to address an expanded list of surface modes off-site. These differences have resulted in development of different analytical tools and design standards for airport roadways that often limit their value for off-site applications. A more detailed understanding of the airport’s differences in traffic characteristics and user expectations is required to properly address planning and facility development on the airport. It would also address why on-site simulation tools may not be relevant for off-site applications (Duncan, 2002).

A few specialized research efforts have focused on internal airport roadway operations. Some of the recommendations and methods contained within these studies have merit for off-site regional roadway consideration, although by their own accord will be of very limited value. Secure and non-secure segregation of uses for the passenger terminal complex, specialized signage, cargo facility operations, concessionaires and service vehicle access, general aviation, non-aviation development and occasionally a joint-use military facility only highlight additional considerations for airport planning and the work required to develop a common surface access planning framework on-site.

Many of these considerations were addressed in a research report entitled “Airport Curbside and Terminal Area Roadway Operations” (Leigh Fischer, 2010). This study also utilized the tradition four-step modeling approach to develop traffic volumes for on-site analysis. Trip generation relied heavily on specific land-uses, like the airport
terminal and linking appropriate operational characteristics of that use, such as passenger volumes, employee data and time of day statistics with the Institute of Transportation Engineers (ITE) trip generation rates to predict generated traffic volumes. Due to the complexity of uses on-site, the study also recommended a quick method for predicting future traffic volumes by obtaining current traffic volumes and escalating them at the same rate and hourly distribution as documented in the airports approved passenger forecasts. Trip distribution focused on locating access points entering the airport, on-site routes and on-site destinations realizing each use had a specific type of demand based upon its operational characteristics. The study highlighted the unique mode choice characteristics of airport users. While regional models typically only consider private vehicles and public transit, the airport must consider a much wider variety of travel options including taxicabs, limousines, courtesy vehicles, rental cars, scheduled buses and several other modes, including rail. Trip distribution used existing and predicted traffic volumes entering and exiting the airport and directed these volumes to the desired on-site land-use by the most direct route. For off-site routing, it was recommend that the airport contact the MPO to determine the most likely regional routes for airport access.

**Airport Access in the MPOs’ Transportation Planning Process**

Predicting an airport’s access needs begins with the discrete identification of each land-use contained or planned within the airport’s property. For each of these uses, the trip generation, distribution, mode-choice and network assignment must be defined for each activity if it is to remain somewhat consistent with the MPO four-step model planning process (McNally, 2007). Most of this base data for the airport can only be defined through airport sources (i.e. passenger counts and projections), and unless
some acceptable form of collaboration between the modal planning agencies is defined
to jointly share data needed for traffic projections, it is unlikely that an accurate forecast
can be developed by the MPO for the airport. In defining and collecting the necessary
surface model input data, close coordination with the MPO staff can reduce the
complexity of some tasks and help ensure usable results from the airport data collection
efforts. A joint effort between MPO and airport staff is needed to produce a workable
data collection methodology. This approach is essential to produce a common, agreed-upon solution since airport ground access is critical to both the airport’s on-site landside
planning, as well as the MPO’s regional transportation modeling and off-site access
planning. It is at this junction that serious disconnects in the planning process can occur
if both parties’ interests are not equally served by the adopted planning process
(Reibach, 2013).

Recent research on airport ground access procedures and modeling has
documented a comprehensive review of relevant literature on this subject (Reibach,
2013); completed numerous surveys of MPOs, airports, researchers, governmental
agencies and other practitioners; and has amassed a sound state of practice, albeit
somewhat narrow and mostly from an airport’s perspective. The report provides a good
overview of air passenger and airport employee mode choice models developed over
the past 20 years, as well as informative survey results from a broad cross section of
MPOs (Gosling G. D., 2008). While the study concludes that an accurate airport ground
access model to reflect the trip characteristics of all airport uses does not exist, it does
concede the fact that the MPO has final authority and is responsible for funding the off-
airport access system (Gosling G. D., 2008). The majority of the models reviewed were
primarily designed to address on-site airport circulation issues, such as curbside congestion, access and service road circulation, parking and related capacity constraints for airport facilities, while a second group evaluated procedures for providing improved transit or rail access. Those identified as dealing with airport access were generally limited in scope (passenger and employee activity), were proprietary or were not able to fully interface with the MPOs transportation planning model. As an example, the study did evaluate the use of the traditional four-step model for airport traffic analysis but applied it to on-site activities only without reference to MPO procedures. It recommended generating traffic volumes for each on-site land-use and focused mostly on the airport terminal utilizing airline passenger volumes as the independent variable to statistically relate to trip production. Other land-use discussions were limited since little research exists for specialized airport uses, such as cargo and maintenance hangars, hotels, airport concessions or corporate aviation facilities. This further complicates the process of defining acceptable airport factors to utilize in quantifying the individual facility’s trip generation characteristics. Trip distribution, mode-choice and trip assignment was focused on defining on-site roadway network usage and vehicle travel patterns to and from various on-site facilities. The inherent value of this study is limited to defining a broad cross section of available airport data that may have value in development of compatible airport input factors for future use in an MPO model to more accurately depict the airport true surface access needs off-site. This study also provides an interesting recommendation for future research, focusing on preparing an airport sponsored and developing models to address off-site access. This is institutionally not a good idea for airports. Airports do not have the primary responsibility for off-site access.
planning, nor can they pay for identified projects. Ideally this effort should be led by the MPO and heavily supported by the airport.

Today, most MPOs utilize a traditional Four-Step Regional Demand Model to develop their long-range plan. This model has been in use for decades and is built on local land-use and demographic data to develop its basis for trip generation. It uses regional origin/destination surveys for trip productions and attractions, incorporates local mode split information to establish trip tables and then completes an iterative assignment to the surface network to establish and validate highway corridor volumes and operational levels-of-service (Goldfarb, 2010). This modeling process has historically served the traditional highway surface transportation planning process well and only more recently has added a model sub-routine to incorporate separate “special generators” that have more unique characteristics.

A recent study found when airports were included in urban models they were almost exclusively treated as special generators. As such, the study also found additional local surveys were typically required to obtain specific data on the facilities’ trip generation characteristics to calibrate the urban models. Typical data collected for airports included the number of employees, passengers and aircraft flights or utilized other accepted trip rates from the Institute of Transportation Engineers Trip Generation Manual (Mamum, Yin, & Srinivasan, 2010). While some of these methods, including adding in a numerical factor to balance trip estimation and actual traffic counts, improved representation of the airport’s trip generation characteristics within the model, it did not fully represent the airport’s access requirements. The standard model process was used for origin/destination, mode split, timing and network assignment. This
procedure did not use airport specific data and therefore did not represent its operations accurately. The airport’s surface access demands are unique and are not represented well in this type of model application. The special generator routine, when utilized for trip generation alone, cannot fully simulate the airports effect on the surface network. Therefore, even use of this sub-routine can produce unreliable results if not properly coded to match the AMP activity levels, unique functions within the airports operations and its related trip characteristics and timing. MPO models generally treat airports as a land-use with distinctive employment characteristics (much like an industrial park); occasionally use the “special generator" module to simulate passenger trips and employee trips although they are distributed in the model by mode and origin/destination similar to other regional home-based work trips; or, in many cases, do not include the airport in the modeling at all, assuming it is included in background traffic data (Gosling G. D., 2008).

The special generator file, when used, is validated to match existing site trip generation characteristics and traffic volumes for the airport with a manual adjustment to the k-factor to make the forecasted traffic match the observed volumes. This method raises the trip rates for home-based work and non-work trips evenly across the modeled area to compensate for trips from visitors outside of the area, which are not included in the model. This number usually remains constant even though future years normally experience significant growth in airport activity, resulting in an even larger underestimation of traffic volumes generated by the airport. Therefore, results in trip generation and network assignments modeled within the surface transportation plan are generally not consistent with actual or anticipated growth of the airport documented
within the adopted AMP that has a very diverse set of internal land-uses and related operational functions. Most other functions within the model, such as mode split or network assignment, are used without further modification for the airport (Wang & Yu, 2007). These functions also do not accurately represent the airport’s operations since they were designed to represent urban surface traffic movements. The operation of the airport could be better defined as operating similar to a city within a city since many of its operational characteristics are unique and only occur on an airport making its simulation somewhat inconsistent with the historic surface transportation modelling process (Gosling G., 2008).

The four-step model’s age and the more recent research documenting the changing travel demand characteristics of urban areas has supported a growing mandate to improve the urban transportation planning process to more accurately reflect the impact of today’s more robust and diverse urban mobility objectives. This has resulted in many MPOs, regions and states initiating research into changing their traditional four-step modeling process to a new Activity Based Model to support development of the MPO long-range transportation plan. This model has many advanced features and advantages over the previous four-step model and is being further developed through application and testing so future results will continue to more accurately reflect actual real world transport activities (Castiglione, Bradley, & Gliebe, 2014). Unfortunately, however, this model does not currently include a model function to represent the airport or other similar special generators. Development of this special generator function has a recognized need in the new activity-based model concept. This function will not likely be developed initially, leaving simulation and proper inclusion of
the airport in the surface transportation planning process qualitative at best. It is likely the new model will depend on data from the previous model database for special generators, producing similar issues apparent with the traditional four-step model. This transition in transportation planning and model application therefore represents the perfect timing to introduce new research for airport access planning.

The use of other specialized research can provide greater breath and understanding for addressing the issue of airport intermodal access and airport/MPO plan compatibility. A recently completed research project dealing with airport systems planning is a good example. While not directly related to this research, it does provide a good understanding and justification for using airport data within the surface transportation planning model. There are three primary planning documents for airports, including the airport master plan (AMP), the system plan, and the National Plan of Integrated Airport Systems (NIPIAS). Airports typically produce the AMP under direction of the state DOT and FAA. The system plan is most often prepared by the state DOT and is utilized to enforce and implement AMP plan consistency through funding incentives. State plans are regulated similarly by the FAA to ensure consistency of all planning criteria with national aviation system objectives. MPOs have a vital role in local AMPs and state system plans to ensure multi-modal, land-use and general transportation planning objectives that are addressed for airports within urban areas (Wilbur Smith Associates, 2009). A key distinction favoring use of local AMP data and forecasts is that it has been vetted and approved by multiple levels of government, ensuring its accuracy and use across multiple modes for comparison. Another research project was designed to provide large airports with the tools, information and best
practices from around the world on how to improve access by public transportation. This report used case studies and provides a wealth of information that can be very helpful in addressing the MPOs Congestion Management obligations in preparing its plan. The study used a market-based approach to identify the needs of air travelers who use ground access modes to the airport. Many items affect the traveler’s decision making process, and the study highlights strategies to address traveler concerns and prompt their decision to take public transportation modes to the airport. These items include baggage, trip reliability and timing, trip costs, lack of familiarity and security. All should be addressed in development of the alternate solutions for access (Coogan, 2008).

Building the transit access strategy within the surface transportation planning process will still require extensive collaboration and data exchange with the airport since the majority of the data needed to validate the model will be available only from airport sources.

**State, Regional and Local Level Efforts to Improve Airport Access Systems**

Several research efforts have been made by states to address improving access to airports within their state. Virginia commissioned a research effort to develop a methodology for evaluating landside access performance from a passenger prospective. This study was commissioned to better understand “quality of service expectations,” as well as to determine public understanding and support for airport access improvements. The study tested its methodology at the Richmond International Airport and highlighted cost, time, reliability, convenience and quality as major concerns for customers of the airport (Hoel, 1998). Texas has also been active in funding research for airports, with a special focus on improving systems efficiency and economic productivity. Mahmassani, Slaughter, and Chebli (2001) highlighted the
economic value of the state’s airports and the critical need to address ground access planning through improved operational, regulatory and capital allocations for high-value projects. In order to highlight best practices, the study used several domestic cases, such as Dallas-Fort Worth, Washington Reagan National, Denver and Chicago O’Hare airports, and global airports, such as Frankfurt, Hong Kong and Zurich. This study suggested that ground access should be addressed at the airport level and must take into account the whole transportation network to accurately evaluate the impact and role of the airports. Mahmassani, Chebli, Slaughter and Ludders (2002) defined ground access to airport as a critical function that must be provided at the regional level in addition to the immediate vicinity of the facility itself. This study argued that planning for airport ground access must be both multimodal and intermodal and consider operational, regulatory and capital-intensive infrastructure provision issues. In particular, this study suggested that airports in Texas need to customize new state-of-the-art methodologies that can effectively analyze the relationship between ground access and the local airport market conditions and attributes, and thus can provide valuable insight into route decisions and the total trip experience of travelers.

California has been active for several years in preparing research to address airport access and interrelated intermodal issues at regional level. Monteiro and Hansen (1996) evaluated the impact of an improvement in airport ground access facilities to one airport on the travelers’ behavior of a multiple airport system (MAS) in the San Francisco Bay area. This study developed airport choice models to predict the effect on airport market share of the extension of the San Francisco Bay Area Rapid Transit (BART) rail system to San Francisco International Airport (SFO). The results indicated
that improvements to SFO ground access would strengthen the role of SFO in the San Francisco Bay Area, and thus many airport authorities, airport operators and regional planners are required to promote ground access improvements to airports to reduce airport landside congestion or to meet with pollution reduction requirements around an airport.

A promising research project completed as part of the PATH Program at the University of California investigated the application of combined qualitative and quantitative approaches to address intermodal access needs for three California airports, although only one evaluation was completed. This multi-year project developed an Intermodal Airport Ground Access Planning Tool (IAPT) that utilizes output from a traffic network model, includes an air passenger mode choice model and a transportation provider behavior model to evaluate air passenger mode choice, provider behavior, and systems performance measures to utilize when considering alternative access scenarios to the airport. Limitations of the model are the amount and cost of data collection and its site specific application and limited value for other airport locations. In addition, the tool does not interface with the MPO model to validate consistency or support the plan’s inclusion of identified access projects. The research did provide a very comprehensive review of airport access planning considerations and data needs, especially when considering transit or rail access options. In fact, the research defined the goal of improving intermodal connectivity as encouraging greater use of transit and rail modes, thus reducing highway demand, reducing emissions and providing better leverage to public investments made in these modes (Lu, Gosling, Ceder, Tung, & Steven, 2009).
The Southern California Association of Government (SCAG) (2016) developed Regional Transportation Plans (RTP) for 2012-2035 with the primary goal of increasing mobility for the region’s residents and visitors. The plan defines the ground access transportation network serving the region’s airports as a crucial component to both the aviation and ground transportation systems. This is because passengers’ airport choices are in part based on travel time, convenience and congestion on the roads around airports. Thus, providing better airport access is critical to the function of the aviation system. To support the current level of airport ground access planning in the region, this plan adopted a conceptual framework for regional aviation ground access, emphasizing regionalization of air travel demand; regional and inter-regional projects to facilitate airport ground access; support of on-going local planning efforts by airport operators; country transportation planning commissions and local jurisdictions; and efforts to achieve a reduction in modes requiring deadhead trips to/from airports.

Systems thinking is especially critical for Florida as a peninsula surrounded by water. Trade, tourism and connectivity for its specialized labor market places even greater challenges on the effective use of all modes. The majority of tourists visit Florida by air. Florida is also a land bridge, linking over 40% of U.S. exports to the Caribbean and Latin America. This places higher demands on rail, ports. Florida also has the leading cargo export airport in the county. The state’s “agglomeration economy,” or large concentration of employment in service industries, transportation and logistics, and highly specialized trades require intermodal access to a broader consumer market for its business activity. Highway and improved intermodal connectivity are essential for continued growth and success of the state (FDOT, 2014).
In practice, the AMP document is the most definitive source of information for existing and planned future airport development activity as documented by multiple public agency approvals supporting full development implementation and funding from aviation regulated funding sources. This document includes a 20-year airport development plan (ALP) and a capital work program for the airport that is based upon the state Department of Transportation (StateDOT) and Federal Aviation Administration (FAA) approved forecast of aviation activity for the facility (FAA, 2008). Government-approved activity levels and future land-uses should provide the most reliable data to accurately define and quantify the airport’s existing and future off-site surface transportation needs. This is especially true if the approved AMP is coordinated with and included in the MPO plan, as required for its approval.

In Florida, the FDOT also has specific requirements and a guidebook for airport master plan preparation. This document has limited guidance for airport access despite having extensive detail for compliance with state laws, rules and regulation; state aviation system plan compatibility; comprehensive plan compatibility; and policy guidance. It does, however, require airport landside planning coordination with local and regional transportation agencies and a requirement that all airport access plans must be integrated with the appropriate local and regional planning efforts (FDOT, 2010). How this coordination occurs and the extent to which the MPO incorporates the results of the adopted AMP is a major driver for this research. Lack of a common planning framework to ensure modal compatibility establishes the public need and benefit. Ensuring modal plan consistency will require the AMP’s on-site activity and resultant off-site transportation access needs to be well documented in the MPOs plan development.
process. Then a separate examination of the MPOs surface transportation planning process is required to establish how this organization can best incorporate the airport’s current and planned future activity as reflected in its adopted AMP.

The Tampa Bay Regional Planning Model (TBRPM) was developed in 2010 under a Regional Transportation Analysis (RTA) framework to enhance the cooperative and combined planning efforts of the FDOT and the MPOs in the Tampa Bay Area (Gannett Fleming, 2010). The TBRPM is based on the traditional four-step transportation planning process, allowing trips in a given area to be estimated, distributed and assigned to specific transportation corridors and destinations. This model was developed for all of the counties and MPOs within FDOT District Seven and specifically included all airports within the region as special generators. Trips to airports are estimated as home-based, non-work trips, balanced against existing traffic counts and then distributed to traffic analysis zones using standard gravity model applications.

The FDOT developed the Florida Statewide Model (FLSWM) in the 1980s and has updated it several times to create a comprehensive picture of vehicle movements within the state of Florida to highlight major transportation corridors and intermodal connections. The 2000 and 2005 FLSWM included a tourist trip generation model as part of the passenger model, developed as an origin-destination matrix by traffic analysis zone. All tourist trips are converted to vehicle trips and then assigned to the highway network. The 2010 tourist trip update aimed to identify the most recent data to incorporate into the FLSWM to aide in defining tourist mobility needs, congestion points and planning means to improve tourist mobility and visitor experience. This model’s framework was designed to predict tourist travel demands within Florida and model the
most important factors of tourists’ travel patterns and linkages (FDOT, 2016). It is surprising with over 50% of Florida tourist arriving by air little discussion or value was placed on improving intermodal connectors to improve access and mobility.
CHAPTER 3
RESEARCH METHODOLOGY

Theoretical Framework

Transportation planning in the U.S. is typically dominated by single-mode legislative policy supported by restricted funding for the designated mode. Modal policies are delegated to federal and state modal agencies to provide guidance and implementation assistance in compliance with these directives. This system has been tremendously successful in planning and building a high-capacity transportation network across the country. However, declining revenues coupled with rapid population growth, urbanization, globalization, technology and changing mobility needs has significantly changed how we plan and utilize transportation facilities. Today there is a general consensus that continuing to add capacity to each mode cannot be fiscally accomplished nor can it meet the changing accessibility needs of urban areas.

Changing mobility and accessibility needs has resulted in policy makers and planners placing an increasing emphasis on the total transportation system and development of performance measures to enhance the overall system’s performance. In particular, connecting the urban airport and the metropolitan surface transportation system has been an increasing emphasis and goal for aviation and surface transportation policy since the early ‘90s. While significant efforts have been made in improving coordination between the air and surface modes in urban areas, existing industry literature still highlights significant differences in modal planning methodologies, which often results in the adoption of inconsistent or even in some cases conflicting modal agency plans. Recognizing the compounding severity of these actions for the transportation system, this study aims to enhance modal collaboration with development
of joint air-surface mode planning framework to produce improved representation of each mode within the planning process of the other. The goal is to produce a true modal agency partnership resulting in substantial benefits for each mode by reducing conflicts, improving modal system integration and performance and making wiser fiscal allocation of limited resources.

For that purpose, this study develops a new transportation planning process to improve the efficiency and effectiveness of integration between airport access and surface transportation plans, linking the MPOs and airports for mutual benefit. This new planning process is expected to:

1. Build its framework using existing data and processes from each modal agency’s regulated planning requirements to reduce cost,

2. Rely on data that the developing mode can easily understand, explain and replicate for future applications

3. Provide modal data exchanges in a format easily utilized by the receiving mode within its currently adopted planning process

4. Allow the using mode to produce a more accurate planning product with improved representation of the other mode

5. Be supported by and add value to both modes’ planning processes and policy goals

Under current urban transportation planning procedures and models, airports are defined as either special generators, having very unique trip generation characteristics, or as an industrial land-use employment zone, attracting trips from home-based work (HBW) traffic analysis zones (TAZs) in the standard model. The special generator model, however, considers airports as unique facilities whose trip generation characteristics are not fully captured by the standard trip generation sub-model used by MPOs. In the four-step urban transportation model, the special generator routine typically utilizes land-use and/or census employee data in combination with the Trip
Generation Manual, produced by the Institute of Transportation Engineers (ITE) for site and development traffic impact analysis, to produce a better representation of the airports trip generation characteristics. The estimated trip value is usually compared to known traffic count data for the site, and then the difference is added to the estimated trip value as a correction factor. In some cases this traffic level is used to represent both base and future plan year trip generation. Some models grow the base year by an annual population or highway traffic growth factor to estimate the plan year trip generation levels. Airport trip generation levels for the special generator are then either input into the standard model for processing or manually distributed to the network and included as a pre-load for background traffic. In either case, no airport specific data is utilized in the process. This represents the basic flaw in the current planning process.

Airports are unique, each one having its own diverse operating characteristics, which are heavily influenced by the airport’s size, the region it serves and its site-specific operating characteristics. While airports have developed a few different approaches to characterize their off-site access needs, these studies and resultant models have typically failed to have the ability or data to be able to work within the current surface transportation planning process or model. For intermodal access planning, a joint collaborative planning framework must be developed. Surface transportation models cannot accurately represent the airport’s regional surface transportation characteristics without better data provided from the source. Development of an improved planning procedure must support inclusion and better representation of specific airport characteristics within the urban model structure to ensure compatible planning results. With this improvement, the surface transportation
model should be able to better replicate the base year and plan year regional network access patterns for the airport, identify areas of access congestion, define needs for improved highway or transit access and define joint performance measures for consistent intermodal systems improvement. To address these needs, this study defines a common theoretical air-surface transportation planning procedure as shown in Figure 3-1.

**Research Methods**

**Selection of Case Airports and MPOs**

Each airport has unique operational characteristics, which can increase the complexity of this research significantly depending on the size and location of the airport and its service area. Primary commercial service airports are divided into size classifications, including large, medium and small hubs and also non-hub airports. Previous research has highlighted the uniqueness of each airport location, creating the need for sight-specific data for the resulting planning process to contribute value or accurately represent the airport’s actual or planned facility demands. To build upon previous research and allow for a more detailed analysis, this study will narrow its focus to one or possibly two hub airports for comparison.

This research examines Commercial Service Hub airports that are also located within a designated MPO transportation planning area. The research efforts will focus on the major access facility(s) whose purpose is to connect the airport property (and on-site activities) to the adjoining major transportation facilities off-site. A secondary goal will be to define regional intermodal access corridor(s) connecting the airport and service area. This initial effort will principally focus on highway access and associated vehicular volumes. It will also explore using MPO management tools and past transit
access research to define where traffic volumes appear to be approaching capacity tipping points and whether the introduction of other forms of public transportation access may warrant a subsequent evaluation. While transit access has been a major focus of previous airport access, research limiting this study to focus on highway access was felt to be a more prudent way to test this theory. This is supported by the fact that MPO surface transportation models are principally focused on highway and rubber tired transit modes to build the urban plan. For the best application, the study will need to focus on an airport with a large geographic regional service area with limited competition, have limited or minimal existing public transit service and have a good existing working relationship with the urban surface transportation planning MPO. Ideally the MPO further needs to be large enough to have its own full-time staff, including modelling expertise, to facilitate an efficient research data exchange. The initial study area will be restricted to Florida. Funding and travel time are two logical reasons for this restriction, although Florida is still possibly the best choice for this initial analysis and testing. This is because Florida is the only state with four large and three medium hub airports, has the largest number of MPOs of any state and has a strong state DOT adopted Aviation System Plan that is coordinated with MPOs and other state modal plans for consistency.

To test and provide an effective intermodal planning process, it is important to first document how the new planning procedure will work within the current airport planning and dominant modal focus of the surface transportation planning process. If this can be successfully accomplished, it will provide a stronger linkage for the subsequent analysis of expanded transit access to airports. While transit planning is
accomplished in a separate modelling process by the MPO, it still may benefit from the previously mentioned airport transit access studies completed by the aviation industry. A data collection and review process will help select the most appropriate airports and MPOs for a more in-depth examination. This material will also be utilized, along with previous research, to refine and narrow the scope of analysis for further testing and development of the recommended planning framework.

**Review of Existing Resources and Data**

To ensure protection of intermodal value, the USDOT, FHWA, FTA and FDOT provide specific and extensive guidelines and planning requirements to MPOs, placing a special emphasis on the need to accomplish coordinated planning and the development of access to airports. In accordance with those guidelines, MPOs are required to adopt a 20-year Long-Range Transportation Plan for the urban area, including a systems-level approach for enhancing intermodal connections. The adopted plan includes a Transportation Improvement Plan covering a five-year period of investment for priority project implementation and is to be incorporated into the Statewide Transportation Improvement Program. Federal legislation also requires airports to establish a 20-year master plan that includes existing and future ground access plans to be coordinated with the local government for future land-use approvals and with the MPO for project consistency.

This study will review existing MPOs and airport plans focusing on their overall planning process, models, coordination procedures and interactions with partner agencies to ensure their resultant adopted airport plans and urban area transportation plans are compatible. To accomplish this objective, this study will first conduct internet
research to evaluate Florida commercial service HUB airports, their partner MPOs and the state DOT’s Aviation Bureau websites. The purpose of this internet research is to:

1. Examine the selected HUB airport’s administrative structure; status of master plan activities; role in aviation system plan; representation on local MPO; location and distance to competing airport(s); classification; posted aviation data; identification of access studies or needs; and link(s) to local surface transportation plan/organization.

2. Examine MPOs containing above HUB airports for identification of aviation-related planning coordination/activity; link to airport/plan; identification of Airport MPO representation/role; representation of airport within adopted plan/model; strategic or policy planning goals for intermodal connectivity; joint airport/MPO Planning studies; and regional traffic count data.

3. Review State DOT Aviation Department’s website and Systems Planning database; state aviation master plan guidelines; access plan requirements; policy goals; and intermodal performance measures.

4. Select best region, based upon above criteria, for more detailed examination and testing.

Second, this study collects and reviews the selected airport(s)’ AMPs to see how they address the issue of airport access and intermodal connectivity, MPO plan coordination and the existing and future uses and activities on-site requiring off-site access planning coordination. AMP data review for existing and future plan year focuses on defined modal access points connecting the airport and the off-site access facilities characteristics/system linkages. Then, the study defines the current state-of-practice with respect to airport surface access and the MPO plan preparation for this study area. This examination evaluates the extent of coordination/engagement, data exchange/cooperative plan formulation, common/innovate methods utilized for transportation analysis and intermodal considerations utilized by the agencies in their adopted plan. In addition, this study develops a common-goal-based planning framework, promoting intermodal data exchange and outcome testing to ensure the resultant adopted airport master plan and urban area transportation plan are compatible.
as a direct result of the required modal coordination. Based upon this initial data review, the study finally identifies the best case airport for test application of the planning procedure and a comparable airport of similar size for data availability and process comparison.

**Analysis of MPO Modeling Structure and Airport Characteristics**

This study explores current MPO models, available resources and data collected for airports. As illustrated in Figure 3-2, MPOs have developed travel forecast techniques from conventional four-step models to recent activity-based models to improve modeling capacity. The research analyzes MPO models, focusing on how the forecast models are addressing airports and airport access transportation systems. It will also examine conflict points existing between the airport plan and the current modeling process or supporting input data for the airport. In reviewing MPO transportation planning models, this study emphasizes the following factors:

1. Identification of airport, airport surface access and related projects
2. MPO model methodology utilized to represent airport trips
3. Detailed content of model traffic analysis zone (TAZ) representing the airport property and how it reflects existing and future airport development
4. If transportation models (such as four-step model or activity-based model) or plans address any specific management, modal diversification or environmental issues relative to future airport activity or access needs
5. If the airport is included in an intermodal, traffic count, freight/cargo, economic or any other specialty program that may assist in the review
6. If the MPO is engaged in the State’s Aviation System Planning and/or the local airports master development plan preparation
In addition, this study puts its initial efforts on collection and review of the selected airports’ master plans, focusing on airport access facilities, on-site land-uses and the unique operational characteristics of each area. In reviewing airport access, this study focuses on how existing and future on-site land-uses impact off-site access needs and how airport access planning coordination is addressed at the local level. Major airport factors influencing access include the airport size, the region it serves and its site-specific operating characteristics. The unique operating characteristics of each airport requires site-specific data to provide an accurate representation of the airport’s off-site needs. Major components that may define airport characteristics include:

1. Defined land-uses and associated activities
2. Passenger volumes
3. Aircraft volumes
4. Employees
5. Parking
6. Access corridors
7. Cargo volumes
8. Based aircraft
9. Special traffic studies, count programs, passenger surveys, airport market research or other pertinent information to assist in review

**Airport Data Collection**

For a more accurate assessment, airports should not be classified as a single land-use category for trip generation purposes but should instead be sub-divided into each different operational unit for evaluation. Many airports can be characterized as containing three to five distinctive development types, each having its own unique operating characteristics. These can include: 1) the airport terminal complex, including
all associated, supporting activities; 2) the air cargo area; 3) the general aviation/corporate area; 4) the non-aviation development area; and 5) the military area. Each development’s activities can generally be defined by a known unique independent variable or combination of variables to help describe the intensity of the facilities use.

In selecting data collection items to best evaluate an airport component’s distinctive operational characteristics, it is also important to consider:

1. the validity and source of the data
2. if it is directly related to and reflects changes in the facility’s operation
3. if it is regulated through data reporting and agency approval requirements
4. does it require consistency at local, state and national levels
5. if it has approved forecasts related to the facilities planned expansion needs
6. if it is verifiable from multiple public sources

Based upon previous research and data review, the initial airport data collection and analysis will focus on variables associated with each land-use type as depicted in Table 3-1 and Figure 3-3. Since an airport organization can operate one or multiple airports in the same region, this study counts the airport authority as the primary source to collect all types of airport information, including data for passengers, employees, air cargo, vehicle access and aircraft operations. This study also includes aviation statistics from the Bureau of Transportation Statistics (BTS) and FDOT as valid sources for annual and monthly data. This study compares airport data from multiple sources to test for consistency and suitability of data for each use.

For each land-use on-site and/or off-site, traffic counts and studies will be collected for arrivals and departure volumes. Where possible, this traffic data will be analyzed and compared to concurrent airport land-use operational statistics. After
reviewing the data in detail, the goal will be to select at least one variable that not only meets the above criterial but also best represents the facility’s operational characteristics. The selected variable(s) will become the independent variable for each development type and will be subjected to further testing by statistically comparing it to exiting traffic volumes and use in making future projections. More importantly, this study will also compare the gathered airport data, such as employees, average daily passenger volumes and number of vehicles (if available) with the numbers used in current MPO models.

**Operationalization of Airport Data and Testing**

As the data collection advances, it is the goal of this research to streamline and simplify the types and volume of data to the factors providing the best representation of the airports surface transportation access patterns and characteristics. A final recommended joint agency planning framework will be developed and tested with the MPO. Both the airport and MPO should approve the recommended procedure prior to final implementation. Once completed, all airport off-site traffic analysis will be prepared by the MPO and shared with the airport for inclusion in their planning efforts. The airport will be responsible for managing on-site traffic circulation in accordance with FAA/FDOT Master Plan Guidelines and sharing aviation data with the MPO to facilitate inclusion of the airports’ travel demands within their models. To ensure the continued validity of the planning process, it is recommended the data and analysis be updated at least every five years or sooner if major changes take place consistent with both MPO and AMP planning update guidelines.
**Airport trip generation**

The most commonly accepted prediction method for surface trip generation is contained in the Institute of Transportation Engineers Trip Generation Manual. The manual’s adopted procedure utilizes individual land-use codes and specific development classifications to more accurately classify and analyze a development’s trip generation characteristics. This manual attempts to improve prediction of a development’s trip generation characteristics by defining unique independent variables or combination of variables to help describe the intensity of the facility’s use. This variable can then be statistically related to the development’s existing surface traffic volumes (dependent variable) to establish the site’s trip generation characteristics. The defined trip generation process has been widely accepted for many years as the best available technique for trip generation, is currently utilized by FDOT and MPOs in preparing traffic assessments and has been utilized and recommended by previous airport research for this purpose. Figure 3-4 presents the data operationalization process for the trip generation analysis.

Unfortunately, however, the trip generation data included in these manuals for airports is characterized as airports or general aviation airports only, unlike other land-use classifications that are subdivided into more specific facility characteristics and land-uses. As an example the ITE’s classification of the Industrial Use is subdivided into nine separate land-use/facility types, such as Manufacturing, Warehousing, Data Center, etc., to produce a more accurate assessment of the facility’s unique operating characteristics and resultant traffic comparison to prepare trip generation statistics. In addition, the trip generation studies included in the current manual for airports are over 30 years old, were limited to California airports (Pacific Time Zone) and were based
upon a limited number of studies. Even recognizing these limitations, this procedure (and data) will continue to be utilized for this research since it is commonly accepted and utilized by the FDOT and MPOs for this purpose. However, the airport land-use will be subdivided into facility types with similar operations, and their unique operational characteristics will be further defined by its most applicable independent variable for testing as previously defined.

In utilizing the selected independent variable for testing, a four-level procedure will be followed. This procedure will start by utilizing existing ITE trip factors when no other sources are available up through to the collection of site-specific airport facility operational data and concurrent traffic studies to produce the most accurate trip generation factor for the facility. The trip generation process will first start by using the most appropriate, currently available ITE trip rate for the specific airport facility type, or best matching category, to produce an estimated trip generation for the site. This estimated traffic level will be compared to existing traffic volumes, where available, and a correction factor to balance trip counts and projections will be noted similar to existing procedures.

Second, this trip rate will be updated by additional industry research and existing airport trip generation studies to provide a more appropriate factor for use in the analysis where possible. As a third step to further improve the research outcomes, the study will attempt to utilize existing operational characteristics for comparison to existing traffic data where available. Fourth, the study will then identify and recommend sites and procedures to improve the airport facilities independent variable classification and
methods to collect additional traffic counts for an updated comparison to the facility’s operational characteristics for future use.

According to the ITE Trip Generation Manual, data for new trip generation studies needs to be collected from similar developments for at least three sites (preferably five). Vehicle classification counts are needed for a typical weekend and weekdays reflecting daily, AM and PM peak hours, which need to be reported separately for entering and exiting trips. If the traffic counts for adjacent streets are not available, additional data collection is required to determine the AM and PM peak hour volume on these streets for comparison to the facility’s operational trip generation timing and volumes. Concurrent with the trip generation counts for each site, data for the facility’s independent variables, as potential predictors of number of trips for each land-use, should be collected for comparison testing. Subsequently, for each land-use and time period under the study, the recommended ITE regression model (ninth edition of Trip Generation) analysis will be completed. The model examines the independent variable and the number of trips to generate a regression curve, a regression equation and a coefficient of determination (R²) for each land-use. R² represents the variance in the number of trips associated with the variance in the size of the independent variable.

The above model should be utilized for each independent variable at each site, and the resulting $R^2$ (coefficient of determination) calculated. The closer the $R^2$ value to one, the stronger correlation between the dependent and independent variable. Ideally, the independent variables with the highest $R^2$ should be selected as the recommended trip generation factor. In addition, ITE Trip Generation Manual requires the following conditions for the regression equations (ITE, 2012).
1. The $R^2$ should be greater than or equal to 0.5
2. The sample size should be greater than or equal to 4
3. The number of trips should increase with the increase of the independent variable

After completing the process described above, weighted average trip generation rates, range of rates and a standard deviations of rates needs to be calculated and reported. As more data is collected over time, the process will continue to improve in accuracy. For detailed instructions, refer to the ITE Trip Generation Manual, 9th Edition.

The goal of the analysis will be to define the most appropriate independent variable for use with the best available trip generation factor to produce site trip generation characteristics and resultant traffic volumes in a format compatible for use in the surface transportation planning and modelling process. After the initial testing and comparison to base year traffic levels is confirmed, the selected trip factor will be utilized to prepare future projections in combination with the approved forecast of the independent variable for the facility under study. In combination, the previous four steps will provide the best available data and procedures for the research and will also note its limitations and methods for future improvements in data collection or analysis procedures for continual improvement to the non-static planning process.

**Airport trip distribution**

Airport traffic is unique and operates substantially different from general urban traffic. In general, airport access typically involves a greater diversity of modes (cars, vans, buses, taxis, limos, etc.), includes a high percentage of visitors and has a high number of large groups because air passengers usually travel to the airport in larger groups, usually travel less frequently to the airport and are gone for several days. Also, parking, baggage, ticketing and security add to the trip’s confusion, timing and
frustration. This factor is especially true for large airports in heavily congested urban areas or for airports with large geographic catchment basins where the driver’s anxiety escalates rapidly with delay and fear of missing a booked flight (ACRP, 2008). To improve access, planning requires defining airport access corridors. Establishing access patterns for airport trips requires this research to define a procedure to establish a reportable value for airport trip origin/destinations for use in the urban model. The initial approach for this research will be to examine the following user/facility characteristics:

1. Passengers – Airports often buy air passenger data from a research firm to characterize their air service market for airline negotiations and a separate data set to characterize the airports originating passenger’s geographic service area for local advertising. The research company obtains the zip code address of the ticket purchaser for part of their analysis. Today over 75% of airline tickets are purchased online with a credit card. For visitors to the area, the research will focus on estimated trip purpose from airport surveys, sample data from rental car companies and data from the commercial vehicle access database to establish categories for local destinations. Airport surveys, visitor bureaus or other groups’ analysis of business, visitor and tourist data for people visiting the area will be collected and analyzed in the analysis of assigning the most likely local trip destination.

2. All on-site employees – A high percentage of people working at the airport are required to have an airport security badge. This data can be used to establish a statistically significant O/D sample. Airport badging offices maintain secure files of all data. The files are secure, but obtaining two non-secure items from the data set in an excel file would not compromise the data but could provide a good statistically significant O/D database. The first item is the zip code of the employee’s home address. The second item is the employer (or the employer category) to establish work shift(s). The data will be converted from census tracts and aggregated into traffic analysis zones. Individual data will not be accessible and no personal information is at risk. Data is needed for the terminal complex, cargo and corporate/GA areas.

3. Cell phone lot: usage surveys to help establish the volume of passenger drop off/pick up traffic utilizing the airport

4. On-site parking studies – Passenger employee lots, hourly, daily or remote usage, turnover, duration of stay, arrival and departure timing, existing studies

5. Commercial traffic access – Detailed statistics are maintained for permitted commercial access to the airport. This includes off-site parking, hotels, rental cars, etc. This data will be helpful is establishing not only the mode of travel to the airport
but will also give insight into the passengers’ local origins (i.e. off-site parking patrons are assumed to have identical O/D patterns as on-site parking patrons).

6. Delivery vendors/cargo entering/exiting – Business zip code, or existing O/D studies
7. Public transit access data – routes, frequency, patronage
8. Establish access patterns for non-aviation development
9. Military uses and access routes

   Most of this data can be obtained from the airport, on-site facilities or on some cases the MPO. As a final step, the collected and projected origins and destinations reflecting the airport’s regional service market will be aggregated and prepared in a format for inclusion and use in the MPO model. Figure 3-5 illustrates how this study operationalizes airport data for trip distribution.

**Airport data for mode split**

   Establishing vehicle occupancy and type is more difficult. Airport traffic typically has significantly higher auto occupancy than other regional traffic on the network (ACRP, 2008). To assist in developing these factors, airport traffic count data for arrivals and departures, commercial access and public transit will be examined. Truck traffic/service vehicle/ or other data is typically available from on-site traffic counts. A sample survey of the on-site cell phone lot, airport and off-site parking lots can be helpful in establishing factors for:

1. Single car occupancy
2. Shared Ride
3. Drop off / Pick up
4. Taxi/Van
5. Transit
6. Off-site Access (parking/hotel/resort vans)
The initial goal of this part of the research is to identify data currently available from airport sources and how well it could be utilized in subsequent transit modelling efforts. As mentioned previously, most MPOs focus exclusively on highway modes with their current models. A separate model is utilized for the transit evaluation. Airport data, the MPOs transit model and previous Airport Transit Access Studies will be reviewed to see what, if any previous analysis or data could benefit the current or future transit access planning process. This data will be discussed with the MPO and will be provided for informational purposes only. It is not expected to have a significant impact on current MPO data or modelling efforts but could potentially contribute significantly to future transit planning for the metropolitan area. Figure 3-6 provides a sample format of airport data to provide to an MPO.

**Evaluate the effectiveness and availability of airport data**

After completion of above steps, a test application of the new planning framework methodology will be prepared for the selected airport based upon the previous review. This phase will include development and refinement of an Airport / MPO planning framework, including analysis results for airport trip generation, origin destination and mode split prepared in a format usable by the MPO for modelling purposes. The planning framework must meet the following criteria: 1) it has to be accurate, be site-specific and utilize approved airport data; 2) it must use industry-accepted planning practice and procedures for both modes, and 3) it must be easy to understand and use if it is to provide an effective tool to test for plan compatibility.

In consideration of the above criteria, this study evaluates the effectiveness and availability of airport data. The first step of the evaluation is to provide an airport property map, divided by facility use and identify major points of off-site surface
transportation systems access, and then compare the airport property to the existing MPO TAZ boundaries and site access locations. The second step is to create an easy-to-use trip generation spreadsheet model for the airport land-use categories using data obtained from the AMP and airport data collection efforts. Land-use categories include:

1. Passenger terminal complex
2. Air cargo facilities
3. Corporate/general aviation facilities
4. Non-aviation development (if applicable)
5. Military facilities (if applicable)

This will be followed by the preparation of an airport local/regional origins and destinations spreadsheet tables for both passengers and employees. The final step is to conduct a mode split analysis for possible future transit applications. This step will include the following components:

1. Review MPO transit model application and input data requirements
2. Review of on-site traffic counts and parking
3. Commercial traffic data analysis

The research planning framework, including the planning methodology, airport data and model application format, will be thoroughly documented. After review and concurrence from the Airport and MPO, the planning procedure will discussed with another similar Hub airport and MPO in Florida for airport access planning application and to verify similar data availability and use.
Table 3-1. Airport Data Collection by Facility

<table>
<thead>
<tr>
<th>Facility and Variables</th>
<th>Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Terminal Complex Area</strong></td>
<td></td>
</tr>
<tr>
<td>Passengers</td>
<td>Annual, monthly, weekly, daily and hourly volumes</td>
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<tr>
<td></td>
<td>Local/visitors, trip purpose, home/destination location</td>
</tr>
<tr>
<td>Employees</td>
<td>Government, concessionaries, airlines, etc.</td>
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<tr>
<td></td>
<td>Work schedule</td>
</tr>
<tr>
<td></td>
<td>Suppliers, service, vendor, delivery</td>
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<tr>
<td>Vehicle Access</td>
<td>Cell phone lot usage, drop-off/pick-up traffic</td>
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<tr>
<td></td>
<td>On-site parking (public and employee): volume, arrival/departure time, length of stay</td>
</tr>
<tr>
<td>Aircraft</td>
<td>Public transit route, frequency, and patronage</td>
</tr>
<tr>
<td></td>
<td>Commercial, GA, Cargo, Military</td>
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<tr>
<td></td>
<td>Aircraft operations: annual, monthly, weekly, daily, and hourly</td>
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<tr>
<td><strong>Cargo Area</strong></td>
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<tr>
<td>Cargo Volume</td>
<td>Annual, monthly, and weekly</td>
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<tr>
<td>Employees</td>
<td>On-site intermodal transfer (if applicable)</td>
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<tr>
<td></td>
<td>Total, work schedule, home location</td>
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<tr>
<td><strong>Corporate/General Aviation</strong></td>
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<tr>
<td>Based Aircraft</td>
<td>Aircraft number</td>
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<tr>
<td>Employees</td>
<td>Total, work schedule, home location</td>
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<tr>
<td><strong>Military Area</strong></td>
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<tr>
<td>Employees</td>
<td>Total, work schedule, home location</td>
</tr>
<tr>
<td>Vehicle Access</td>
<td>Authorized vehicles (badged for entry)</td>
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<tr>
<td><strong>Non-Aviation Development</strong></td>
<td>Status report and development forecast</td>
</tr>
<tr>
<td></td>
<td>Land-use activity and intensity</td>
</tr>
</tbody>
</table>
Figure 3-1. Theoretical Planning Procedure
Figure 3-2. MPO Modeling Structure and Airport Characteristic
Figure 3-3. Airport Data Collection
Figure 3-4. Airport Data Analysis for Trip Generation
Figure 3-5. Airport Data Analysis for Trip Distribution
<table>
<thead>
<tr>
<th>AMP Land-Use</th>
<th>Development Type</th>
<th>ITE Land-Use Category</th>
<th>ITE Land-Use Code</th>
<th>Independent Variable Tested for Average Flights and Passenger Volumes for Best Fit</th>
<th>Size Base Year</th>
<th>Size Plan Year</th>
<th>Growth Rate</th>
<th>Size MPO Year</th>
<th>Daily Trip Equation</th>
<th>Daily 2-Way Trips (vpd)</th>
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<tr>
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<td>HUB Commercial Service</td>
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<td>Average Flights per Day$^1$</td>
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<td>Corporate General Aviation</td>
<td>General Aviation</td>
<td>Category</td>
<td>Code</td>
<td>Average Flights per Day$^2$</td>
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<tr>
<td>Cargo Facilities</td>
<td>Air Cargo</td>
<td>Category</td>
<td>Code</td>
<td>Cargo Volume$^3$</td>
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<td>Sub-Totals</td>
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<tr>
<td>Non-Aviation Development</td>
<td>Approved Uses</td>
<td>Category</td>
<td>Code</td>
<td>Per ITE</td>
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<tr>
<td>Military</td>
<td></td>
<td>Employees</td>
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</tbody>
</table>

$^1$ Independent Variable Tested for Average Flights and Passenger Volumes for Best Fit
$^2$ Independent Variable Tested for Average Flights per Day and Number of Employees for Best Fit
$^3$ Independent Variable Tested for Cargo Volume and Number of Employees for Best Fit

Figure 3-6. Airport Daily Trip Generation Using ITE Trip Generation Methodology (Adapted to Airports)
CHAPTER 4
DATA ANALYSIS

Selection of Airports and Partner MPOs

Overview of Airports in Florida

The initial study area will be restricted to Florida. Funding and travel time are two logical reasons for this restriction, although Florida is still possibly the best choice for this initial analysis and testing. This is because Florida is the only state with four large and three medium hub airports, has the largest number of MPOs of any state and has a strong state DOT-adopted Aviation System Plan that is coordinated with MPOs and other state modal plans for consistency. In Florida, the state has 20 primary commercial airports. All but one, Key West, is located within a designated MPO. Figure 4-1 depicts MPO Boundaries and Airports in Florida. Large hubs are located in Orlando, Miami, Ft. Lauderdale and Tampa. Medium hubs are located in Ft. Myers, West Palm Beach and Jacksonville. Small hubs are located in Sanford, Pensacola, Clearwater, Sarasota, Panama City and Key West. Primary non-hubs are located in Valparaiso, Tallahassee, Punta Gorda, Daytona Beach, Melbourne, Gainesville and St. Augustine. Annual passenger volumes for large hubs range from 22 to approximately 36 million. Medium hubs range from 5 to 15 million. Small hubs range from 1 to 2 million. Finally, non-hubs are less than 1 million (FDOT, 2015). Table 4-1 shows 2015 annual passenger volumes for commercial airports. Because of the large number of airports and MPOs located within the state, scoping this assignment will be critical to test the research hypothesis supporting development of an improved joint agency planning framework for airports and MPOs.
Currently the four large hub airports in Florida are in close proximity to other major commercial service airports and also have developed or are in process of planning and development of major access changes involving several different forms of transit to improve passenger access and connectivity. For these airports, the proposed planning framework would prove beneficial for highway access planning but would require substantial additional analysis to address transit access both from an airport and from a separate MPO model application perspective. This second-level transit analysis, while addressed in a limited fashion, is beyond the scope of the current research effort.

For the three medium hubs, West Palm Beach is located in close proximity to a large hub (FLL) and a major passenger rail line where future connections are planned.

The two remaining medium hubs (JAX, RSW), while unique, share some similar characteristics. Both serve a large geographic local market, depend almost exclusively on surface highway access and have an active, engaged working relationship with their local MPO both at the board and staff level.

**Case Airport and Partner MPO for Analysis**

MPOs’ existing surface transportation planning and modelling procedures are dominated by highway analysis, so further limiting the scope of this research to airports with the largest, non-overlapping local geographic service areas and to airports principally served by highway access will provide the best fit for this research analysis and testing by keeping the extraneous variables and their influence on the data to a minimum. It is also desired that both the airport and MPO organizations have a good existing working relationship, actively participate in their modal partners planning activities and have the staff resources to support the agencies’ planning and development goals. Both organizations must benefit from the shared planning
methodology, which must ensure the development of compatible plans where joint responsibilities overlap in providing intermodal connectivity.

Given these consideration points, this study selects two medium airports, the Jacksonville International Airport (JAX) and Southwest Florida International Airport (RSW). The selection of JAX for this research has several advantages: 1) it has a large geographic area without overlapping MPO or airport service areas, 2) JAX is a medium-hub commercial service airport located totally within the TPO boundaries and, 3) JAX has an updated airport master plan and Development of Regional Impact Report (DRI) for use as a data source. The selection of JAX also has advantages regarding its partner MPO, the North Florida Transportation Planning Organization (NFTPO). First, it has a larger, more technically diverse staff, including modelling experts. Second, it has recently undergone a modelling transition from the traditional Four-Step Urban Model (4-Step) to the new Activity Based Urban Model (ABM). Having access to and staff familiarity with both models is a major advantage in testing the applicability of the new planning framework, as well as testing the airport data formats against input requirements of both model applications for preparation of the surface transportation plan. After validation, the new planning process can be utilized for application to small and non-hub airports.

To effectively accomplish the research objectives for MPOs and airports in Florida, this study focuses the research analysis on the planning process of the North Florida Transportation Planning Organization (NFTPO) and the Jacksonville International Airport Authority (JAA) in more detail. This study examines the Airport Master Plan (AMP), DRI documents, TPO Regional Transportation Plan and supporting
surface transportation planning models. The initial scope of this research evaluated the previously adopted surface transportation planning four-step model to examine how it incorporated the JAX operations within its model structure to establish base year validation. The evaluation also examined how the model utilized the approved AMP data to support development of the Long-Range Surface Transportation Plan. At the early stages of this research, the TPO was actively developing an Activity Based Model (ABM) to develop, test and prepare its new Long-Range Transportation Plan. The research timing provided the opportunity to examine how this new model would incorporate planned airport activity to support development of the long-range transportation plan. As the initial testing was completed, it also provides an opportunity to examine how the new ABM model reflected the airport’s operation in the newly adopted surface transportation plan. Then, this study compares RSW data to JAX data to assess whether airport data could be generalized for MPO models.

**Analysis of Current Airport and MPO Planning Process**

**Policy Requirements for Plan Consistency**

In Florida, communities like Jacksonville and Ft. Myers spend a great deal of time and energy constructing their local growth management plans and implementing land development codes in compliance with the “Community Planning Act,” as mandated in Chapter 163, Florida Statutes (Florida Legislature, 2015). This planning act requires development of a local, comprehensive growth management plan containing an extensive multi-modal transportation element, including elements for traffic circulation, mass transit, ports and aviation planned to be fully consistent with the proposed future land-use plan. The plan is to be coordinated and consistent with MPO plans, transportation authorities, the Florida Transportation Plan and the adopted FDOT
five-year work program. When a local jurisdiction, like the City of Jacksonville, is within an MPO’s boundaries, this element is to include a schedule of all transportation capital improvements planned within the five-year period. The capital improvements are provided to ensure the adopted level-of-service standards are achieved and maintained for the period; identifies existing and future intermodal deficiencies and needs; addresses and include aviation, rail, ports, access facilities and intermodal terminals; addresses land-use compatibility with planned airport and aviation development; and coordinates airport plans with the transportation circulation element. At the local government option, the airport master plan (AMP) and amendments can be included in the local adopted Growth Management Plan for consistency.

This later airport plan inclusion exempts the airport’s planned development from Florida’s Development of Regional Impact requirements (Florida Legislature, 2015). The Jacksonville International Airport (JAX) operates as an independent authority, and development plans are regulated by a Development of Regional Impact Report (DRI) and approved Development Order for reporting purposes. However, the previous requirements must still be completed. In reviewing the local planning documents, most references to the airport were dated and at a very high level. For more detailed data, the documents referred to the airport DRI and annual sufficiency report. The JAX annual report is provided to local, regional and state agencies for their use in coordinating plan consistency. It includes an update on all regulated development activities, including an updated CIP, and provides an extensive traffic data collection, concurrency review and reports on all other permitted development activities. The Southwest Florida International Airport (RSW) is a Lee County Authority, and its master development plan
is contained within the local Growth Management Plan, exempting it from State DRI requirements. This agency provides its development plan updates annually to the county. The different regulatory frameworks will provide insight into the possible effects of different regulatory compliance alternatives.

Technically, these local land-use and transportation plans are also linked to a community’s projected population and its associated demographic characteristics, supporting adoption of each plan element. Consistency of the plans with regional and statewide plans becomes even more important due to the fact that local growth management plans and their supporting demographics become key components for model development and preparation of the TPOs long-range transportation plan. The NFTPO’s Long-range Transportation Plan and supporting model is built on land-use and demographic data for five north Florida counties and cities within the boundaries of the TPO. Most communities that adopted future land-use plans are also tied to their own political and economic aspirations for continued growth and prosperity, making transportation planning in the urban area a multi-faceted process to achieve a diverse set of policy objectives.

Policy for the TPO is typically dictated by a non-technical board of elected local political officials from the North Florida local governments they represent. The TPO is also supported by a technical committee composed of a mixture of planning and engineering representatives from the local governments and modal agencies represented on the board. JAX and RSW are both represented at the policy and technical committee levels of their respective area TPO. Most of the technical committee, including the airport representatives, are composed of staff with a scope
focused on representing the local government’s or agency’s interests in preparation of
the surface transportation plan and CIP. The underlying transportation plan preparation
itself evolves through a myriad of inter-local and joint revenue sharing agreements.
Local government planning staff usually takes responsible charge for assembling the
locally approved land-use and demographic information required for model simulation.
Regional TPO staff coordinate with local planners to assemble and compile much of the
data in support of regulated "agency and public involvement" coordination and review.
The FDOT provides technical transportation and funding assistance working with the
TPO to develop, calibrate, refine, project and restrain a simulation model to best
approximate a cost feasible long-range plan. The TPO agency structure is designed for
coordination of a continually evolving comprehensive transportation plan. Policy and
technical committee participants are expected to provide input and validate that their
organizations’ interests are met in the adopted plan. Once adopted, this 20-year plan
sets the foundation for the compatible and sequential development of the CIP or five-
year work program. This is the foundation for funding prioritization and subsequent
development of the regional transportation system, including all surface transportation
intermodal connectors to airports.

**Jacksonville International Airport Planning Policy and Access Guidance**

**Airport planning policy and guidance**

Intermodal facilities are unique transportation facilities that can often double or
even triple their off-site traffic impacts during the period covered by a typical airport
master plan because of projected increases in passenger and cargo activity. They can
create both trip productions and attractions for people and goods movement and are a
vital link in the overall regional transportation network. Therefore, it is important for
federal, state and local governments to maintain high levels of service at airports. For that consideration, FAA and FDOT require airports, especially larger commercial service facilities like the Jacksonville International Airport (JAX), to develop a 20-year Airport Master Plan (AMP) and associated capital improvement program (CIP). FAA and FDOT also require these plans to be coordinated and consistent with the local governments’ adopted Growth Management Plans and the TPO Plan as a part of the airports’ grant assurances (Government, 2012).

To support required planning activities, the FAA and FDOT provide guidelines for the Airport Master Plan (AMP). FAA’s AMP Airport Advisory Circular (AC) addresses airport access planning needs from the airport’s perspective (FAA, AC No. 150/5070-6b: Airport Master Plans, 2007). This document indicates AMPs should include a section on the regional transportation network and should work directly with the MPO to address the airport’s off-site access needs. The AC also contains a section to address on-site airport circulation roadways. In this section, the on-site roadway network is to consider the needs of many different user types. These include: 1) originating and terminating air travelers, 2) employees on-site, 3) delivery vehicles and 4) other vehicles. This later group consists of assorted user groups, including taxi/limo, rental car, courtesy van/buses and charter bus operations. Other FAA guidance documents suggest identification of surface access connections linking the airport to the central business district and existing or proposed major arterials or interstates. Since the airport’s jurisdiction and funding are limited to on-site activities, the surface planning designations outside of the airport should be of a general nature since planning and implementation for off-site surface transportation improvements in Florida are identified
as the responsibility of the MPO and Florida Department of Transportation (Federal Aviation Administration, 2008).

The FDOT engages in the process as a funding partner, provides AMP preparation guidelines, assists in evaluating consistency with other state plans and programs, performs operational safety inspections and annual certification for the FAA and provides grant assistance to facilitate annual capital project implementation. In 2016, the FDOT published a revised “Guidebook for Airport Master Planning” (Florida Department of Transportation, 2016), providing AMP preparation guidance for airports in the state. While the guidebook has extensive detail covering aviation-related facilities, forecasting, coordination and preparation requirements, it only provides broad guidance for off-site access considerations. The guidelines note landside access is not specifically an FAA requirement; however, they suggest the airport coordinate with local and regional surface transportation agencies and complete an evaluation of off-site traffic access needs for the airport as part of the AMP. No technical guidance is provided except a reference to a separate ACRP Report 25 (Airport Cooperative Research Program, 2010) for general planning criteria.

Both agency guidelines suggest airports should become more engaged in the planning and programming of off-site airport ground access planning with appropriate surface transportation agencies, especially the MPO. In accordance with these goals, the JAX Board and staff actively participate in all TPO hearings to advance surface transportation planning for the region. The goal for the active airport in the TPO plan would then be to create an integrated transportation system to facilitate the efficient movement of people and goods to and from the airport.
In defining responsibilities and project funding, state regulatory guidance also establishes criteria for project prioritization and performance measures to quantitatively evaluate airport access needs. As an independent, self-funded authority, the airport often has the ability to act independently to implement its master plan after approvals. As examples, both JAX and RSW utilized the SIS status to work directly with the FDOT to upgrade off-site access instead of pursuing access improvements through the MPO. Both organizations worked with the FDOT to hire a consultant to complete a new traffic study for the airport SIS Connector facilities. In both cases, the consultant’s traffic projections for these facilities were substantially higher than those documented in the local MPO plan. In both cases, the FDOT validated and accepted the updated traffic studies, warranting interstate interchange and highway corridor connector upgrades even though they were not previously designated in the MPO plans or CIP. Projects upgrading airport access were funded by state SIS allocations.

In addition to legislative guidelines, transportation policy and funding are heavily directed by the Strategic Intermodal System Plan at a state level in Florida (Florida Department of Transportation, 2016). Recognizing JAX’s value to the total transportation system, it has been designated as an SIS Primary Commercial Service Airport. With this designation, essential highway connections are identified as Strategic Intermodal Connectors and are also to be consistent with the TPO plan. For JAX, the designated facilities are Airport Road connecting I-95 to the airport terminal complex and International Airport Boulevard connecting I-295 to the airport terminal complex and cargo facilities. Designated SIS facilities have specific performance measures and goals to ensure satisfactory performance. A new set of guidelines have been developed
by the FDOT for performance measure metrics. These are included in the “Florida Multimodal Mobility Performance Measures Source Book” (Florida Department of Transportation, 2016). Performance measures have been developed to evaluate the quantity, quality, accessibility and utilization of the surface highway SIS facilities for the airport. Aviation performance measures utilize annual passenger volumes, aircraft departure reliability and demand to capacity ratios to assess performance for moving people to and from the airport. For people and freight movements, the evaluation criteria is highway peak hour level of service on SIS connectors to the airport. For freight, cargo tonnage and value are evaluated. These systems seem to work outside of the MPO planning process or maybe are supplemental to it.

**Jacksonville International Airport master plan**

The Jacksonville Aviation Authority (JAA) developed the Jacksonville International Airport Master Plan (JAX AMP) in 2001, and updated portions of the plan in 2010 to reflect socio-economic changes in both the Jacksonville community and the aviation industry due to the economic recession. The plan is prepared in compliance with FAA’s Airport Advisory Circular 150/5050-6a and is reviewed and approved by the airport, the FDOT and the FAA (FAA, 2015). The JAX AMP is included in the Florida Aviation System Plan (FASP) and the National Plan of Integrated Airport Systems (NIPIAS). All three documents are completed under FAA and/or FDOT guidance to ensure consistency with national and state aviation plans and policies. This system-wide integration places tight controls on planning forecasts and growth projections utilized in plan preparation. This level of conservative guidance and control substantially improves the accuracy of aviation forecast for use in airport planning and for coordination with other modal partners. Grant assurances also reinforce airport planning
and development activities to make sure future airport development is consistent with local land-use and transportation planning for the area surrounding the airport (FAA, Program Guidance Document - Intermodal Planning Coordination, 2004).

The JAX AMP process is designed to be a comprehensive, coordinated and continuing program for establishing the airport’s role in the national and state aviation system. The process aims to define the airport’s future passenger and cargo needs and analyze alternatives to meet those needs with preparation of a long-term master development plan. For this purpose, the JAX AMP provides probable aviation activity forecasts, including passenger traffic, aircraft movement and air cargo forecasts. As shown in Table 4-2, total annual enplaned passengers are forecast to increase an average of 2.9% per year between 2007 and 2027, carrying 4.1 million in 2015, 5.0 million in 2022 and 5.6 million in 2027. Enplaned passenger forecasts are higher than the actual annual enplaned passenger volume of 2.7 million in 2015. This lower passenger volume is a direct result of the economic recession’s impact on the Jacksonville region and the aviation industry. The level of aviation activity at JAX is increasing steadily, and the authority believes the long-term forecasts are still valid. To address this issue, the airport plans to update the JAX AMP next year. This document will include updated forecasts for all on-site activities.

Besides passenger traffic, the AMP provides forecasts of aircraft operations and air cargo between 2007 and 2027. Aircraft movements are estimated to reach about 169,000 by 2027, with an average of 2.0% increase in passenger aircraft and an average of 3.3% increase in all-cargo aircraft per year over the planning period. The volume of air cargo, including freight and mail, carried in the belly compartments of
passenger aircraft is forecasted to grow an average of 2.0% per year between 2007 and 2027, while cargo volume transported by all-cargo carriers is predicted to increase an average of 3.3% per year. The recent selection of Jacksonville for the development of a new regional Amazon distribution facility may affect projections. The facility is located adjacent to the airport with good access the interstate and airport cargo area. The rapid growth in internet shopping and the impact of the new distribution facilities increased traffic volumes on airport access roadways are a major concern to the airport. The AMP update will address forecast issues.

To accommodate the forecasted aviation activities over the future planning years, the JAX AMP presents the estimation of demand/capacity and facility requirements for airside, terminal, local road network, public and employment parking, curbside roadway and supporting facilities (such as rental car, air cargo, general aviation and airlines/airport support facilities). In calculating the capacity and facility needs, the AMP used the hourly distribution of operations occurring during a 24-hour period and the hourly 24-hour cycle of enplaned and deplaned passenger based on total enplaned passengers scenarios, such as PAL 2 (Planning Activity Level) for 4 million enplaned passengers and PAL 3 for 5 million enplaned passengers. For hourly passenger distribution, the AMP adopted a schedule of airline activity from the Official Airline Guide (OAG). Figure 4-2 shows hourly distribution of aircraft operations, while Figure 4-3, Figure 4-4, and Figure 4-5 illustrate the 24-hour cycle for enplaned, deplaned and enplaned/deplaned passenger volumes, respectively. Since capacity and facility needs rely on peak hour demand, it is important to define hourly aircraft operation and/or hourly passenger volumes.
Using the estimated passenger volumes and 24-hour distributions, the AMP calculated peak-hour passenger volumes and peak-hour vehicle trips. Then the AMP analyzed the level of service on major road networks based on the Highway Capacity Manual (HCM), and also projected the needs of parking spaces for passengers and employees. Additionally, it provided alternatives for airport roadway improvements, assuming the vehicle volumes entering and exiting the JAX are expected to generate traffic problems. Figure 4-6 presents the road network analyzed in the JAX AMP.

In addition, the AMP provides a short-term CIP to implement the long-term plan sequentially through funding of an annual capital program. This airport planning process is designed to facilitate agency approval, airline and stakeholder acceptance and plan coordination with other agencies long-term development plans. The JAX CIP is annually coordinated with all local and regional agencies through its Annual DRI Status Report.

**North Florida Surface Transportation Planning**

**North Florida Transportation Planning Organization (NFTPO)**

In Jacksonville, development of the independent regional Transportation Planning Organization’s (TPO) Transportation Plan to achieve federal, state and regional goals is supported by a high-level of inter-local agreements, including federal and state agencies (FHWA, FTA, DOE, FDOT); regional modal partners; counties and municipalities; and professional associations and coalitions. Membership includes a broad list of public agency and private business interest, all of whom have an active role in development and approval of the transportation plan (NFTPO, 2015). These groups serve on active board or advisory committees including:

1. TPO Policy Board (TPO Policy Board)
2. Technical Coordinating Committee (TCC)
3. Citizens Advisory Committee (CAC)
4. Transportation Disadvantages Coordinating Board (TD Board)
5. Business, Industry and Government Committee (Joint with Chamber Committee)

The TPO Policy Board and staff rely on the unique perspective and expertise provided from the membership of supporting committees to build and obtain consensus for the regional transportation plan and CIP. Modal representation for JAX is provided by having an Airport Authority Board Member on the NFTPO Policy Board and a senior technical airport staff representative as a member of the TAC. The committee’s work with TPO staff to prepare, review and update elements of the regional plan include:

1. Unified Planning Work Program (UPWP)
2. Long-Range Transportation Plan (LRTP)
3. Transportation Improvement Plan (TIP)
4. Congestion Management
5. Bicycle and Pedestrian Program
6. Commuter Services Program
7. Transportation Disadvantaged Program
8. Freight Mobility
9. Intelligent Transportation System (ITS)
10. Clean Cities

**Theoretical framework of NFTPO planning process**

The regional transportation plan is based upon the result of a complex series of database compilations and analysis, transportation modeling, alternatives analysis, program funding analysis and a final fiscally constrained plan selection. Transportation planning to accomplish the goal for development of a long-term plan is a result of a
comprehensive, coordinated, cooperative and continuing planning process relying on research and analysis of current conditions and forecast of what is planned for the future in the region. The analysis to build the plan requires a systematic planning process to integrate multiple plans and accurately model future outcomes.

Jacksonville’s TPO historically utilized a traditional four-step transportation planning model until last year. This model structure evolved from a basic understanding of land-use/trip generation and network distribution in the ‘50s to a fairly sophisticated micro-computer simulation model today. The Florida Standard Urban Transportation Model Structure (FSUTMS) is the standardized model structure that utilizes unique data formats and operating procedures for data input to the urban transportation model to more consistently define and control data quality and use. Jacksonville utilizes the Northeast Regional Planning Model (NERPM) and a unique regional dataset structure for modeling, analysis and plan preparation consistent with the recommended state modeling structure (NFTPO, 2015). The demand model structure provides four distinct modeling processes that are interdependent. These planning steps are shown in Figure 4-7.

To complete the modeling process, the transportation model utilizes twelve independent procedures to create input files to support the basic four-step process. It is important to understand how each data set interacts in the model, its purpose and how it supports the transportation plan development. Trip generation is the first step in travel forecasting and utilizes several different databases as input files to prepare appropriate output within the modeling process. The TPO acquired adopted local planning agency land-use and supporting socio-economic data (ZDATA files) as a foundation for the
transportation models utilized in development of the regional transportation plan. This data is used in the model, with other sampling data, to establish trip purpose by traffic analysis zone (TAZ). The trip generation routines estimates the number of trips beginning or ending in each zonal location using trip tables. All trips are aggregated to a specific TAZ. Input/output productions and attractions numbers are established by TAZ for each trip purpose. The next step is trip distribution linking the previously produced trip productions and attractions to TAZ locations.

This routine also includes estimates for trips beginning or ending outside of the metro area. The next model routine, mode choice, takes distribution output and assigns mode characteristics for each trip. Auto occupancy is a major factor in converting person trips to vehicle trips in the model. Transit and non-motorize modes of travel, as well as time of day and commercial vehicle/freight travel, are also evaluated in this segment. The last step, trip assignment, routes highway and transit separately. Highway vehicle link assignments connect origins/destinations from the trip tables and transit trip table assignments utilize individual transit routes and connectors (Cambridge Systematics; VHB, 2012). In aggregating and developing model databases, the TPO collaborates with and seeks technical and funding assistance from the FDOT, FHWA and FTA.

The TPO modelling seeks to develop, test and implement a model structure supporting analysis of alternatives for building and implementing a successful cost-feasible long-range transportation plan. This long-range plan is implemented through an annually updated rolling five-year capital improvement program to promote its successful implementation. The FHWA and FTA jointly audit and approve the TPO’s
plan and implementation, funding programs for consistency with federal guidelines (FHWA, 2015). It is also important to note TPO surface transportation planning activities must comply with FHWA/FTA MPO planning guidelines to evaluate airport intermodal access, including alternatives analysis, transit, congestion management and freight and air quality (particularly in non-attainment areas). The FDOT serves in an advisory capacity for the TPO, providing technical assistance and promoting consistency with statewide transportation plans (NFTPO, 2015).

The local governments adopted comprehensive growth management plans for the TPO area support creation of land-use databases (ZDATA1), population, socio-economic and employment databases (ZDATA2), and special generator databases (ZDATA3). Special generators are defined as unique land-uses, such as airports, having unique trip generation characteristics not adequately defined by the models standardized trip rates. These datasets are prepared in traffic analysis zone (TAZ) format for use in the transportation modeling process to ensure land-use/transportation plan consistency by defining and assessing the future mobility needs of the communities adopted comprehensive growth management plan. Concurrent with the production of the “Z” data files, the TPO, FDOT and local government also prepares an extensive database to document the existing and possible future transportation network (highways, streets, transit, airports, ports and rail). The stated policy intent of this combination of land-use and transportation plans is to ensure consistency and to utilize the transportation system as a means to promote improved mobility and enhanced economic competitiveness (AASHTO, 2010). The first two datasets are the principal drivers for the model’s trip production and attraction routines. The unique operations of
intermodal facilities, particularly airports, ports and rail intermodal facilities, produce trip
generation characteristics not adequately addressed in the first two data sets or the
resulting trip generation equations. The model equations utilize home-based work trips
(Mamum, Yin, & Srinivasan, 2010).

**JAX in the NERPM-AB model**

The adopted long-range cost feasible plan for the NFTPO region, the previously
adopted four-step model and the newly adopted activity based models were obtained
and evaluated for how each addressed the airport in detail. As shown in Figure 4-8, the
four-step model recognizes the airport as TAZ 149 (NFTPO, 2015). Uniquely this traffic
analysis zone reflects traffic generation related to the industrial/commercial land-use
code and employment levels defined for this TAZ. The results are trip-generated from
an interpretation of this land-use activity, rather than employing land-use data from the
adopted airport master plan or actual direct employment numbers.

As shown in Table 4-3, the NERPM model assumes TAZ 149 has 2,065
employees, while it is home to 11 people. The same population level data is in the
database for 2040, while the NERPM-AB model update significantly increased
employment to 4,414 in 2040 for future trip estimations. The NERPM uses these
population and employment figures to estimate both attraction and productions of home-
based trips, non-home based trips and truck trips.

The airport TAZ is coded with approximately 10,612 trip attractions and 3,760 trip
productions in its base year of 2010 to balance this land-use/employment based TAZ
with traffic counts for departing highway access locations. These numbers are doubled
in 2040 to 20,757 trip attractions and 7,436 trip productions. Attractions are coded as
home-based, non-home based and truck trips for the airport TAZ. A relatively low
number of productions, approximately 2%, are listed as non-home based shopping trips and truck trips. The tables from the model displays the dataset characteristics used by the NERPM model and the resultant regional trip distribution depicted in the model as trips originating from or destined to TAZ 149. Table 4-4 shows trip generation and attractions utilized by NERPM-AB for both the base year of 2010 and plan year of 2040.

In addition, the NERPM-AB update includes 15,000 daily trips derived from airline enplanements to represent intense airport passenger traffic. The NERPM-AB assumes these daily trips by this special generator are constant over the planning period. Table 4-5 provides passenger data for both airport special generators used in the NERPM-AB and added for each separate airport.

Analysis of Current Airport and MPO Modeling Process

Problems Related to Current Jacksonville International Airport Master Plan

The challenge for the airport, and local coordination with the TPO, is to define a common dataset and a technical communication process to ensure future development compatibility between the airport and surface transportation system, promote seamless intermodal connectivity and enhance economic productivity for the region served by the airport. While many policy goals and intermodal system performance measures have been developed, little specific data exchanges occur between JAX and the NFTPO. The JAX AMP development follows the requirements of an approved DRI. Both planning processes include massive amounts of required data collection and reporting. These documents should give the NFTPO substantial insight into the airport’s planned development program and give them comfort in accepting approved airport forecasts that are well coordinated and approved by the FDOT for consistency. It is also likely participating agency staff have significant technical expertise and experience in their
own mode, while their technical understanding of the other modes programs is limited, requiring them to accept the producing agencies plan without significant input. After reviewing both agency documents, with the exception of annual traffic counts, it appears little other information is used by either agency in preparation of their plans.

In addition, no coordination or AMP input is identified as being coordinated with the NFTPO. The airport’s ability to compete for implementing TPO surface transportation funds for off-site access improvements is directly related to the documentation of long-term need expressed in the surface transportation model as trip generation and system impact. In both instances, FAA and FDOT guidance indicates JAX should provide supporting documentation of need and recommends coordination of off-site access planning with the TPO and FDOT. The NFTPO utilizes traditional surface transportation planning methodologies to establish project need and prioritization for the airport’s intermodal access facilities. Currently the modelling process does not contain sufficient information to support the access needs of the adopted long-range AMP. This is true for the previous four-step model as well as the current Activity Based Model, which was utilized to build the new Long-Range Surface Transportation Plan.

Unfortunately, the ABM relies heavily on the previous model’s database for special generators, including the airport, and therefore results in a similar lack of airport data. The NFTPO is attempting to update and correct the special generator features where feasible. Without some form of agency collaboration and a specific intermodal plan to develop a joint database to accurately define and include airport trip generation and origin/destination data, future intermodal connectivity will be limited by poor, inconsistent modal priorities and lack of a clear definition of airport access needs within
the TPO planning process. It will also likely result in JAX and other airports working
directly with the FDOT to improve access, further making their plans inconsistent.

The JAX AMP includes several sections dealing with on-site traffic circulation,
parking, capacity analysis, safety and recommended project alternatives to enhance
traffic flow. However, the JAX AMP is heavily focused on maintaining the safety and
security of its aviation customers within the airport boundary. The concerns on major
access roads and their off-site connections are noted, but no detail is provided for off-
site facilities as to their functional capacity or safety. Airport access, defined as
intermodal priority by policy, must first recognize that airline passengers, airport
employees and other on-site activities must be included to establish the trip generation
and mode distribution characteristics of the airport facility. As a transportation mode,
airport-related travel varies significantly from the traditional trips accounted for in the
current surface transportation models. Air passenger trips, for example, vary
significantly from other urban travel. The JAX and RSW airports include a large number
of air passenger trips, including a high percentage of local residents and new visitors to
the region having distinctive mode splits, less frequency, higher vehicle occupancy,
luggage and longer durations between surface trips (ACRP, 2008). Other airport trip
generation includes passenger pick-up/drop off and meeter-and-greeter volumes, which
can substantially affect trip totals made by the air travelers. While this research tends to
substantiate the need for development of a unique airport ground access planning
process, linkages to on-site activities and the AMP are required for the off-site access
analysis to work.
Problems of NFTPO Planning Process to Address Airport

The NFTPO Four-Step Model Structure utilizes a special generator sub-model to evaluate JAX since the model does not adequately address intermodal facilities. Airports are an integral part of transportation system and require special treatment in the model structure to be accurately represented. In the model, database input files (ZDATA3) address JAX by providing coded census employment data and land-use information from the Comprehensive Plan. This data serves to generate trip attractions to the airport TAZ. To balance network trips to the airport with adjacent roadway traffic counts, an attraction factor is added to the base airport TAZ to help the model more closely simulates existing trip characteristics of the airport operations in the base year for calibration. The special generator model is only utilized for trip generation from the TAZ. All other functions are processed as standard model input.

The NFTPO recently converted to an Activity Based Model to build their Long-Range Transportation Plan. Initially when reviewing the model and its structure for dealing with airports, it did not include a process or routine to analyze airports or, for that matter, any other special generator. It also did not have a provision to address freight within the model structure. As the ABM model moved toward regional testing and plan development to save cost and time, the model was modified to include the base network, land-use, most demographic files and the special generator files from the existing four-step model. THE NFTPO recognized model limitations and has updated many of the models socioeconomic and special input data. While the ABM model has more advanced features, the inclusion of the data from the previous model carries these limitations forward. For purposes of this analysis, the models are separate. The four-step model utilizes a special generator to produce trips generated by the airport but
utilizes the traditional model for the remaining functions. The ABM model, on the other hand, utilizes the previous special generator files, processes them with a separate CUBE model and then returns the results to be added to the model network as a pre-load or background traffic. The results appear similar; however, the ABM models updated data and network application does provide some improvements in the evaluation of airport access. The special generator files are being updated.

**Airport Data Collection**

**Airport Employment and Performance Data**

This study collected terminal area employment including JAA, concessionaries, rental cars (including remote service area), FAA tower, TSA, police and fire employees, janitorial service, maintenance and others whose work is associated with terminal activities or works for the authority. This number also includes employment totals for the cargo, general aviation and military areas. Military employment includes Florida Air National Guard (FANG) 125th Fighter Group personnel with active badges. The employment numbers reflect active security badge holders. The number does not include employees who are not required to use registered badges for work because they do not need access to Security Identification Display Area (SIDA). Totals for Cargo, GA and Military may not be for all on-site employment. Employment totals were not available for non-aviation development areas. As shown in Table 4-6, a total of 3,345 employees currently have a JAX security badge as of October, 2016. This consists of 2,888 terminal area employees, 303 cargo area employees, 115 GA/Corporate employees and 39 military employees.

Table 4-7 shows historical performances of aircraft operations at the JAX. Air carriers’ aircraft operations decreased since 2007 and recorded the lowest operations in
2014 at 49,457. Air carriers’ operations increased in 2015 to 54,552. General aviation’s aircraft operations have been fluctuated year-to-year, but overall its operations show decreasing trends between 2010 and 2015.

Because of the impacts of the economic recession, the number of passengers at JAX decreased by an average of 2.6% per year between 2007 and 2013. However, the airline industry has regained profitability as the nationwide economy has strengthened. This economic recovery at JAX resulted in rapid increases in the number of passengers from 5.1 million in 2013 to 5.5 million in 2015, representing an average annual growth rate of 3.6%. Figure 4-9 presents the number of passengers at JAX between 2007 and 2015. Peak-month for the number of passenger has changed from year-to-year, but as indicated in Table 4-8, May and July are distinctive months at JAX to record the highest passenger volume within a year. In particular, July is the most common peak-month at JAX historically. In 2015, 514,172 total passengers traveled through JAX during July, which was nearly 50% higher than February where the passenger volume was 343,125. During July of 2015, an average of 17,139 passengers used JAX as either an origin or destination for their trips.

For commercial passenger airline groups, national and major commercial carriers transported approximately 97.4% of all passengers in 2015, while regional carriers and air taxis carried approximately 1.4% and 1.3%, respectively. Table 4-9 presents the performance of each air carrier group. As presented in Table 4-10, leisure travelers accounted for an average of 58.5% of total passengers during the last four quarters. The share of leisure travelers slightly increased from 54.7% in the 3rd quarter of 2015 to 61.4% in the 2nd quarter of 2016.
The catchment analysis for JAX shows the service areas encompass more than 20 counties in NE Florida and SE Georgia bordering Savannah/Hilton Head International Airport to the north; Tallahassee Regional and Gainesville Regional Airports to the west; and Daytona Beach International Airports to the south. JAX’s primary service areas include the five Florida counties of Duval, Baker, Clay, Nassau and St. Johns, and the five Georgia counties of Camden, Charleston, Clinch, Pierce, and Ware. According to the JAX catchment area analysis, more than 80% of air travelers from these counties used JAX. In addition to these primary service areas, its secondary service area extends to large geographical areas in both Florida and Georgia. Florida counties in the secondary catchment area include Putnam, Union, Bradford, Suwannee, Columbia and Hamilton, while Georgia counties include Brantley, Glynn, Wayne and McIntosh. In these secondary areas, nearly 50% of air travelers use JAX. In some counties in Florida and Georgia, up to 40% of air travelers choose JAX as their primary origin or destination airport. This data helps define JAX users’ origins and destinations for access modelling purposes. Figure 4-10 presents a visual analysis of the JAX passenger catchment area results.

In addition to passenger travel needs, JAX is becoming one of the fastest growing air cargo hubs in the southeast region. Several passenger airlines and dedicated all-cargo airlines provide air cargo service at JAX. The dedicated all-cargo carriers include United Parcel Service (UPS), FedEx, ABX Air (carries freight for DHL) and Mountain Air Cargo (a major contract carrier for FedEx). These dedicated all-cargo carriers transport both freight and mail. The volume of freight sharply decreased from
about 158 million pounds in 2010 to 151 million pounds in 2011, and then fluctuated between 148 million and 151 million. The amount of high-value parcel freight occupies the vast majority of air cargo at nearly 96%. Airmail service carried through JAX experienced a rapid increase from about 3.0 million pounds in 2010 to 6.9 million pounds in 2015. This resulted from a contract change between FedEx and the U.S. Postal Service (USPS) for mail carried through JAX. Table 4-11 presents air cargo volumes at JAX from 2010 to 2015.

**24-Hour Traffic Count Data**

This study collected existing hourly traffic count data for both passengers and vehicle trips to identify the peak-hour travel needs at JAX. The peak-hour travel data is one of the most critical factors defining the development of demand-based on-site and off-site airport facilities. Hourly travel patterns are especially important for the airport because of the difference between scheduled flight departure times and passengers’ arrival at the airport. This results in traffic on the airport access network responding earlier for arrivals and later for departures. Previous airport plans and related studies have reported airline passengers arrive at the terminal from 60 minutes to as early as 3 hours prior to their scheduled flight departure time.

This study identified 24-hour traffic count data to document in-bound and out-bound traffic.

1. *Jacksonville International Airport Development of Regional Impact: 2014 Biennial Monitoring Report* (December, 2015) provides 24-hour traffic count data collected from three locations: 1 station (In-bound #1) and 2 stations (Out-bound #1 & #2)

2. *Access Management Study to I-95: Final Report* (February, 2014) includes 24-hour traffic count information from three locations: 1 station (In-bound #2) and 2 stations (Out-bound #3 & #4)
3. Jacksonville Aviation Authority Operational Data provides passenger shuttle ridership in 2016 and daily aircraft operations data. The passengers’ shuttle ridership data was collected for departing (In-bound #3) and arriving (Out-bound #5) passengers. Aircraft operations data was also collected for departures (In-bound #4) and arrivals (Out-bound #6).

Figure 4-11 presents in-bound and out-bound traffic count locations examined in this study.

This study examined the hourly traffic distribution collected at each location, and then identified the most representative data depicting actual passenger movements to/from JAX. Figure 4-11 presents in-bound and out-bound traffic count locations, Figure 4-12 shows hourly in-bound traffic distribution and Figure 4-13 shows hourly out-bound traffic distribution. In-bound #4 has a peak-hour between 11:00 a.m. and 12:00 p.m., and second peak between 12:00 p.m. and 13:00 p.m. In-bound #2 has peak traffic flows between 13:00 p.m. and 14:00 p.m., and has second peak from 12:00 p.m. to 13:00 p.m. Meanwhile, in-bound #3 has a peak-hour between 5:00 a.m and 6:00 a.m, and second peak appears from 10:00 a.m. to 11:00 a.m. Traffic flow between 17:00 p.m. and 18:00 p.m. represents another peak-hour, but has relatively low traffic volumes. In-bound #4 has three peaks, including 6:00-8:00 a.m., 11:00 a.m.-12:00 p.m., and 19:00-20:00 p.m. In-bound #4 represents actual aircraft arrivals at JAX and is close to the passenger traffic flow presented in the JAX AMP. Figure 4-12 presents hourly inbound traffic flows.

As illustrated in Figure 4-13, out-bound traffic distribution has multiple similar peak-periods during the day, although each has distinctive characteristics. Out-bound #1 shows the highest peak-hour traffic between 15:00 and 17:00 p.m, and has secondary peaks during 7:00-8:00 a.m and 12:00-13:00 p.m. Out-bound #2, #3, and #4 show similar travel patterns having multiple daytime peaks between 10:00 a.m. and
19:00 p.m., and increased traffic flow during the evening between 9:00 p.m. and 2:00 a.m. Out-bound #5 also has multiple peaks during the day, but it is different from other hourly distributions because it has the highest peak-hour traffic flow at night between 23:00 p.m. and 1:00 a.m. This results from the large number of aircraft arrivals from 9:00 p.m. to midnight, as shown out-bound #6. These distributions appear reasonable. Out-bound #6 has four similar peaks occurring at 10:00-11:00 a.m., 14:00-15:00 p.m., 18:00-19:00 p.m., and 22:00-23:00 p.m.

This in-bound and out-bound traffic count data can present only approximate patterns of airport passenger traffic. The current count data has limitations in providing full information of airport related traffic flow because the locations of the traffic counts are not appropriate to collect total in-bound and/or out-bound traffic generated by passengers, employees and air cargo. For example, in-bound #1 and out-bound #1 may include traffic other than to/from airport, while in-bound #2 and out-bound #3 possibly miss traffic to/from I-295 direction. In-bound #4 and out-bound #2, #4 and #6 may present passenger related traffic patterns at the terminal area, but are likely to miss employee and cargo related traffic using different roads. Shuttle ridership data (in-bound #3 and out-bound #5) represents only partial passenger counts who use the economy parking lots. Therefore, hourly trip distributions of total daily trips may not exactly represent the actual 24-hour trip cycle.

Utilization of Airport Data

Trip Generation

For planning purpose, it is important to determine the numbers of vehicle trips generated by specific land-use patterns because the majority of vehicle trips to/from an airport are a function of the number of passengers on commercial flights and employees
working at the airport terminal facilities. Given this consideration, this study attempts to calculate peak-hour vehicle trip generation by passengers and employees. Ideally, it would be best if trip generation could be calculated using actual trip generation rates by airport land-use or facilities. For example, 24-hour work schedule data for employees will present hourly distribution of trips generated by employees. While 24-hour passenger counts at the security check points by Transportation Security Agency (TSA) will show how passengers are distributed across the 24-hour operational cycle. Similarly, 24-hour traffic count data will be valuable if they are collected from the right locations where passenger and employee movements can be accurately counted. However, currently available data and methodologies have limitations to define accurate peak-hour passenger trips and consequent vehicle trips generated by specific activities at the airport.

Considering these limitations, this study attempts to utilize various alternative methods to predict peak-hour passenger trips and/or vehicle trips. This study adopts the ITE trip generation handbook, which is a common procedure and manual to determine the number of vehicle trips generated by specific land-use patterns. The ITE handbook provides trip generation rates as follow:

1. For commercial airports, the ITE handbook provides two average vehicle trip generation rates, one by the number of employees and a second by average flights per day

2. For general aviation airports, the ITE Handbook provides two average trip generation rates, one by the number of employees and a second for based aircraft

3. For air cargo facilities (as intermodal truck terminal), the ITE Handbook provides average trip generation rates by the number of employees and facility acreage

4. For military base, the ITE Manual provides average vehicle trip generation rates by the number of employees
This study utilizes these trip generation rates to predict average peak-hour vehicle trips. This study uses employment data for terminal area, GA/corporate, military, and air cargo area to calculate average vehicle trips. For that, this study applies the number of employees by each facility. This study also uses aircraft operation data for terminal area and GA/Corporate use to estimate average daily vehicle trips. To predict average vehicle trip generation by average flights per day, this study uses aircraft operation statistics in 2015, such as 54,552 for air carriers and 11,223 for GA/corporate. This study first determined average peak-month operations using the share of peak-month passenger in total number of annual passengers, which is 9.35%. Then this study projected the average day of aircraft operations of the peak-month dividing the peak-month operations by the days in the peak-month. This is a typical method recommended by the FAA to determine the average day of the peak month (ADPM). As shown in Table 4-12, this study obtained a daily aircraft operations of 165 for air carriers and 34 for GA/corporate.

Using the number of employees and average daily aircraft operations, this study predicted daily vehicle trips for JAX. As shown in Table 4-13, total daily vehicle trips are estimated to be 59,871, of which 17,347 trips are generated by passenger-related activities and 42,524 trips are employees-generated. Among airport facilities, the terminal area appeared to generate the largest portion of daily trips at 93.5% with 55,979 trips, and it was followed by air cargo at 3.5% with 2,118 trips and GA/corporate at 2.8% with 1,705 trips.

Using hourly in-bound and out-bound trip distributions, this study distributed the estimated daily trips into hourly trips in a peak day. For that, this study used a total
estimated vehicle trips of 59,871 to represent peak day daily trips. This is especially true for passenger-related vehicle trips because it is predicted based on average daily aircraft operations in the peak-month. In calculating hourly trip distributions, this study assumed that directional shares are 50% for entering trips and 50% for exiting trips. This makes an average of 8,674 passenger day trips in the peak-month and an average of 21,262 employee day trips in the peak month. In calculating peak-hour passenger number, this study assumes that departing passengers arrive at the JAX 90 minutes prior to their flight schedule, while arrival passengers leave from the airport 45 minutes after they arrive at the JAX. It should be noted that this study only calculates passenger trips because there is no available 24-hour cycle distribution data. An average day trips by employees can be analyzed by either MPO transportation model or new data collection for hourly based work schedule. Figure 4-14 presents the distributions of in-bound vehicle trips, and Figure 4-15 shows the distributions of out-bound vehicle trips.

Among departing vehicle distributions, in-bound #3 and #4 are considered to reflect actual passenger movement at the JAX. In-bound #3 shows the highest peak-hour passenger related vehicle trips of 1,202 between 6:00-7:00 a.m., and has a secondary peak during 11:00 a.m. - 12:00 p.m. at 691 vehicle trips. It also has a third peak hour between 18:00-19:00 p.m. with 411 vehicle trips. In-bound #4 has three similar levels of peak-hour trips occurring during 6:00-8:00 a.m., 11:00 a.m. - 12:00 p.m., 19:00-20:00 p.m., and second peak between 14:00 p.m. and 17:00 p.m. ranging 789 to 887 vehicle trips. In-bound #1 and #2 are likely to represent regular hourly roadway trip distributions that have the highest peak-hour during afternoon commute.
In-bound #1 has the highest peak-hour trips of 562 between 16:00 and 19:00 p.m., while in-bound #2 shows the highest vehicle volume between 19:00 and 20:00 p.m.

Among hourly arrival distribution scenarios, out-bound #5 and #6 present similar patterns by having the highest passenger traffic between 22:00 p.m. and 23:00 p.m. with 961 trips and 877 trips, respectively. They also have multiple secondary peak-hours occurring during 10:00 -11:00 a.m., 14:00 - 15:00 p.m., and 18:00 - 19:00 p.m. Other out-bound passenger distributions show morning, mid-day and afternoon peak hours. In particular, out-bound #1 and #2 present almost identical passenger travel patterns, while out-bound #3 and #4 are similar in their passenger travel distributions.

**Trip Distribution**

It is desirable to use air passengers’ origin and destination information to distribute vehicle trips generated by air passengers and employees. However, currently available data from the JAA provides only county-level catchment areas. Therefore, it is not possible to conduct more accurate trip distribution analysis. This condition can be improved when air passenger origin and destination data from ARC is available. The ARC data provides an actual depiction of passenger travel information by zip code level, including ticket buyers’ home addresses. This study also expects that employees’ home location information on a zip code level would greatly improve the trip distribution analysis and is available from security badging if needed.

**Test the Availability of Airport Data**

Ideally, it is desirable to compare the trip generation and trip distribution features discussed previously with those used by the MPO models allowing for appropriate updates. However, currently available airport employment data does not fit within the NFTPO’s NERPM-AB requirements for input data. In addition, currently available air
passengers’ origin and destination information from the JAA provides only broad county level catchment areas. Therefore, testing the availability of collected airport data is not possible in this study. Given these limitations, this study presents potential trip generation and trip distribution by the NERPM-AB model predicted utilizing updated existing employment and passenger data. The recommended practices are expected to enhance the understanding of the objectives of this study and provide an alternative for future enhancements in the model.

Table 4-14 presents the results of trip generation analysis obtained from the NERPM-AB Model. The table provides an estimation of employment at the JAX between 2005 and 2035 for use in trip generation. There are four industry classifications, including manufacturing, industrial, commercial and service. Manufacturing is the largest with 437 employees, followed by service, commercial and industrial with 312, 116 and 24 employees, respectively. Manufacturing is predicted to decrease, and service has no change. In contrast, industrial and commercial are estimated to grow in 2035.

These trips are expected to generate 34,100 and 37,000 peak season weekday average daily traffic (PSWADT) in 2005 and 2035, respectively, for the roads represented in the modeled highway network. Table 4-15 shows the estimation of peak season weekday average daily traffic. To assign these trip productions, the model used an equal distribution of trip purposes. Using the employment data, NERPM estimated trips by purpose as shown in Table 4-16. The airport TAZ is coded with roughly 50,000 trip attractions in its base year of 2005 to balance this land-use/employment based TAZ with traffic counts for departing highway access locations. This number is held constant
in the 2035 plan year. Attractions are coded as home-based and external trips for the airport TAZ. The low number of external trips, roughly 3%, also does not seem to correspond to the airport’s service area, which draws substantial numbers of passengers and cargo from outside of the TPO model boundaries. A relatively low number of productions, approximately 2%, are listed as non-home based trips. It also does not appear this number accurately reflects the level of airline passengers who visit this region from other areas. Figure 4-16 exhibits the resultant regional trip distribution depicted in the model as trips originating from or destined to the JAX. The NERPM-AB might produce more consistent data to represent the airport if it allowed and was supported by better data from the airport.

As can be seen from review of the data, the model effectively goes back to utilizing land-use categories for trip generation. While a separate number has been credited for passenger trip generation and the model results are better than the previous four-step model, the methodology effectively has the same procedures and also does not effectively represent the airport.
<table>
<thead>
<tr>
<th>FAA</th>
<th>Airport name</th>
<th>Hub Type</th>
<th>Enplane</th>
<th>Deplanes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLL</td>
<td>Fort Lauderdale–Hollywood International Airport</td>
<td>L</td>
<td>10,486,857</td>
<td>10,495,457</td>
<td>20,982,314</td>
</tr>
<tr>
<td>MIA</td>
<td>Miami International Airport</td>
<td>L</td>
<td>10,498,433</td>
<td>10,521,037</td>
<td>21,019,470</td>
</tr>
<tr>
<td>MCO</td>
<td>Orlando International Airport</td>
<td>L</td>
<td>16,283,610</td>
<td>16,412,433</td>
<td>32,696,043</td>
</tr>
<tr>
<td>TPA</td>
<td>Tampa International Airport</td>
<td>L</td>
<td>8,834,166</td>
<td>8,797,705</td>
<td>17,631,871</td>
</tr>
<tr>
<td>RSW</td>
<td>Southwest Florida International Airport</td>
<td>M</td>
<td>3,995,256</td>
<td>3,946,144</td>
<td>7,941,400</td>
</tr>
<tr>
<td>JAX</td>
<td>Jacksonville International Airport</td>
<td>M</td>
<td>2,714,872</td>
<td>2,706,550</td>
<td>5,421,422</td>
</tr>
<tr>
<td>PBI</td>
<td>Palm Beach International Airport</td>
<td>M</td>
<td>3,055,997</td>
<td>3,038,192</td>
<td>6,094,189</td>
</tr>
<tr>
<td>EYW</td>
<td>Key West International Airport</td>
<td>S</td>
<td>362,101</td>
<td>348,591</td>
<td>710,692</td>
</tr>
<tr>
<td>SFB</td>
<td>Orlando Sanford International Airport</td>
<td>S</td>
<td>1,093,195</td>
<td>1,111,487</td>
<td>2,204,682</td>
</tr>
<tr>
<td>ECP</td>
<td>Northwest Florida Beaches International Airport</td>
<td>S</td>
<td>428,696</td>
<td>431,755</td>
<td>860,451</td>
</tr>
<tr>
<td>PNS</td>
<td>Pensacola International Airport (Pensacola Gulf Coast Regional Airport)</td>
<td>S</td>
<td>787,608</td>
<td>786,673</td>
<td>1,574,281</td>
</tr>
<tr>
<td>SRQ</td>
<td>Sarasota–Bradenton International Airport</td>
<td>S</td>
<td>586,067</td>
<td>582,048</td>
<td>1,168,115</td>
</tr>
<tr>
<td>PIE</td>
<td>St. Pete–Clearwater International Airport</td>
<td>S</td>
<td>809,754</td>
<td>820,790</td>
<td>1,630,544</td>
</tr>
<tr>
<td>DAB</td>
<td>Daytona Beach International Airport</td>
<td>N</td>
<td>306,016</td>
<td>303,605</td>
<td>609,621</td>
</tr>
<tr>
<td>GNV</td>
<td>Gainesville Regional Airport</td>
<td>N</td>
<td>213,120</td>
<td>209,860</td>
<td>422,980</td>
</tr>
<tr>
<td>MLB</td>
<td>Melbourne International Airport</td>
<td>N</td>
<td>220,346</td>
<td>217,061</td>
<td>437,407</td>
</tr>
<tr>
<td>PGD</td>
<td>Punta Gorda Airport (was Charlotte County Airport)</td>
<td>N</td>
<td>421,157</td>
<td>421,595</td>
<td>842,752</td>
</tr>
<tr>
<td>TLH</td>
<td>Tallahassee International Airport</td>
<td>N</td>
<td>332,653</td>
<td>332,006</td>
<td>664,659</td>
</tr>
<tr>
<td>VPS</td>
<td>Destin–Fort Walton Beach Airport (Eglin Air Force Base)</td>
<td>N</td>
<td>372,936</td>
<td>372,395</td>
<td>745,331</td>
</tr>
<tr>
<td>SGJ</td>
<td>Northeast Florida Regional Airport</td>
<td>N</td>
<td>22,029</td>
<td>21,874</td>
<td>43,903</td>
</tr>
</tbody>
</table>

Source: Bureau of Transportation Statistics (BTS) (2015), T-100 Domestic Market (All Carriers), *Air Carrier Statistics – All Carriers*
Table 4-2. JAX Enplaned Passenger Forecasts between 2007 and 2027

<table>
<thead>
<tr>
<th>Year</th>
<th>Air Carrier Passengers</th>
<th>Regional/Commuter Passengers</th>
<th>Total Enplaned Passengers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Historical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>2,140,283</td>
<td>285,451</td>
<td>2,425,734</td>
</tr>
<tr>
<td>2003</td>
<td>2,041,968</td>
<td>391,349</td>
<td>2,433,317</td>
</tr>
<tr>
<td>2004</td>
<td>1,985,537</td>
<td>582,049</td>
<td>2,567,586</td>
</tr>
<tr>
<td>2005</td>
<td>2,199,116</td>
<td>649,714</td>
<td>2,848,830</td>
</tr>
<tr>
<td>2006</td>
<td>2,264,047</td>
<td>655,747</td>
<td>2,919,794</td>
</tr>
<tr>
<td>2007</td>
<td>2,453,549</td>
<td>707,280</td>
<td>3,160,829</td>
</tr>
<tr>
<td></td>
<td>Forecast</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>2,540,100</td>
<td>723,300</td>
<td>3,263,400</td>
</tr>
<tr>
<td>2012</td>
<td>2,865,800</td>
<td>860,500</td>
<td>3,726,300</td>
</tr>
<tr>
<td>2015</td>
<td>3,143,000</td>
<td>973,800</td>
<td>4,116,800</td>
</tr>
<tr>
<td>2017</td>
<td>3,354,200</td>
<td>1,054,200</td>
<td>4,408,400</td>
</tr>
<tr>
<td>2022</td>
<td>3,765,000</td>
<td>1,227,000</td>
<td>4,992,000</td>
</tr>
<tr>
<td>2027</td>
<td>4,206,800</td>
<td>1,407,600</td>
<td>5,614,400</td>
</tr>
<tr>
<td></td>
<td>Average Annual Growth Rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002-07</td>
<td>2.80%</td>
<td>19.90%</td>
<td>5.40%</td>
</tr>
<tr>
<td>2007-12</td>
<td>3.20%</td>
<td>4.00%</td>
<td>3.30%</td>
</tr>
<tr>
<td>2007-27</td>
<td>2.70%</td>
<td>3.50%</td>
<td>2.90%</td>
</tr>
</tbody>
</table>


Table 4-3. JAX TAZ (149)’s Population and Employment Used in NERPM-AB

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Employment</th>
<th>SCH ENR</th>
<th>STPK CST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SF</td>
<td>MF</td>
<td>TOTAL</td>
<td>MFG</td>
</tr>
<tr>
<td>2010</td>
<td>11</td>
<td>0</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>2040</td>
<td>11</td>
<td>0</td>
<td>11</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: North Florida Transportation Planning Organization
Table 4-4. JAX TAZ (149)’s Trip Generations and Attractions

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>2010 Generation</th>
<th>2040 Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Productions</td>
<td>Attractions</td>
</tr>
<tr>
<td>Home Based Work</td>
<td>2,934</td>
<td>6,272</td>
</tr>
<tr>
<td>Home Based Shopping</td>
<td>2,395</td>
<td>3,480</td>
</tr>
<tr>
<td>Home Based Social/Rec</td>
<td>220</td>
<td>513</td>
</tr>
<tr>
<td>Home Based Other</td>
<td>1,303</td>
<td>3,056</td>
</tr>
<tr>
<td>Non Home Based Shopping</td>
<td>2,509</td>
<td>5,048</td>
</tr>
<tr>
<td>Light Truck Trip</td>
<td>899</td>
<td>1,737</td>
</tr>
<tr>
<td>Medium Truck Trip</td>
<td>240</td>
<td>445</td>
</tr>
<tr>
<td>Heavy Truck</td>
<td>112</td>
<td>206</td>
</tr>
<tr>
<td>Total</td>
<td>3,760</td>
<td>10,612</td>
</tr>
</tbody>
</table>

Source: North Florida Transportation Planning Organization

Table 4-5. Special Generators Used in NERPM-AB

<table>
<thead>
<tr>
<th>TAZ</th>
<th>Special Generator</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>149</td>
<td>Jacksonville International Airport</td>
<td>15,000</td>
</tr>
<tr>
<td>1277</td>
<td>St. Augustine</td>
<td>2,288</td>
</tr>
</tbody>
</table>

Source: North Florida Transportation Planning Organization

Table 4-6. JAX Employment by Facility

<table>
<thead>
<tr>
<th>Facility</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal Area</td>
<td>2,888</td>
</tr>
<tr>
<td>Cargo Area*</td>
<td>303</td>
</tr>
<tr>
<td>GA/Corporate*</td>
<td>115</td>
</tr>
<tr>
<td>Military*</td>
<td>39</td>
</tr>
<tr>
<td>Total</td>
<td>3,345</td>
</tr>
</tbody>
</table>

Source: Jacksonville Aviation Authority
Note: * incomplete data
Table 4-7. Annual Aircraft Operations

<table>
<thead>
<tr>
<th>Year</th>
<th>Air Carrier</th>
<th>Air Taxi</th>
<th>GA</th>
<th>Military</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>53,004</td>
<td>22,602</td>
<td>12,694</td>
<td>6,553</td>
<td>94,853</td>
</tr>
<tr>
<td>2011</td>
<td>58,105</td>
<td>19,956</td>
<td>13,536</td>
<td>7,275</td>
<td>98,872</td>
</tr>
<tr>
<td>2012</td>
<td>55,101</td>
<td>15,594</td>
<td>12,519</td>
<td>5,926</td>
<td>89,140</td>
</tr>
<tr>
<td>2013</td>
<td>51,358</td>
<td>18,301</td>
<td>13,755</td>
<td>7,145</td>
<td>90,559</td>
</tr>
<tr>
<td>2014</td>
<td>49,457</td>
<td>20,168</td>
<td>11,544</td>
<td>6,460</td>
<td>87,629</td>
</tr>
<tr>
<td>2015</td>
<td>54,552</td>
<td>18,528</td>
<td>11,223</td>
<td>9,199</td>
<td>93,502</td>
</tr>
</tbody>
</table>

Source: Jacksonville Aviation Authority

Table 4-8. JAX Air Passenger Volumes

<table>
<thead>
<tr>
<th>Month</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>379,981</td>
<td>386,699</td>
<td>375,549</td>
<td>370,529</td>
<td>362,424</td>
<td>378,396</td>
</tr>
<tr>
<td>February</td>
<td>372,814</td>
<td>379,653</td>
<td>379,292</td>
<td>368,204</td>
<td>346,567</td>
<td>343,125</td>
</tr>
<tr>
<td>March</td>
<td>380,360</td>
<td>487,463</td>
<td>469,698</td>
<td>466,090</td>
<td>470,348</td>
<td>467,819</td>
</tr>
<tr>
<td>April</td>
<td>481,137</td>
<td>467,987</td>
<td>453,153</td>
<td>444,538</td>
<td>462,899</td>
<td>489,536</td>
</tr>
<tr>
<td>May</td>
<td>477,886</td>
<td>485,920</td>
<td>463,672</td>
<td>467,509</td>
<td>480,827</td>
<td>497,722</td>
</tr>
<tr>
<td>June</td>
<td>495,435</td>
<td>492,214</td>
<td>457,240</td>
<td>452,197</td>
<td>460,699</td>
<td>491,617</td>
</tr>
<tr>
<td>July</td>
<td>504,741</td>
<td>498,781</td>
<td>456,168</td>
<td>454,199</td>
<td>470,971</td>
<td>514,172</td>
</tr>
<tr>
<td>August</td>
<td>480,684</td>
<td>451,094</td>
<td>447,119</td>
<td>433,807</td>
<td>445,025</td>
<td>479,361</td>
</tr>
<tr>
<td>September</td>
<td>425,797</td>
<td>410,714</td>
<td>386,081</td>
<td>390,493</td>
<td>407,969</td>
<td>440,981</td>
</tr>
<tr>
<td>October</td>
<td>480,629</td>
<td>455,392</td>
<td>433,503</td>
<td>441,006</td>
<td>459,270</td>
<td>484,816</td>
</tr>
<tr>
<td>November</td>
<td>466,068</td>
<td>447,926</td>
<td>423,810</td>
<td>411,112</td>
<td>417,898</td>
<td>459,037</td>
</tr>
<tr>
<td>December</td>
<td>461,493</td>
<td>435,822</td>
<td>410,036</td>
<td>431,871</td>
<td>446,091</td>
<td>455,307</td>
</tr>
<tr>
<td>Annual</td>
<td>5,507,025</td>
<td>5,399,665</td>
<td>5,155,321</td>
<td>5,131,555</td>
<td>5,230,988</td>
<td>5,501,889</td>
</tr>
</tbody>
</table>

| Average day in Peak-Month | 16,825 | 16,626 | 15,657 | 15,584 | 16,028 | 17,139 |

Source: Bureau of Transportation Statistics, “TranStat”
Table 4-9. JAX Air Passenger Volumes by Air Carrier Group

<table>
<thead>
<tr>
<th>Group</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Carriers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Departure</td>
<td>2,728,950</td>
<td>2,690,117</td>
<td>2,564,306</td>
<td>2,528,479</td>
<td>2,567,196</td>
<td>2,643,531</td>
</tr>
<tr>
<td>Arrival</td>
<td>2,725,966</td>
<td>2,692,981</td>
<td>2,566,467</td>
<td>2,527,916</td>
<td>2,561,901</td>
<td>2,635,361</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>5,454,916</td>
<td>5,383,098</td>
<td>5,130,773</td>
<td>5,056,395</td>
<td>5,129,097</td>
<td>5,278,892</td>
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<tr>
<td>Regional Carriers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Departure</td>
<td>8,270</td>
<td>1,252</td>
<td>1,896</td>
<td>136</td>
<td>120</td>
<td>37,918</td>
</tr>
<tr>
<td>Arrival</td>
<td>8,237</td>
<td>1,052</td>
<td>1,648</td>
<td>0</td>
<td>124</td>
<td>36,762</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>16,507</td>
<td>2,304</td>
<td>3,544</td>
<td>136</td>
<td>244</td>
<td>74,680</td>
</tr>
<tr>
<td>Air Taxi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Departure</td>
<td>17,982</td>
<td>8,205</td>
<td>10,782</td>
<td>19,117</td>
<td>20,755</td>
<td>33,423</td>
</tr>
<tr>
<td>Arrival</td>
<td>17,620</td>
<td>6,058</td>
<td>10,222</td>
<td>19,644</td>
<td>21,476</td>
<td>34,427</td>
</tr>
<tr>
<td>Total</td>
<td>35,602</td>
<td>14,263</td>
<td>21,004</td>
<td>38,761</td>
<td>42,231</td>
<td>67,850</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Departure</td>
<td>2,755,202</td>
<td>2,699,574</td>
<td>2,576,984</td>
<td>2,547,732</td>
<td>2,588,071</td>
<td>2,714,872</td>
</tr>
<tr>
<td>Arrival</td>
<td>2,751,823</td>
<td>2,700,091</td>
<td>2,578,337</td>
<td>2,547,560</td>
<td>2,583,501</td>
<td>2,706,550</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>5,507,025</td>
<td>5,399,665</td>
<td>5,155,321</td>
<td>5,095,292</td>
<td>5,171,572</td>
<td>5,421,422</td>
</tr>
</tbody>
</table>

Source: Bureau of Transportation Statistics, "TranStat"

Table 4-10. JAX Air Passengers' Trip Purpose and Demographic Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Business Travelers</th>
<th>Leisure Travelers</th>
<th>Average Age</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Q2015</td>
<td>45.3%</td>
<td>54.7%</td>
<td>41-60</td>
<td>52.2%</td>
<td>47.8%</td>
</tr>
<tr>
<td>4Q2015</td>
<td>41.6%</td>
<td>58.4%</td>
<td>41-60</td>
<td>49.4%</td>
<td>50.6%</td>
</tr>
<tr>
<td>1Q2016</td>
<td>40.4%</td>
<td>59.6%</td>
<td>41-60</td>
<td>48.7%</td>
<td>51.3%</td>
</tr>
<tr>
<td>2Q2016</td>
<td>38.6%</td>
<td>61.4%</td>
<td>41-60</td>
<td>47.0%</td>
<td>53.0%</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>41.5%</td>
<td>58.5%</td>
<td>41-60</td>
<td>49.3%</td>
<td>50.7%</td>
</tr>
</tbody>
</table>

Source: Jacksonville Aviation Authority
Table 4-11. JAX Air Cargo and Mail Volumes in Pounds

<table>
<thead>
<tr>
<th></th>
<th>Freight</th>
<th>Mail</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>157,654,436</td>
<td>3,018,140</td>
<td>160,672,576</td>
</tr>
<tr>
<td>2011</td>
<td>150,874,558</td>
<td>2,970,440</td>
<td>153,844,998</td>
</tr>
<tr>
<td>2012</td>
<td>150,142,036</td>
<td>3,915,327</td>
<td>154,057,363</td>
</tr>
<tr>
<td>2013</td>
<td>148,058,233</td>
<td>5,785,300</td>
<td>153,843,533</td>
</tr>
<tr>
<td>2014</td>
<td>150,872,232</td>
<td>6,709,991</td>
<td>157,582,223</td>
</tr>
<tr>
<td>2015</td>
<td>152,441,653</td>
<td>6,854,291</td>
<td>159,295,944</td>
</tr>
</tbody>
</table>

Source: Bureau of Transportation Statistics, “TranStat”

Table 4-12. Calculation of JAX Daily Aircraft Operations in 2015

<table>
<thead>
<tr>
<th></th>
<th>Air Carrier</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>54,552</td>
<td>11,223</td>
</tr>
<tr>
<td>Peak-month (9.35%)</td>
<td>5,101</td>
<td>1,049</td>
</tr>
<tr>
<td>Day in peak-month</td>
<td>165</td>
<td>34</td>
</tr>
</tbody>
</table>

Source: Jacksonville International Airport
Table 4-13. JAX Daily Trip Generation Estimates per ITE Trip Generation Method

<table>
<thead>
<tr>
<th>Category</th>
<th>Facility</th>
<th>Numbers</th>
<th>ITE Generation Rate</th>
<th>Daily 2-Way Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passengers</td>
<td>Terminal Area</td>
<td>165</td>
<td>104.73</td>
<td>17,280</td>
</tr>
<tr>
<td>(Using average flights per day)</td>
<td>GA/Corporate*</td>
<td>34</td>
<td>1.97</td>
<td>67</td>
</tr>
<tr>
<td>Employees</td>
<td>Terminal Area</td>
<td>2,888</td>
<td>13.4</td>
<td>38,699</td>
</tr>
<tr>
<td></td>
<td>GA/Corporate*</td>
<td>115</td>
<td>14.24</td>
<td>1,638</td>
</tr>
<tr>
<td></td>
<td>Military*</td>
<td>39</td>
<td>1.78</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>Cargo Area*</td>
<td>303</td>
<td>6.99</td>
<td>2,118</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3,345</td>
<td></td>
<td>59,872</td>
</tr>
</tbody>
</table>

Table 4-14. JAX Employment per NFTPO Model

<table>
<thead>
<tr>
<th>Employment Category</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>437</td>
</tr>
<tr>
<td>Industrial</td>
<td>24</td>
</tr>
<tr>
<td>Commercial</td>
<td>116</td>
</tr>
<tr>
<td>Service</td>
<td>312</td>
</tr>
<tr>
<td>Total</td>
<td>889</td>
</tr>
</tbody>
</table>

Source: NFTPO, NERPPM-AB Model
### Table 4-15. Peak Season Weekday Average Daily Traffic (PSWADT)

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2035</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSWADT</td>
<td>34,100</td>
<td>37,000</td>
</tr>
</tbody>
</table>

Source: NFTPO – 4-Step Model – Special Generator

### Table 4-16. JAX Daily Trip Generation Estimates by Trip Purpose

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>2005 Generation</th>
<th>2035 Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Productions</td>
<td>Attractions</td>
</tr>
<tr>
<td>Home Based Work</td>
<td>7</td>
<td>12,513</td>
</tr>
<tr>
<td>Home Based Shopping</td>
<td>3</td>
<td>423</td>
</tr>
<tr>
<td>Home Based Social/Rec</td>
<td>3</td>
<td>11,331</td>
</tr>
<tr>
<td>Home Based Other</td>
<td>6</td>
<td>11,724</td>
</tr>
<tr>
<td>Non Home Based</td>
<td>738</td>
<td>11,968</td>
</tr>
<tr>
<td>External</td>
<td>0</td>
<td>1,617</td>
</tr>
<tr>
<td>Total</td>
<td>757</td>
<td>49,576</td>
</tr>
</tbody>
</table>

Source: NFTPO – NEFRPM-AB
Source: FDOT- Aviation System Plan, 2015

Figure 4-1. MPO Boundaries and Airports in Florida
Source: Jacksonville Aviation Authority (2009), Draft of Jacksonville International Airport Master Plan, p. IV-7.

Figure 4-2. Hourly Distribution of Aircraft Operations During 24-hour period
Figure 4-3. Hourly Distribution of Enplaned Passengers by Scenario

Figure 4-4. Hourly Distribution of Deplaned Passengers by Scenario

Source: Jacksonville Aviation Authority (2009), Draft of Jacksonville International Airport Master Plan, p. IV-49.
Source: Jacksonville Aviation Authority (2009), Draft of Jacksonville International Airport Master Plan, p. IV-49.

Figure 4-5. Hourly Distribution of Enplaned and Deplaned Passengers by Scenario
Figure 4-6. Analysis of Roadway Network around JAX

Figure 4-7. TPO Four Step Model Components
Figure 4-8. MPO TAZs in Airport Planning Area (JAX Property in Blue)

Source: NFTPO NEFPM-AB and JAX Airport Master Plan

Figure 4-9. Trends of the Number of Passengers at the JAX

Source: JAX Website, Passenger Data, November, 2016
Figure 4-10. JAX Catchment Area Analysis

Source: Jacksonville International Airport, Airport Market Analysis, 2014
Figure 4-11. In-Bound and Out-Bound Traffic Count Locations

Figure 4-12. Hourly In-bound Traffic Distribution
Source: Jacksonville International Airport, Annual DRI Monitoring Report, 2015

Figure 4-13. Hourly Out-bound Traffic Distribution
Figure 4-14. Hourly Departing Vehicle Trip Estimation
Figure 4-15. Hourly Arriving Vehicle Trip Estimation
Figure 4-16. JAX Airport Related Trip Distributions Map (Productions/Attractions)
CHAPTER 5
POLICY IMPLICATIONS FOR INTEGRATED AIRPORT ACCESS PLANNING

This research project has progressed through many different phases both technically and also in my own personal understanding and appreciation of the issue under study. During the initial development of the research problem statement, supported by extensive literature reviews and evaluations of current industry practice, the need and potential benefit for development of a common, collaborative intermodal access planning framework for aviation and surface transportation became very clear. Significant ongoing research supported an evolving planning practice in both the aviation and surface transportation planning fields to enhance and improve each mode’s ability to assess its current operational status, project regional modal needs for 20-plus years into the future and then construct an organized, financially sound 5-year capital improvement program to sequentially implement the modes long-term plan. Even with these more comprehensive modal planning procedures and improving coordination between aviation and surface transportation organizations, little progress has been made in establishing joint planning procedures for intermodal collaboration.

Discussion of Special Generator Application for Access Planning

The aviation and surface transportation mode’s ability to utilize and integrate other agencies’ regional land-use plans and related socio-economic data and forecasts into its own plan became more and more sophisticated as the volume of available planning data rapidly increased. The degree and extent of this integration was further supported by federal and state planning guidelines for compatible development and to protect the government’s investment in its transportation infrastructure. New technologies and tools like GIS provided almost unlimited access to other governmental...
agency planning data. This created a growing transition in many modal planning practices to integrate many sources of big data into building their own plan. Building these massive data bases as technical input files became standard planning practice for both aviation and surface transportation planning agencies. Both agencies incorporated this information as support for modal plan development and projections, helping to establish project need and benefit, ensuring stronger plan integration and future compatibility and documenting quality of service needs as a technical basis for sequential plan implementation. This integration process was generally seen as the most effective means to promote intermodal compatibility.

Surface transportation planning for Metropolitan Planning Organizations (MPOs) and aviation planning for airport development both advanced along similar paths, using similar data and at least in theory had much in common to serve their mutual interest. Both organizations use the same regional land-use and demographic data to assess their current operational status. Both use future regional comprehensive plans and demographic forecasts to support their own projections of future need and required facility improvements to serve future growth expectations. This affiliation with the region goes well beyond data as future modal planning also embraces the cultural and economic identity of the region, building it into its future plans to make each facility type somewhat unique to reflect more of the regional values than the often more commonly expected operational characteristics. Goals to improve intermodal surface access to airports are contained in nearly all levels of local, regional, state and national plans, and thus should become an integral part of any new plan development.
Almost every previous airport access research project put its emphasis on collecting vast amounts of airport data for analysis, justifying this tremendous analytical burden and expense as essential to define the site-specific, unique nature of the airport and its operational characteristics. The resulting studies, while generally doing an excellent job at analyzing on-site circulation and access, noted that airports were too complex to utilize the same analytical tools and models as surface transportation. Without a way to integrate aviation demand into the surface transportation plan, and vice-versa, an effective intermodal planning process cannot be achieved.

Surface transportation is also undergoing a renaissance through examination of new processes, models and technologies. The surface transportation plan is based upon the results of two different models’ abilities to process supplied regional data into coherent long-range plans. The two principal models currently in use are the four-step and ABM. Both share a common sub-model, the Special Generator, to address the unique trip generation characteristics of airports but then return to the core model for all other processing. With some traffic level adjustments, these models have the ability to produce reasonable trip demands for the airport. The static nature of this process, however, does not in fact simulate the actual airport operation nor does it give the airport staff the opportunity to fully understand and support its outcome. As a minimum, improvements to the Special Generator modelling process warrant enhancements to simulate the full operation of each airport function. Developing the collaborative planning tool to identify the most appropriate airport data, defining an industry accepted method to convert this airport data into a usable format for surface transportation
application and then being able to execute the surface model containing the new aviation information is the ultimate compatibility goal of this research.

**Identifying Airport Data**

The evolution of airport access planning has legitimately placed most of its emphasis on the on-site roadway circulation system and its beneficial interface with on-site facilities. This has resulted in very positive outcomes, especially for on-site passenger terminals and cargo facilities, which are in fact the true intermodal interface between air and surface transportation modes. While off-site surface transportation planning by MPOs to improve access to the airport is essential for the airport to effectively serve the urban region, it is the on-site terminal and cargo facilities that actually provide the intermodal exchange transition between modes and thus should be a key focus for intermodal planning.

Passenger access considerations has resulted in significant changes over time in the passenger terminal design. This facility was historically developed as a centralized terminal, designed to process all passenger functions, including ticketing, baggage processing and pick-up, security, concessions and aircraft boarding, in one location. By the 1970s, increasing passenger demands favored terminals with a more decentralized development concept, separating airside and landside functions. The landside facility was designed for an efficient interface with ground transportation often vertically separating arrival and departure passenger functions, as well as horizontally separating commercial, larger vehicles and transit into a separate access roadway system to reduce congestion and dwell time, expand curbside access and spread out the operational peaking characteristics of the curbside roadways. The landside buildings contained passenger processing functions, including baggage claim and drop off,
concessions and airline ticketing, and were designed primarily to reduce ground access congestion. A remote airside building was designed to separate landside and airside aircraft loading functions to provide more parking for larger aircraft, improve ramp maneuverability and reduce aircraft congestion. Airside facilities, often connected to landside facilities by people movers, allowed a more remote facility to include security, hold rooms, concessions and additional ramp space for aircraft parking and boarding functions. Combining the new design could effectively serve larger and larger passenger volumes.

The evolution of the passenger terminal and cargo facility design continued to evolve in response to rapidly growing demands, increasing security requirements and new technology, especially in larger urban areas where demand and space limitations drove innovation. For the terminal, different types of hybrid designs began to emerge. The new designs focused on increasing the separation of uses. The goal was to reduce passenger and baggage transfers; simplify surface access by separating access corridors and parking areas; provide remote rental car processing; mechanize baggage handling and passenger transfers to reduce walking; and improve security, convenience and passenger safety. Remote parking and rental car facilities were designed to be served by vans and could also transfer passenger baggage. On-site roadways operate at lower speeds than off-site access roadways and place an emphasis on splitting approach traffic into different on-site destinations and providing many different types of informational signs to assist in efficient on-site processing. The expanding ability and growth of urban airports to process greater and greater passenger volumes also resulted in many airports separating different on-site land-uses. This has resulted in the
development of many different points of access to the airport connecting to different off-site corridors in order to reduce congestion and improve access.

Airport terminals and cargo facilities develop future expansion plans based on approved passenger and cargo forecasts and aircraft movements by aircraft size. For commercial service airports, annual, monthly, peak-month, average day/peak-month and peak-hour passenger and aircraft movement statistics are maintained and utilized to support design of the passenger terminal. The best sources for this data include the Airport Master Plan, the Federal Aviation Authority’s (FAA) terminal area forecast and the Bureau of Transportation Statistics (BTS). Annual and peak hour statistics support design of an efficient facility with the ability to process passengers with minimal delay or congestion from curbside access to airside aircraft hold rooms. The projected annual and peak month passenger volumes are analyzed to establish the required supporting design criteria. The peak month passenger volumes are divided by the number of days in the peak month to establish the average day/peak month baseline for existing and future conditions. A peak hour volume is developed using this data for each day of the week based upon passenger arrival and departure records from the airlines and takes into consideration many different regional factors making the airports operation unique. Passenger characteristics likely to affect facility design considerations and access include the business or recreational trip purpose, the volume of meet-and-greeters, whether the airport is an origin/destination or transfer hub and if the region has some form of high demand draw, such as being a major tourist destination. Using site specific passenger data to represent the facility’s operations is used for terminal design and
access considerations by the airport. (American Association of Airport Executives, 2004/2005).

Similar data is maintained for cargo movements to support development and funding for these facilities. Like terminal design, which is based upon passenger volumes and flow, cargo facility design largely depends on the type and volume of cargo being processed locally and its future growth expectations. Cargo facilities at airports have undergone explosive growth in recent years as with the growth of package express and the overnight delivery of online purchases. While this light, high-value cargo growth is expected to continue, the cargo facility itself is experiencing a design renaissance with the help of improved technology, mechanization and communication, which helps classify, package, sort, transfer, load, schedule and route effective deliveries to customers. With increasing fuel efficiency, cargo carriers are using larger and larger aircraft to transfer goods across the continent and around the globe. In addition, logistics and package express automation is allowing this on-site airport intermodal transition of cargo between the aircraft and truck for regional distribution to process larger and larger volumes of products in less space with fewer workers (Maynard, Clawson, Cocanougher, & al., 2015). As the technical basis for the terminal and cargo design, classifying operations and use in developing future estimates of need these factors are legitimately the best operational sources of reliable, usable data. As such, these factors also become incredibly important in development of a technical interface tool for use in projecting surface transportation access needs as well since they both have historical records, are heavily regulated by outside agencies, have reliable future forecasts and are well understood by the aviation industry.
On-site airport land-uses for general aviation/corporate, non-aviation development and military facilities also require the identification of defining criteria for use in linking operational and off-site trip generation characteristics for intermodal use. These are no less important but are usually easier to define from existing literature and practice. Military facilities are often limited to reserve uses, making access sporadic and off-peak. These facilities have extensive ITE trip generation studies, and because of their secure nature and limited access, measuring and characterizing their trip characteristics is less of an issue. Non-aviation development has similar facility characteristics to other urban and regional land-use. For this use both ITE and current surface transportation models were originally built around this type of land-use, making its application within current models very reliable and practical once it is identified by the airport for this application. General aviation and private corporate facilities on larger urban airports are usually small but economically important, representing large regional business interests. The unscheduled and sporadic use of these facilities makes measurement and prediction a challenge. Current ITE and other operation references suggest the most predictable element for use in characterizing trip generation is the employee count or less frequently based aircraft (Institute of Transportation Engineers, 2012). Pairing this specific operational facility data with arrival and departure surface traffic counts consistent with the ITE Site Impact Handbook methodology can produce the most reliable trip generation data for the airport special generator. Utilizing this data and methodology for intermodal collaboration makes sense for its well established modal planning validity. Using existing required aviation information, limiting data usage to these requirements for accurate predictions and using an acceptable industry
practice to convert airport data into a usable format for surface modeling makes it much more reliable and much more likely to be utilized in the planning process. Reasons to include this data in the new collaborative intermodal planning process includes: modal and agency assurances that both the base data and its forecasts are reliable; available from multiple public sources; documented consistency with other plans; federal- and state agency-approved for use in planning required future facility expansions; an industry accepted trip generation methodology; and, are generally supported for project funding and implementation.

A reliable and tested methodology for developing the trip generation characteristics of on-site airport land-uses must be established first for application in the surface transportation model consistent with the above recommendations. The next equally important step is to define an acceptable method to identify an accurate source and methodology to define and assign the origins and destinations for these airport trips. Current surface transportation planning models and supporting data sets do not have any source of information to utilize for most airport trips, especially passengers and their timing. While surface models do have a statistically valid method to assign traditional employment trips occurring within the region, it typically underrepresents the airport in data utilized by current models because of the way airport employment is accounted for in some airport employer files and in local census records. This is valid for airline employment, including those traveling through the airport to work at other locations, part-time concession, vendor and rental car personnel and rotating service personnel, as well as for employers who centralize personnel data in a more remote administrative office located elsewhere on the airport or more often in a nearby off-site
office location. Accurate employee counts by on-site land-use must be provided by the airport as well as definitions of their unique work cycles, which do not match normal urban employment work or commute schedules.

Historical and most current literature for airports suggests the most utilized method to define passenger characteristics for both local originations and incoming visitors is to complete a very large and expensive passenger survey. Occasionally these surveys are expanded to include participation and data needs of other local agencies, such as tourist bureaus or transportation planning organizations. Numerous methods are defined, but common methods typically utilize a large student survey crew, equipped with a clipboard and pre-prepared questionnaire with standardized questions, to survey enplaning and deplaning passengers at convenient locations in the terminal. Other questionnaire types include ones for employees, concessionaires, tenants and regional businesses. Each are specifically designed to obtain specific information to help the airport. Occasionally mail-back questionnaires are given to exiting parking lot patrons to assist in obtaining a broader cross-section profile of the airport customer. Even with extensive preparation and multiple days of sampling, this often results, at best case, in obtaining only a very small, less-than-desirable sample set for analysis unless it is accurately collected, tabulated and analyzed (Biggs, Bol, Baker, & al., 2009).

Today many airports obtain and utilize a much more statistically reliable source of data to characterize their customers, market, visitors and ways for them to improve the airports operations. Airports often hire specialized marketing consultants to help in defining their regional catchment area, their passenger’s characteristics, leakage to other nearby airports, visitor characteristics and points of origin, local visitor
destinations, airline usage and destination, trip purpose and other data to help the airport market and obtain increased airline service or other identified services to help improve their customer draw and experience. These specialized aviation marketing consultants utilize similar new electronically available passenger data to build and base their conclusions and recommendations on for the airport. One company specializing in providing passenger sample data is ARC – Airlines Reporting Corporation. This company processes online ticket purchases for a large cross section of travel agencies, airlines and large corporations. As a part of this transaction, the company collects pertinent passenger information for subsequent resale to airlines, airports and aviation consultants. The company maintains a very large data base comprised of a sampling of approximately 30% of U.S. ticket purchases. The database is accessed through a paid subscription, allowing use of a sophisticated web-based data analysis tool to analyze the U.S. air passenger market for each airport. The tool provides the ability to analyze the geographic zip code location of the ticket purchaser, flight itinerary, airline usage, departure timing and other value-added information. This data is continuous, updated weekly, has multiple years of historical data and can be queried for site-specific airport analysis and then paired with graphics for presentation purposes. Like all data, however, each electronic data source does have defined limitations. Knowing these restrictions allows the user to gain unprecedented insight into the air passenger market and to examine the unique aspects of the airports specific market. Since many airports already obtain and utilize this information for business and marketing purposes, and it represents a statistically significant sample, its use for assigning local surface trips is ideal. The traveler’s local originating zip code can be defined and converted into a
traffic analysis zone (TAZ) format for use in the surface transportation model to produce a reliable network assignment consistent with the airports operations. Visitors to the region can be assigned to regional TAZ locations based on trip purpose and likely destination.

There are many other actors potentially affecting the airport’s trip generation module. These include passengers who are dropped off and picked up, the amount of persons per auto accessing the airport, meeters-and-greeters, visitors and new trending activities, such as setting corporate meetings and professional interviews in airport conference rooms for expediency. It is virtually impossible to define all of the potential limitations of unique activities that may occur at an airport. Visual observation and industry literature supports the facilities uniqueness, but unless some simplified, minimal-cost, verifiable method is selected, the airport will likely remain a standalone activity without proper representation in the surface transportation planning process.

**Recommendations**

Preparing and entering the recommended airport specific data sets into the urban model for execution, as defined above, goes one step beyond giving the TPO a copy of the airport master plan and attending monthly Technical Advisory Meetings. It gives the airport the opportunity to produce very specific data, which it stands behind as a valid representation of the airport’s operations and planned growth. By transferring this data to the TPO in an agreed-upon format, the TPO is assured the new data will work inside their current model and assist them in developing valid short- and long-term priorities for intermodal access to the airport based upon public need. The result will benefit both parties, and the access studies of both agencies can be mutually shared. As a component of the Long-Range Surface Transportation Plan, the airport will not only be
compatible with the NFTPO plan but it will be included as a fundamental element of its plan development process.
Summary of Study

Purpose of Study

The purpose of this research is to identify a plausible method to address the current planning gap existing between urban airports and their local urban surface transportation planning partners. As the federal government has adopted numerous legislative transportation policies to meet accelerating demand from the 1940s, each mode has developed a very strong independent technical planning process supporting its own plan development. From the early 1990s, however, growing policy requirements placed greater and greater emphasis on intermodal coordination, systems compatibility and intermodal connectivity improvements. For both agencies to work cooperatively to maximize mutual support and intermodal connectivity, each plan must include an accurate representation of the other modes’ operations and long-term plans. Ideally this joint collaborative planning process would utilize existing modal planning processes and data to assure accuracy and reduce costs.

The current planning process for each mode already has developed and utilizes defensible operational analysis and planning forecast methodologies for their respective modes. However, each agency generally lacks staff expertise to understand the technical nuances of the other modes planning processes. MPOs especially suffer from lack of quality data needed to reflect current travel patterns in metropolitan areas and to support development of their long-range transportation plans, allowing them to be more objective and credible. Given these conditions, using appropriate modal data is a good place to start since both modes need to understand and verify their own technical input
into the other modes plan preparation. The data each mode receives from the other partner must also be prepared in a format usable by the receiving agency in their plan development process. Both modes need to understand and support the modal data exchange and agree to and be able to use the planning results for intermodal access. Ideally the modal plan element reflecting the results of the intermodal exchange should be able to be analyzed as a separate element of the modal plan and support development of joint agency transportation performance measures to assure long-term improvement.

**Methodology and Analysis of Airport Data**

In order to achieve its research objectives, this study develops a new transportation planning process to improve the efficiency and effectiveness of plan integration for airport access and surface transportation plans by linking the MPOs and airports planning process for mutual benefit. This new planning process is expected to:

1. Build its framework using existing data and processes from each modal agencies regulated planning requirements to reduce cost,

2. Rely on data the developing mode can easily understand, explain and replicate for future applications

3. Provide modal data exchanges in a format easily utilized by the receiving mode within its current adopted planning process

4. Allow the using mode to produce a more accurate planning product with improved representation of the other mode

5. Be supported by and add value to both modes planning processes and policy goals

More importantly, this study set an empirical analysis goal to design and test a new collaborative planning process that can utilize currently existing data and planning processes at airports and MPOs. The analysis procedure includes seven steps as follows:
1. Selection of case study airport and partner MPO
2. Review of existing resources and data from both agencies
3. Analysis of MPO modeling structure and relevant airport characteristics
4. Airport data collection to support access planning requirements
5. Operationalization of airport data
6. Evaluation of compatible airport data for input into MPO model structure
7. Comparisons of airport data availability and use at similar commercial hub airport

This study selected the Jacksonville International Airport (JAX) and the North Florida Transportation Planning Organization (NFTPO) for the initial case study. JAX is a medium hub commercial service airport relying almost exclusively on highways for access and has a large geographical service area. Their surface transportation planning partner, the NFTPO, has a technically diverse staff with expertise and experience in both the four-step and activity-based models. After meeting with both agencies and reviewing their planning processes, a joint theoretical planning framework was prepared for illustrative purposes and use in discussing the development and testing of the new collaborative planning process. Since the NFTPO had primary responsibilities for off-site airport access, it was agreed their planning process should be led and airport planning data should be incorporated into the existing surface planning procedures. The NFTPO historically utilized a traditional four-step model in its plan development process. This model has four key routines guiding plan development. These are trip generation, origin/destination, mode split and network assignment. The NFTPO recently transitioned to an Activity Based Model for plan preparation. In general, the new model utilizes the same procedures and data as the previous four-step model. For the airport to be properly included in the long-range transportation plan, it had to be properly represented within
the models database for the airport TAZ, effectively replacing the existing database items. The airport data also required being prepared in a similar format to the existing data so it could execute in the model. To keep key elements consistent to the extent possible, the analysis followed a defined methodology but provided a great deal of flexibility in actual data examined, allowing for multiple ways to achieve the same objectives with different levels of data. This process used a good, better, best approach to collecting and using airport data. Cross checking was completed where possible to validate the data.

To begin the examination of the airport data, the JAX airport property map and access points were verified for consistency with the NFTPO TAZ. Surprisingly the model boundaries and access points were incorrectly displayed in the model. Significant discrepancies existed. A new supplemental TAZ map was prepared, and all access points were correctly labeled. The next step was to change out the TAZ land-use categories for more representative airport land-uses defined in the JAX Master Plan. The airport had five distinctive land-uses, including the terminal area complex, the cargo area, the general aviation/corporate area, a non-aviation development area and a separate Florida Air National Guard joint-use facility across the airfield. The JAX aviation land-uses are each distinctive, operate largely independently and have their own associated operational database and forecasts. Keeping the trip generation database, using JAX land-uses allowed for the use of the same NFTPO model data format. However, the aviation land-uses were not defined in the current NFTPO model. In examining each JAX land-use, a dominate facility type and operational characteristic was identified by the airport plan. These operational characteristics serve to define the
facility’s current operational status as well as serve as the technical criteria for use in projections to define future facility expansion needs. For the terminal, passenger volumes (arrivals/departures) served as the primary independent variable with commercial aircraft landings used for checking. For cargo, the independent variable was defined as pounds of cargo with employment as a supplemental data source. For general aviation, based aircraft and employees were the independent variables used to define operational levels. For the non-aviation areas, the airport is not the owner operator but instead leases surplus properties for private on-site development as a secondary source of income to support airport operations. For this use, the airports leasehold forecast was used to establish the extent of development. The current model already recognizes this land-use type, so no additional operational criteria was needed for the model other than on-site totals. The same applies to the joint use military facility. While this land-use itself is a separate special generator, it is a relatively isolated, small facility operating independently of all other uses on-site. For purposes of this project, it will be included as a separate land-use with badged employees as the independent variable. For each on-site land-use the historic, current and projected activity levels for each independent variable was collected and analyzed. This data contained annual, monthly, peak month, peak month/average weekday and peak hour statistics for each activity.

Once on-site land-uses were defined for each operation, existing traffic counts, traffic studies, parking lot data and commercial access lane records were collected and analyzed. To the extent possible, these traffic counts were isolated for a closer representation of operational activities at each land-use. This study analyzes arrivals,
departures and 24-hour traffic levels in 15-minute intervals to compare variations in each land-uses independent variable. Not enough data was available to complete a valid Institute of Transportation Engineers (ITE) Trip Generation Analysis, but a similar protocol was followed for comparison of the independent variable representing the airport land-use operations and the dependent variable or the entering, exiting and total traffic volumes to the site. The NFTPO and FDOT accepts and has utilized the ITE method to generate projected traffic volumes from airport sites. However, while the method is valid using the exiting airport, ITE data is possibly of limited value in defining off-site trip generation since it is dated and lacks flexibility for considering unique airport characteristics. For a better application, the airport classification was broken down into more defined operational uses prior to the application of the ITE analysis and re-tested. Using the ITE method to convert airport operational data into a standard trip generation table for use in the NFTPO model uses an accepted methodology and produces data for the model in a usable format. Another benefit of using airport data and on-site traffic counts is the NFTPO model will be utilizing the same planning data the airport uses in development of its own facility master plan for each on-site operation. Further, the independent variables, projections and traffic counts are all approved and available from several governmental sources for verification, if needed. Using airport data for development of a common trip generation planning process prepared in an acceptable and usable NFTPO format lets both agencies own the results.

For the next step, airport data sources were examined to locate the best information to establish origin and destinations for airport employees and passengers. Historical passenger and employee surveys, airport security and badging, airport
marketing reports, the airport master plan, O/D traffic studies, visitor and tourist bureau reports, chamber studies and airline surveys were collected and analyzed. Each of these studies provided some usable information, although most were too generalized or too small of a sample to produce meaningful results. The last passenger survey found contained many useful facts but unfortunately was over 20 years old. For employee trip assignments, the best source of airport data was contained in the airport security and badging department. Most employees, especially those requiring access to secure areas, are badged by the airport for security clearance. This department maintains files for all holders of security clearances. From this listing, it is possible to secure the home zip code location, work schedule and employer classification, giving ideal employee origins and destination for work-based trips. Unfortunately, the data did have limitations. These included use restrictions, a noted heavy turnover in staff and incomplete files for some employers. Since the urban model had a good routine for assigning employee trips but lacked verified employment totals, the data collection refocused on obtaining updated and projected employee totals by land-use for input and assignment by the urban model as home based work trips.

To address passenger origins and destinations, the best source of information was contained in the airport's market assessment. This consultant-prepared study used an approximate 30% passenger sample survey obtained from online ticket purchases of JAX passengers. This is a statistically significant sample, characterized passenger volumes as 42% business and 58% leisure travel and identified the airport regional catchment area as stretching from Daytona to the south, Savanna to the north and Tallahassee and Gainesville to the west. The initial study used large tracks to define the
percentage of passengers using JAX. Greater census tract data was available, and the results could be converted to TAZs locations based upon population density. But for purposes of this analysis, the larger tracts were used by county level. The data was factored to a total of originating passengers. For visitors to the region trip purpose and likely local destinations were established from data provided by the local tourist bureau and chamber of commerce. This information was utilized in assigning these passengers to likely local destinations. Both were formatted in TAZ tables for model input.

The next research step was to collect and analyze commercial access data and any form of transit access. The goal was to examine the characteristics and passenger loads of commercial vehicles accessing the airport to see if it had any value for the trip generation research or if it contained data that may ultimately have value for a future regional transit study. All airports regulate by permit commercial ground transportation access by all modes. The commercial lane at the airport is for all vehicles transporting passengers for any commercial entity, but due to its size, location and passenger processing facilities, it is also typically used for remote airport shuttles and local transit service access. Commercial traffic consists of taxis, limousines, buses, pre-arranged transportation, destination management services, digital dispatch services, shared-ride vans, off-site rental car companies, hotels and off-site parking companies (Jacksonville Aviation Authority, 2013). Evaluation of the data revealed it had little value for future transit application and consisted predominately of off-site parking, rental car companies and hotels transporting their customers to the airport. These patrons consisted of local originating airline passengers who preferred to use off-site parking or business or
visitors who utilized an off-site rental car company or stayed a portion of their visit in an adjacent hotel for ease of access to the airport by hotel vans. Periodic resort shuttles and shared-ride vans provided a steady but minor component of the traffic volume. Since the data did not add value, it was not included in the mode split analysis, but some of the findings were utilized in the trip generation analysis.

**Findings**

The principal conclusion from the research project’s review of the aviation and surface transportation planning process, supporting data, models and resultant adopted plans was to develop recommendations for changing the current intermodal planning process. The surface transportation and aviation planning practice appears to be sound, but the lack of aviation data to accurately depict the airport in the development of the surface transportation plan is problematic. The current four-step model and ABM depends upon the same local land-use and demographic data to represent the airport’s trip generation characteristics within the model and resultant surface transportation plan. This database is not reflective of the actual airport operations nor does it have anyway to represent the airports approved future master development plan or growth projections. Trip generation and origin/destination from the airport site is largely a function of passenger and employee traffic demands. The current surface planning process lacks the means to obtain current or projected airport passenger volumes or on-site employment growth to accurately project the airports trip generation growth and resultant access needs. The surface planning process also lacks passenger origin and destination information for use in modelling a more accurate assessment of the airports regional service demands. In addition, there does not appear to be any joint intermodal performance measures to help in providing a common goal.
Concluding Remarks

The research supported making several changes in using the NFTPOs Special Generator Routine sub-model and full model routine processing. This sub-model was originally designed to address the airport’s unique trip generation characteristics. However, it does not accurately simulate the airport’s actual operations, current or forecast. The first part of this limitation is due to the fact improper data is used in the model. Bad data in, bad data out. The second part deals with using the full model for all airport trip assignments. The current model does not contain data or structure to adequately define airport passenger trip origins and destinations. This is true for both regional originating passengers and especially the incoming visitors to the region.

Simulating the airport’s existing and future operations within the urban model by using specific airport data consistent with their adopted AMP as technical input is the most feasible manner to jointly plan and achieve region intermodal objectives. The research verified the use of this airport data in the aviation planning process at JAX and RSW, although different airports have different organizational structures, record keeping procedures and operational approaches to uses this information. Generally all of the necessary airport data is available, although it is often in different forms and is sometimes challenging to locate.

In reviewing the airport’s commercial access records, the research also discovered that most private development off-site located along the primary airport access roadways exhibited characteristics similar to the airport. This property is dominated by off-site airport parking, rental cars, hotels, restaurants and other businesses whose operational cycle closely resembles the airport. In addition to changing the Special Generator database and network assignment protocol for the
airport, it is recommended the NFTPO consider changing the trip generation and assignment modules for these airport highway access parcels to reflect operations more consistent with the airport and less with more traditional regional land-use with similar zoning. We also recognized that many of the trips assigned to these parcels are in fact on their way to the airport. Because of the interrelated nature of these trips it should be evaluated jointly with the airport trip generation model since it represents trips from an adjacent private commercial use and is currently accounted for separately in the model.

**Further Study**

This research produced valuable insight into existing urban intermodal planning procedures and levels of cooperation between Metropolitan Surface Transportation Planning Organizations (MPOs) and Urban Airports. It identified representative aviation data and an industry-accepted procedure to convert aviation data into a format usable by MPOs in their models. Model inclusion assures the airport is considered in plan development and that adequate priorities are given to intermodal airport access based upon public need and benefit. Most of the previous research on methods to improve intermodal access to airports focused almost exclusively on large hub airports and transit access but did not focus on development of a cooperative planning framework to improve intermodal planning results between airports and MPOs. This research took a different tactic and focused on improving the collaborative process by development of a joint planning procedure for highway access planning. This focus may limit the benefits of this research for application to medium hub, small and non-hub primary commercial service airports only. In the U.S., there are 389 Primary Commercial Service Airports. Of these, 29 are large hubs, 33 are medium hubs, 76 are small hubs and 251 are primary non-hubs (Federal Aviation Administration, 2014). Undoubtedly the large hub airports
have critical access needs, but because of their size a single modal solution will not likely work. For medium and smaller hub airports they cannot afford to be left out of the MPO surface transportation plan until a solution is found for large airports. This research supports an immediate cost-feasible approach for these airports to improve intermodal access in urban areas and improve the compatible planning results for both modes.

To maximize the benefit of this research and improve its practice ready application the following specific activities are recommended for further study:

1. Airports function more like a land-use classification rather than a specific use. Airports include multiple types of independent facilities and associated land-use activities, such as the terminal complex, cargo area, general aviation/corporate area, non-aviation development and military uses. Each of these on-site uses should be examined further to study their unique trip generation attributes, linking trips produced to each facilities primary independent variable consistent with ITE procedures.

2. Airports and Surface Transportation Planning Agencies can benefit by additional airline passenger research. Defining better ways to predict airline passenger origins and destinations in urban areas is becoming even more important in Florida. Today over 50% of tourist traffic arrives by air. As this volume continues to grow, in addition to originating local passengers, route planning and mode choice will become critical factors to maintain access and mobility for this economically important group.

3. Airports are large employment centers, both on-site and off. Maintaining accurate records for all on-site employment and requiring security badges or not are very vital records for the airport in assessing its economic impact on the region as well as determining accurate access needs. This area should be studied to determine a more effective record-keeping function for airports’ existing and future employment needs.

4. Special Generator routines contained in the four-step model and similar functions in the ABM should be reexamined for application to transportation facilities, such as airports, ports and railroads. Transportation facilities operate substantially different from other special generators, such as shopping malls or large mixed use developments. It may be time to develop another approach for transportation facilities.

5. Land-uses near airport entrances tend to adopt unique characteristics reflecting a heavy interplay with the airport. Additional research is needed to properly classify
the operational characteristics of these land-use types and to determine their level of impact on airport access demands.

6. Urban areas continue to grow in size and density, placing new demands on all shared transportation facilities. Additional research is needed for development of shared multi-modal transportation performance measures. As transportation moves more toward performance monitoring, joint intermodal performance measures could produce positive collaborative results.

7. The rapid growth of Transportation Network Companies (TNC) and their short- and long-term impact on airport parking, revenue, MPO modeling and urban travel patterns must be studied and given full consideration in all future planning applications and research.
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BIOGRAPHICAL SKETCH

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