BUSINESS INFORMATION AND SYSTEMS PLAN

SEPTEMBER 1994

Retooling TxDOT

Texas Department of Transportation

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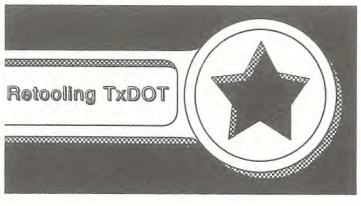

Texas Department of Transportation

Chapter I - Executive Summary

NOTES

Chapter I
Executive Summary

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OVERVIEW:

The Texas Department of Transportation currently faces the challenges of a drastically changing business environment. These challenges include: increased customer expectations, changing demographics, environmental pressures, global competition, increased accountability, a less-experienced workforce and trying to do more with less. Additional pressure has been exerted on the department from federal mandates, state legislation and the general public. In addition, employees demand more timely and accurate information and decision support tools to perform their duties. To keep up with these demands, TxDOT has taken a proactive role to be accountable for the quality of the products and services the department provides. In an attempt to meet these change imperatives, the executive management directive is to work smarter (i.e., retool/reengineer many of the business processes).

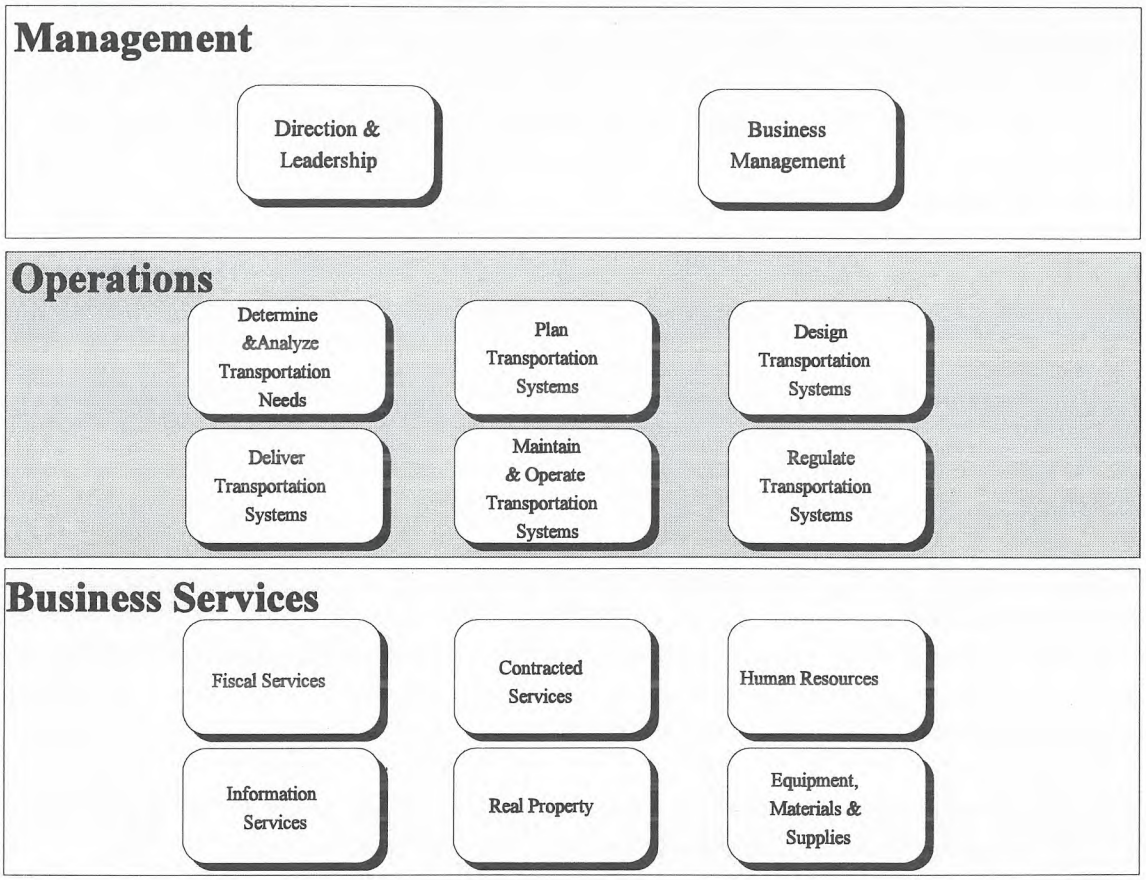
The culmination of these change imperatives are expected to be revolutionary in nature versus the historical evolutionary change. Retooling TxDOT is a program that has been established to assist the department in "creating tomorrow today." There are three stages of Retooling TxDOT: Business Information and Systems Planning, business process retooling, and the implementation of business improvement projects.

The Business Information and Systems Plan (BISP) defines guidelines to assure that the investments made by the department in both retooling its business processes and establishing its information systems environment are:

- consistent with the department's business mission, vision, goals and objectives;
- justified by the business benefits provided; and
- providing the technology infrastructure necessary to proactively meet future business challenges and opportunities.

The Management Team and various personnel participated in a number of workshops to identify the department's mission, vision, goals and objectives. This information was utilized by employees from districts, divisions, and special offices to develop the TxDOT business model. The business model provides a representation of the actions performed by the department in the course of conducting business.

The business model consists of three functional areas and fourteen (14) business areas. Each business area was defined by identifying business processes, sample activities, inputs and outputs. The business model represents what the department does, whereas an organization chart depicts who is responsible. The TxDOT business model is shown below.



This business model is the foundation for developing the future direction of the department and will drive all business and technology projects. The next stage of Retooling TxDOT involves the business process retooling of the fourteen business areas.

Business process retooling (BPR) provides a multidisciplinary approach for implementing fundamental changes in work performance across the organization to dramatically improve efficiency and effectiveness. In this stage, the department evaluates "how" the processes are performed and identifies ways to improve the business processes, including benchmarking and evaluating similar processes in other local, state, and federal agencies and the private sector. Target performance measures are established and business cases to address the value added of business opportunities are prepared. This stage results in the identification of business improvement projects.

Business improvement projects are opportunities identified during business process retooling efforts to improve the way the department does business. It is anticipated that 10 - 20 business improvement projects will result from each business process retooling effort. These business improvement projects will fall into one of three categories: projects which will require business changes only (changes in policies and procedures), projects which will require information systems changes only, and projects which will require a business change and result in a change to information systems. These business improvement projects will be prioritized by the Senior Management Team for implementation.

It is important that the department position itself to fully utilize information systems as an enabler of change. Therefore, the department has established information infrastructure directions in the Business Information and Systems Plan to ensure the rapid delivery of information services and application systems which provide complete, accurate, timely, and user-friendly information to satisfy business needs. The business model was utilized to establish the data, application, and technology architectures which will direct future information systems development. A number of infrastructure projects have also been identified which will provide the foundation for utilizing information systems and technology as key enablers in the business improvement projects.

The TxDOT business information and systems planning process is an ongoing process. As the business processes are retooled/reengineered, and as new business directions are established, the business model and information infrastructure can be utilized for proactive change.

The department has identified several factors key to Retooling TxDOT. These factors include:

- maintaining a clear, strategic business direction
- utilizing the BISP as a guide for future investment and direction
- recruiting and retaining a quality staff
- managing the fear, anxiety and expectations of retooling/reengineering
- training staff on the use of new and innovative tools
- managing resistance to change by key stakeholders
- revising the information infrastructure in a timely manner

The department has taken proactive steps to assure success as it strives to "create tomorrow today" to serve the citizens of Texas.

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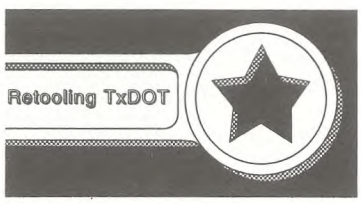
CHAPTER II

STRATEGIC ASSESSMENT AND DIRECTION

BUSINESS INFORMATION AND SYSTEMS PLAN



Texas Department of Transportation

Chapter II - Strategic Assessment and Direction

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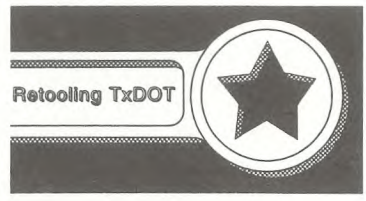
CHAPTER II

STRATEGIC ASSESSMENT AND DIRECTION

MANAGEMENT SUMMARY

SECTION A



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Section A
Management Summary

The "Strategic Assessment & Direction" represents the culmination of many activities conducted to determine the business needs and objectives of the department. In performing a strategic assessment of the department, the following questions were addressed:

- Where is the department positioned today?
- Where is the department heading in the future?
- Where are other DOTs heading?
- What are the issues involved in achieving the chosen direction?

The Direction document was developed by a project team with a variety of skills, filled by individuals from management, the business functions, the user community and the information systems organization. This team compiled and analyzed a wealth of data obtained through interviews, facilitated workshops, user and technical surveys, and included the participation of hundreds of representatives from all areas of the department.

The "Strategic Assessment & Direction" consists of four sections which address the business and technology areas of the department. The following summarizes the intent and primary conclusions of each section.

Section B - Business Direction & Needs

The focus of this section is to describe the business. This section examines the department in terms of its organization, the location of its facilities and its purpose and direction. Critical success factors for the department have been identified. The Business Direction & Needs section details the products and services the department provides to the state, and the industry trends and challenges which face the department now and in the future.

Historically, TxDOT has been considered a "highway department," but has recently changed its business strategies to focus on all modes of transportation in an effort to become a complete provider of transportation systems. During this transition, the department is also emphasizing preservation of the current transportation systems, the state border area, improved accessibility to persons with disabilities and the aging population, and the protection of environmental and cultural resources.

TxDOT has implemented several quality and change programs to evaluate the effectiveness of business procedures and improve the manner in which goods and services are provided to the

department's customers. To support these improvements, the Management Team is fostering a culture which promotes diversity, teamwork, open communication and internal staff development.

Section C - Internal Assessment

The Internal Assessment evaluates the current application, data and technology environments of the department, and describes the history of information systems (IS) spending at the department. A survey of user satisfaction was also conducted to assess the end-user perspective of information systems services and products.

The department uses a mainframe platform for the majority of its data storage and application processing. The transition towards a microcomputer platform and an easier-to-use application portfolio has been seriously hindered by the lack of high-level processors in the user community.

The current application inventory supports a wide variety of business processes. The continued maintenance of these applications will become increasingly challenging due to changing business needs, application age, antiquated programming languages, the extent of batch processing and the interfaces between applications. In the future, information systems development will need to concentrate on support of the non-highway aspects of the transportation infrastructure, the implementation of a wide variety of decision support systems, and improving end-user access to enterprise data.

A review of the IS spending history indicates the need to allocate more funds to technology procurements, IS staff salaries, and education and training.

Section D - External Assessment

The External Assessment assesses the use of information systems at TxDOT relative to other transportation departments. The purpose of this assessment is to gain an external perspective on the quality of TxDOT's information systems support and to identify significant trends which may affect TxDOT in the future.

TxDOT ranks above average in the cumulative assessment of applications, data, technology and resource strategies. TxDOT is highly effective in deploying its application and technology components, due to the overall level of automation and application integration. TxDOT is less effective, however, in managing the data and IS resource components, highlighted by the lack of an enterprise data model and the need to improve satisfaction with overall IS support.

Section E - Information Systems (IS)/Information Resource Management (IRM) Strategy

The purpose of this section is to review the current IS/IRM organization and management approach. Roles and responsibilities are reviewed, and the information resources mission, vision, goals and critical success factors are defined.

The mission of the IS/IR organization is to provide effective operations and continuously improve through the timely application, implementation and support of well-developed information resources. The IS/IR goals are to establish an infrastructure to support implementation of the BISP, to partner with customers to meet business needs, and to establish an IR environment which is effective in meeting information needs.

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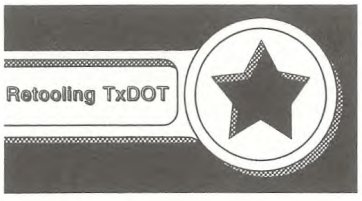
CHAPTER II

STRATEGIC ASSESSMENT AND DIRECTION

BUSINESS DIRECTION AND NEEDS

SECTION B



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Section B
Business Direction and Needs

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OVERVIEW:

TxDOT's business environment is described in the following section. The description covers the department's organizational structure, goals and objectives, critical success factors, products and services, and governing economics.

ORGANIZATION STRUCTURE AND LOCATION:

Overview:

TxDOT's organizational structure, key personnel and location of operations are described in this section. The current organizational structure is depicted in Appendix 1.

Organization Units:

Texas Transportation Commission:

TxDOT is governed by the three-member Texas Transportation Commission and an Executive Director selected by the commission. The commission members, serving six-year overlapping terms, are appointed by the Governor with the advice and consent of the Texas Senate. The Governor designates the Commissioner of Transportation.

Motor Vehicle Board:

The Motor Vehicle Board, formerly the Texas Motor Vehicle Commission, consists of six members appointed by the Governor. Board members serve six-year terms, are independent from the Texas Transportation Commission, and must have no affiliation with any business that manufactures, distributes or sells new motor vehicles.

Executive Director:

TxDOT's Executive Director oversees 25 district offices, 18 functional divisions, and 11 special offices. The Executive Director's duties include establishing departmental direction and priorities, establishing policies and procedures, and interacting with the public, other government agencies, and the legislature.

The Executive Director is appointed by and reports to the Texas Transportation Commission.

Senior Management Team:

The Senior Management Team (SMT) oversees the seven organizational functions of the department. The team includes the Executive Director, Deputy Executive Director for Transportation Planning and Development, Deputy Executive Director for Administrative Services, Assistant Executive Director for Field Operations, Assistant Executive Director for Multimodal Transportation, Assistant Executive Director for Human Resources Management, Assistant Executive Director for Motorist Services and Director of Staff Services.

District Offices:

District area, maintenance, vehicle registration, and headquarters offices provide direct delivery of transportation products and services. District activities include highway planning, design, construction oversight, and maintenance; right-of-way acquisition; traffic operations; public transportation and general aviation airport coordination; and development and construction oversight of transportation enhancement projects. By decentralizing these activities, TxDOT is able to more efficiently and effectively address the needs and concerns of local areas.

District Engineers are also responsible for district support operations, including planning, human resources, public affairs, training, automation support, budget, and fleet maintenance. District Engineers report to the Executive Director.

Management Team:

The Management team includes the Senior Management Team, District Engineers, Division Directors and Directors of Special Offices as outlined in the following functional areas.

Transportation Planning & Development Function:

The Deputy Executive Director for Transportation Planning and Development directs transportation planning and development operations. The activities include development of statewide short range and long range transportation programs with respect to project programming, transportation planning, environmental issues, international relations, roadway, bridge and landscape design, and right-of-way issues.

The five offices and divisions which make up the Transportation Planning and Development function are:

International Relations Office:

The International Relations Office (IRO) serves as focal point for federal, state and local governments, the public, businesses and groups regarding TxDOT international activities. This includes being contact and coordinator for international transportation planning organizations.

The International Relations Office is the protocol office and liaison with the Governor's Office for international activities. The IRO director chairs the TxDOT Standing Committee on Border Affairs, which consists of border-area district engineers and directors of divisions whose activities include some international element. The director also represents TxDOT on the Joint Working Committee for U.S.-Mexico Binational Transportation Planning. Most of the office's activities are focused on Mexico. However, there are also NAFTA related activities involving Canada. Because IRO coordinates foreign transportation officials' visits to TxDOT, its contacts range worldwide.

Transportation Planning and Programming Division:

The Transportation Planning and Programming Division is the staff support for development of the Texas Transportation Plan, the Project Development Plan and the Statewide Transportation Improvement Plan. It assists the districts in their coordination role with the Metropolitan Planning Organizations and conducts urban and statewide planning and feasibility studies. The division is responsible for the gathering, analysis and reporting of the federal Highway Performance Monitoring System information, route designation, road inventory, bridge and rail crossing inventory, the reference marker project, road life data, maintenance of the Design and Construction Information System, and map development and distribution. It also conducts the department's traffic counting, analysis and forecasting programs, including vehicle weighing, classification, speed and travel surveys.

Environmental Affairs Division:

The Environmental Affairs Division oversees all TxDOT environmental activities and operations. This includes the review and coordination of environmental documents submitted by the district offices for compliance with all applicable environmental laws and regulations. Coordination and consultation with various

resource agencies such as the Texas Parks and Wildlife Department, Texas Historical Commission and the U.S. Army Corps of Engineers is an important element of the review process. The division also provides guidance to the districts on environmental and public involvement procedures and is responsible for reviewing projects included in monthly letting schedules for environmental clearance.

Another area of responsibility is the development and/or implementation of several environmental programs such as the National Pollutant Discharge Elimination System storm water permitting program, State Historic Bridge Inventory Program, Sound Wall Program and Congestion Mitigation and Air Quality Program. The division's environmental policy-making efforts include the development and implementation of TxDOT's environmental and public involvement and memorandum of understanding with various resource agencies. A variety of training programs have also been developed by division staff for the districts that include the Environment in Project Development course; Wetland Identification School; Wetland Delineation School; Project Specific Location Training; and Field Archaeology Training.

Right of Way Division:

The Right of Way Division is responsible for acquiring all real estate necessary for the operation, construction and maintenance of the transportation system overseen by TxDOT. Corollary responsibilities of the division are disposal of surplus real property, leasing of department assets, controlling outdoor advertising signs and junkyards along the state's highways and the administration of Road Utility Districts and Transportation Corporations. The Transportation Division of the Attorney General's office provides legal counsel for any eminent domain proceedings required by the department.

Design Division:

The Design Division guides transportation construction projects through preliminary engineering phases. These services include geometric design, pavement design and management, bridge design and management, landscape design, project plan review and processing, standard construction specifications, and hydrology and hydraulics engineering. The division inventories, inspects and appraises the states's 47,000 bridges and administers bridge replacement and rehabilitation programs.

The division evaluates and reports on the condition of the pavement on the 77,000

centerline miles of roadway on the state-maintained system. The division is the liaison with the Federal Highway Administration on preliminary engineering matters. The division coordinates the monthly and annual construction letting schedule of approximately $1.6 billion.

Field Operations Function:

The Assistant Executive Director for Field Operations directs all field operations including statewide construction, maintenance, traffic operations, materials and tests functions, and research and technology transfer.

The four offices and divisions which make up the Field Operations function are:

Research and Technology Transfer Office:

The Research and Technology Transfer Office administers the Cooperative Highway Research Program and other department research activities including the Technology Transfer System.

Construction and Maintenance Division:

The Construction and Maintenance Division administers all TxDOT construction contracts from the opening of bids through construction and final payment. The division also inspects construction operations, provides consultation to districts, and processes and assists in the approval of plan changes and contract modifications. The division is the liaison with the Federal Highway Administration on construction matters. The division also oversees ferry operations, the maintenance program, vegetation management, bridge construction and welding inspection.

Materials and Tests Division:

The Materials and Tests Division provides quality control of materials used in transportation construction and maintenance. It advises districts on the selection and use of materials and provides field consulting on problems with materials. The division also administers contracts with commercial laboratories, certifies core drilling and test equipment, and accredits district laboratories. It also participates in organizations that write national specifications.

Traffic Operations Division:

The Traffic Operations Division is responsible for safe, efficient flow of traffic on the highway system. It reviews plan sheets for signs, pavement markings, illumination and signal operations; develops rest area plans and traffic safety programs; and administers railroad signal and planking programs.

Multimodal Transportation Function:

The Assistant Executive Director for Multimodal Transportation directs all multimodal transportation functions, including gulf intracoastal waterways, abandoned rail, bicycle and pedestrian coordination, aviation and public transportation services. In addition, the director serves as liaison to the Texas Turnpike Authority and the Texas High Speed Rail Authority.

The three offices and divisions which make up the Multimodal Transportation function are:

Multimodal Operations Office:

The Multimodal Operations Office is responsible for planning, maintaining, preserving and improving the Gulf Intracoastal Waterway. This office serves as liaison to the port authorities and the Texas High Speed Rail Authority. It is responsible for the coordination of freight and passenger rail, bicycle, pedestrian and intermodal project planning operations.

Aviation Division:

The Aviation Division administers all applicable state aviation laws. It is responsible for engineering and technical services for planning, constructing, and maintaining general aviation facilities, as well as for receiving and disbursing federal aviation funds. The division conducts long-range aviation facilities planning and coordinates the statewide system of airports. These functions are carried out through zoning, inspections and educational services for system operators and users.

Public Transportation Division:

The Public Transportation Division is responsible for preparing and updating a statewide master plan for public transportation and processes applications for public transit financial assistance. The division administers Federal Transit Administration (FTA) programs for elderly, handicapped, and rural public transportation, and the State Public Transportation Grant Fund for city and rural

providers. The division sponsors and monitors research and development in public transportation.

Administrative Services Function:

The Deputy Executive Director for Administrative Services directs all administrative support operations including financial management, information systems, general services and business opportunities.

The four offices and divisions which make up the Administrative Services function are:

Business Opportunity Programs Office:

The Business Opportunity Programs Office is responsible for administering the department's Disadvantaged Business Enterprise (DBE) and Historically Underutilized Business (HUB) programs. This office coordinates with the General Services Division's Contract and Procurement Sections, the Construction and Maintenance Division and the Civil Rights Division to provide a strong program that is organized, uniform and consistent in policies and procedures.

Budget and Finance Division:

The Budget and Finance Division is responsible for TxDOT's accounting, forecasting, budgeting, processing all receipts and revenues, and payment for all goods and services. The division also analyzes and reports the financial impacts of proposed legislation on TxDOT.

General Services Division:

The General Services Division is responsible for purchasing equipment, materials, services and supplies. It manages the equipment fleet and maintenance programs and operates regional warehouses. The division is also responsible for the department's recycling program. At Camp Hubbard in Austin, the division operates repair shops and a warehouse. The division manages and provides maintenance and security for all TxDOT headquarters buildings. Other operations include managing an electronic publishing center, administering the records management program, disposing of surplus property, the Alternative Fuels Program, printing and reproduction, mail services, contract review and processing, and architectural services.

Information Systems Division:

The Information Systems Division manages the department's automation operations, including the central computer system. The division provides an extensive, automated statewide management system; maintenance and enhancement of automated systems; decentralized engineering design operations; an automated vehicle title and registration system; photogrammetry; and telecommunications system management.

Human Resources Management Function:

The Assistant Executive Director for Human Resources Management directs the Human Resources, Civil Rights, and Occupational Safety Divisions and Continuous Improvement and Appeals Offices. The Appeals Office conducts appeal hearings for complaint investigation determinations and for employee complaints arising from adverse personnel actions such as probation, suspension with or without pay, involuntary demotions, involuntary transfers or terminations.

The four offices and divisions which make up the Human Resources Management function are:

Continuous Improvement Office:

The Continuous Improvement Office coordinates the department's quality initiative, TxDOT's approach to Total Quality Management. In recognizing the needs of external and internal customers, the Continuous Improvement Office works with districts, divisions and special offices to improve products, services and processes through team work. Trained facilitators are provided to conduct team-building retreats and guide teams through the decision-making process. In an effort to align activities within TxDOT, the Partnering Program is now administered by the Continuous Improvement Office. Partnering teams work to provide cohesive relationships between suppliers, contractors and TxDOT representatives during construction projects.

Human Resources Division:

The Human Resources Division coordinates the department's recruitment programs, conducts long-range human resource analyses, administers affirmative action and training programs, coordinates personnel benefits and employee assistance programs, and maintains the functional classification system for the department.

Civil Rights Division:

The Civil Rights Division conducts internal and external discrimination and non-discrimination complaint investigations. The division also provides technical assistance to all organizational units in achieving compliance with equal opportunity policies and procedures.

Occupational Safety Division:

The Occupational Safety Division is responsible for the department's self-insured workers compensation insurance program; the employees safety program; those aspects of hazardous materials involvement that affect employees safety and health; the resolution of tort claims against the department; and, liability insurance for claims that arise from the use of motor-driven vehicles and road-building equipment.

Motorist Services Function:

The Assistant Executive Director for Motorist Services directs TxDOT's motorist services, including vehicle title and registration, motor vehicle administration, travel and information, and the central permit functions.

The four offices and divisions which make up the Motorist Services function are:

Central Permit Office:

The Central Permit Office is responsible for issuing oversize and overweight permits to freight haulers using the state highway system.

Vehicle Titles and Registration Division:

The Vehicle Titles and Registration Division registers vehicles, issues certificates of title and collects fees using the 254 county tax assessor-collectors as agents. The division also administers more than 60 categories of license plates and processes about 4 million title applications each year.

The Automobile Theft Prevention Authority Board (ATPA) has been incorporated into the Vehicle Titles and Registration Division responsibilities. The ATPA consists of seven members. Six members are appointed by the Governor and serve staggered six-year terms. The seventh member is the director of the Department of Public Safety or the director's designee, who serves as an ex-

officio member. ATPA is charged with developing a plan for Texas to reduce vehicle theft through a statewide effort.

Motor Vehicle Division:

The Motor Vehicle Division regulates the new-vehicle industry in Texas. It licenses dealers of new motor vehicles and motor-vehicle manufacturers, distributors, and converters. The division enforces provisions of the Texas Motor Vehicle Commission Code and the Lemon Law.

Travel and Information Division:

The Travel and Information Division provides travel literature and materials and publishes the *Texas State Travel Guide* and *Texas Highways*, the state's official travel magazine. The division also operates 12 Travel Information Centers, including one in the Capitol Complex in Austin.

Staff Services Function:

The Director of Staff Services directs all management services, legislative affairs, public information, information resource management and general counsel functions.

The five offices which make up the Staff Services function are:

Management Services Office:

The Management Services Office coordinates TxDOT's strategic planning, which helps to determine department direction. The office provides demographic, economic, and statistical analyses and coordinates the development of performance measures for TxDOT. In addition, the office coordinates activities related to commission meetings and provides committee support to the Consultant Review Committee and the Contractor Claims Committee. It also coordinates human resource staffing standards.

Legislative Affairs Office:

The Legislative Affairs Office is responsible for all state and federal legislative activities, as well as for monitoring and coordinating comments on rules in the Federal and Texas Registers. It serves as liaison to congressional delegations and the state legislature, provides policy analysis and review, and prepares policy and communication manuals.

Public Information Office:

The Public Information Office is responsible for the department's internal and external communications, including news media relations, community outreach and TxDOT's employee newsletter, *Transportation News*.

Information Resource Management Office:

The Information Resource Management Office is responsible for information resource strategic direction, development of TxDOT's Executive Information System (TExIS), other executive information management duties and the coordination of Retooling TxDOT.

General Counsel Office:

The General Counsel Office is the in-house legal office. The office facilitates proposed legislation, provides legal support to statutory advisory committees, serves as department executor for Title 43 of the Texas Administrative Code, and serves as liaison with the Texas Secretary of State and the Texas Attorney General's Office. In addition, the office gives legal advice on policies, procedures, rules, open meetings, commission agenda, open records and personnel issues.

Business Locations:

The following provides a description of the locations within TxDOT. These will be used throughout the BISP to classify information.

Location Types	Description
Headquarters	All divisions, special offices and the Senior Management Team are located in Austin.
District Office	Decentralized organizational units responsible for direct delivery of transportation products and services. There are 25 locations throughout the state.
Area Office	Organizational units responsible for the construction and maintenance activities at a local level. They serve as the first point of contact for local communities. There are 126 locations in Texas that report to the district offices.
Maintenance Office	Organizational units responsible for maintaining current transportation systems. There are 288 maintenance offices that are assigned to the area offices.
Regional Office	Organizational units responsible for carrying out certain division activities on a localized basis. Divisions which have regional offices include Civil Rights, Travel and Information, Vehicle Titles & Registration and General Services.

BUSINESS PURPOSE AND DIRECTION:

Overview:

The Management Team and various TxDOT personnel selected by the Executive Director participated in a series of workshops to define the goals and objectives of the organization. The Senior Management Team identified critical success factors for the organization. This section describes workshop results and TxDOT's products and services, as well as the trends and challenges the department faces.

Current Business Plans and Strategies:

Mission and Vision:

In October 1993, the Executive Director announced the TxDOT mission and vision statements. These statements were developed by the Texas Transportation Commission and the Senior Management Team.

MISSION
To work cooperatively to provide safe, effective, and efficient movement of people and goods.

VISION
To be a progressive state transportation agency recognized and respected by the citizens of Texas: • Providing comfortable, safe, durable, affordable, and environmentally sensitive transportation systems that work together; • Ensuring a desirable work place which creates a diverse team of all kinds of people and professions; • Using efficient and cost effective work methods that encourage innovation and creativity; and • Promoting a higher quality of life through partnerships with the citizens of Texas and all branches of government by being receptive, responsible and cooperative.

Business Goals:

Department goals were developed by department cross-functional teams, approved by the Senior Management Team and are included in the department's strategic plan for 1995-1999. It is important to note that Goal Number 3, relating to Historically Underutilized Businesses (HUBs), was mandated by state law and that a goal relating to internal and external customer satisfaction (Goal Number 2) was a first in TxDOT history. Strategic business goals are also discussed in Chapter V, Section A: Business Projects.

GOAL 1
To provide the State of Texas with transportation services and systems that: • work together • are safe, comfortable, durable, affordable • are environmentally sensitive • support economic and social prosperity

GOAL 2
To achieve the highest level of external and internal customer satisfaction

Note: (External customers include the general public, private businesses, and governmental entities; internal customers include all TxDOT employees.)

GOAL 3
To establish a comprehensive program that increases the opportunities for historically underutilized businesses (HUBs) to provide goods and services to the department

Business Objectives:

Department objectives were developed by cross-functional teams consisting of division, district and special office employees selected by the Executive Director. They met in facilitated workshops to produce objectives, outcome measures, strategies and output measures. The cross-functional teams also revisited the goals developed by the Senior Management Team and made suggestions for improvement. This was the first time that a team of employees of this nature was directly involved in the strategic planning efforts. Strategic business objectives are also discussed in Chapter V, Section A: Business Projects. The following are the objectives from the department's strategic plan for 1995-1999.

GOAL 1 OBJECTIVES
• To develop, operate and maintain efficient and effective transportation systems and services
• To improve public safety and security on transportation systems
• To facilitate economic and social prosperity through the efficient movement of people and goods
• To protect and enhance the environment in transportation activities
• To improve and promote the connectivity of transportation services and systems
• To optimize transportation funding to meet the mobility needs of the state

GOAL 2 OBJECTIVES

- Improve methods of identifying customer needs
- Maximize the quality and improve the delivery of products and services used or provided by TxDOT
- Continuously improve the way we do business
- Promote an environment of mutual respect, trust, and fairness in which all employees' contributions are recognized as important
- Enhance the public's perception of TxDOT

GOAL 3 OBJECTIVES

- To increase the number of HUBs participating in TxDOT contracting and purchasing activities
- To increase the number of contracting and purchasing opportunities in TxDOT for HUBs
- To develop a comprehensive HUB education program
- To expand communication efforts with the business community, other agencies and organizations regarding HUB opportunities and services in TxDOT

Critical Success Factors:

Critical success factors are activities which people in an organization must do right in order to achieve the organization's mission, vision and goals. The Senior Management Team developed TxDOT's critical success factors in a workshop led by Retooling TxDOT facilitators. The results of that workshop are listed below in priority order. These critical success factors are also discussed in Chapter V, Section A: Business Projects.

CRITICAL SUCCESS FACTORS
• Plan, design and construct transportation systems
• Understand and partner with the external and internal stakeholders
• Construct, maintain and operate safe highway systems
• Maximize funding and resources
• Develop new programs to foster alternative modes of transportation and their connectivity
• Diversify the TxDOT workforce
• Measure and monitor the department's collective performance
• Streamline the business processes and reduce bureaucracy
• Provide a good public information program
• Educate business community about historically underutilized business opportunities
• Define the responsibilities and authority of each employee and hold them accountable

Products and Services:

TxDOT is the largest provider of transportation services in Texas. With an annual budget of over $3 billion and approximately 15,000 employees, TxDOT provides services to the state through its headquarters in Austin and its 25 district offices located throughout the state. Historically, TxDOT has been considered a "highway department," but has recently changed its business strategies to focus on all modes of transportation in an effort to become a "complete provider" of transportation systems. The following is a brief description of the products and services provided by TxDOT:

Products:

Transportation Systems and Facilities:

The department constructs and delivers transportation systems and facilities using either internal or external resources or by grant assistance. These include roads, tunnels, ferries,

bridges, rest areas, picnic areas, pedestrian paths, bicycle routes, tourist information facilities, public transportation vehicles and vehicle facilities and general aviation airports.

Permits and Licenses:

The department regulates the use of transportation systems through the issuance of permits and licenses. Examples of permits and licenses include oversize and overweight permits, utility permits, access permits, outdoor advertising sign licenses and permits, salvage yard and junkyard permits, motor vehicle titles and registration, and motor vehicle dealers licenses. The department also licenses motor-vehicle manufacturers, distributors, and converters.

Specifications and Standards:

The department develops standards, specifications and measures for use in conducting department business. Examples of specification and standards include the Texas Manual on Uniform Traffic Control Devices (TMUTCD), highway design standards, construction specifications and standards, material specifications and requirements, testing procedures, sign design standards, construction plans and transit vehicle specifications.

Literature and Publications:

The department publishes and distributes literature for use by the general public. Examples include tourism and travel literature, the *Texas Travel Guide*, the *Texas Highways* magazine, anti-litter materials, public safety-materials, airport directories, maps and transit marketing materials.

Miscellaneous Products:

Miscellaneous products that the department provides include license plates, landscaping, aerial photography, highway construction materials, illumination, traffic control devices, traffic counts and research and feasibility studies.

Services:

Maintain and Operate Transportation Systems:

The department provides services relating to maintaining and operating transportation systems. These include roadway maintenance; emergency services; environmental enhancements; bridge inspections, maintenance and load zoning; landscaping and

vegetation management; railroad crossing warning devices; signing and illumination; roadside facilities; right-of-way maintenance; traffic management systems; ferry services; and Gulf Intracoastal Waterway dredging.

Provide Information Services:

The department provides information to the general public, industry partners and law enforcement officials, including travel information and counseling, tourist information, news release information, construction information, proposed roadway design information, road condition information, wildflower reports, traffic safety information, right-of-way information, transit information, routing information, aviation information, registration and titling information, traffic volumes and types, and accident and highway statistics.

Provide Education and Training:

The department provides various training and educational assistance to external entities. Examples include traffic safety awareness programs, aviation education programs, and transit training and technical assistance.

Miscellaneous Services:

Other services provided by the department include courtesy patrols, call boxes, grant assistance, right-of-way relocation assistance, research, minority scholarships, litter abatement programs, alternative fuels programs, recycling programs, local government assistance, off-state system project design and construction, administering the Texas lemon law, and assisting consumers with warranty complaints.

Industry Trends and Challenges:

Several trends and challenges within the transportation industry affect TxDOT. Not only do these trends and challenges provide obstacles to successfully conducting business, but also provide opportunities for enhancing the types of products and services offered and the ways in which they are provided. These trends and challenges include:

- Increased need for alternative sources of funding to adequately fund all modes of transportation
- Use of integrated multimodal transportation planning from a statewide perspective
- Increased emphasis on preservation of current transportation systems
- Increased emphasis on the state border area and the availability and improved condition of trade routes
- Required changes to transportation systems so that they are accessible and usable by persons with disabilities and the aging population
- Increasing awareness of enhancing, protecting and preserving natural and cultural resources
- Recruitment of minorities and women into the work force and as contractors and suppliers
- Increased political mandates and influences, including compliance with the Intermodal Surface Transportation and Efficiency Act of 1991 (ISTEA) and the Americans with Disabilities Act (ADA)
- Increased utilization of private businesses to perform activities historically performed by TxDOT (i.e., privatization)
- Increased emphasis on the transportation system supporting economic development
- Increased demand for alternative modes of transportation (e.g., public transportation, aviation, bicycle paths, etc.)

BUSINESS NEEDS:

Overview:

To assess business process effectiveness and provide a context for the information systems support requirements, the strategic environment surrounding TxDOT will be discussed, as well as the economics of the department. Issues and opportunities identified by the Management Team which face TxDOT will also be described.

Strategic Environment:

TxDOT's strategic environment for conducting business is complex and constantly changing. The department works with a wide variety of external entities and must comply with numerous rules and regulations. The following is a description of TxDOT's environment as well as pressures and influences.

Customers:

A wide variety of entities are considered to be customers of TxDOT. The public is the department's largest customer, making a focused set of activities a challenge due to the public's diverse needs. The public continues to become a more knowledgeable customer as its awareness of and concern for transportation issues increase. One of the greatest needs expressed by the public is the maintenance and expansion of the existing transportation system. There is also increased demand for expanded services and alternative transportation mode choices. Examples include dedicated bicycle lanes, wider roads and comprehensive services for persons with disabilities.

Another major public expectation is to have greater input into the planning and design of transportation systems. Special interest groups are becoming more prevalent in public hearings and are persuading the department to re-examine projects and designs which were once readily accepted. In addition, the public is demanding a greater level of accountability from TxDOT, optimum use of transportation funds, and timely completion of jobs.

The department's customers also include other government agencies and planning organizations, including the Federal Highway Administration (FHWA), Metropolitan Planning Organizations (MPOs) and the state Legislature and Congress. The amount of information required by and coordination with these groups is continually growing, forcing TxDOT to reevaluate the volume and type of information it collects. The department must submit budgets and performance updates to the legislature on a regular basis.

Government Agency Influences:

In addition to the influences exerted by the general public, several state and federal government agencies influence the way TxDOT conducts business. Examples include the federal government which has passed the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the North American Free Trade Agreement (NAFTA); Metropolitan Planning Organizations (MPOs) which now have increased influence over the types of projects selected; and the Environmental Protection Agency, which have input into the type of transportation system built in given areas due to the types of pollution emitted from the current system. Other government agencies which exert influence on TxDOT include; the Federal Highway Administration, the Occupational Safety Health Administration, the U.S. Army Corps of Engineers, the Federal Aviation Administration, the General Land Office, the Texas Natural Resource Conservation Commission, the Texas Parks and Wildlife Department, the Texas Attorney General's Office, and the Texas Department of Public Safety.

Environmental Issues:

Environmental sensitivity is one of the largest issues confronting the department today. It is so important that the need to be sensitive to the environment has been *explicitly* stated in both the vision and objectives of the department. The most prevalent environmental issues TxDOT encounters include noise, water, and air pollution, traffic congestion, waste reduction, hazardous material management, coastal erosion, beautification, historical preservation and conservation of natural and cultural resources. The public is also concerned that private property rights are being violated to attain environmental goals. These issues must be carefully balanced with social and economic issues to ensure that the public will is satisfied.

Economic Influences:

Since the department receives most of its revenues through government funding and special fees and taxes, federal and state governments are the primary economic influence on TxDOT. The federal government can withhold money from the department if it is not in compliance with existing mandates, such as compliance with the federal metrication mandate and the enforcement of speed limits and the legal drinking age. In addition, taxes collected to fund operations can vary as factors outside of the department's control change. An example of this is the revenue received from fuel taxes, which is decreasing due to the increased use of alternative fuels and more fuel efficient cars.

Business Economics:

From a financial perspective, TxDOT's expense structure has remained very stable over the past couple of years and is expected to remain so in the near future. In 1993, total expenses for the department were approximately $3 billion with almost half of that attributable to construction costs. The amount spent on each type of construction (e.g., highways, airports, ferries) is not expected to change as agreements currently in place with existing external entities keep construction budget levels fairly consistent.

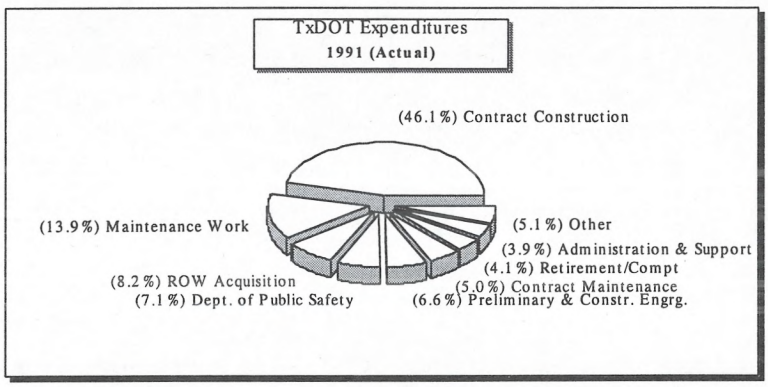


Figure 2.1 - TxDOT Expenditures (1991)

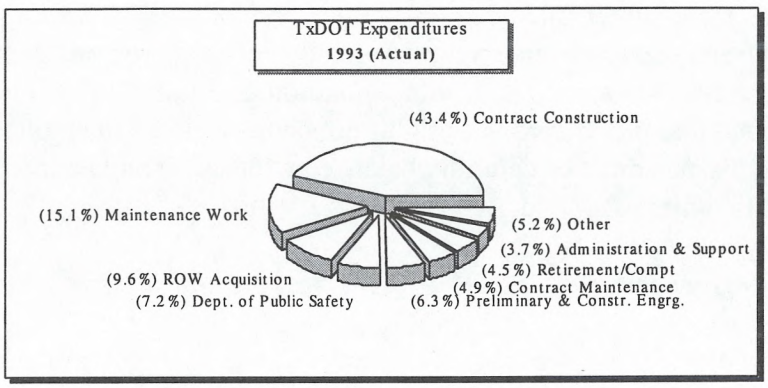


Figure 2.2 - TxDOT Expenditures (1993)

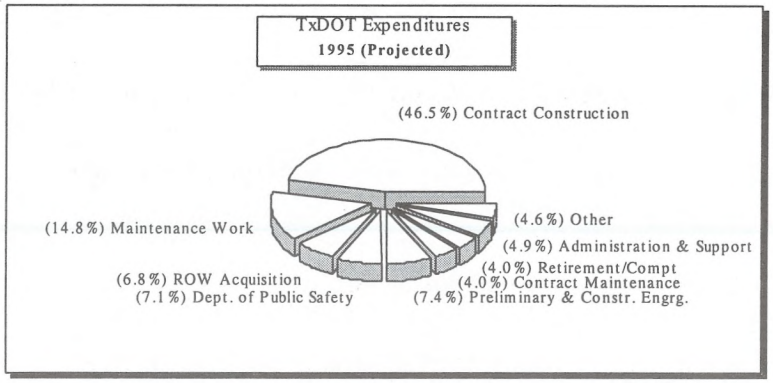


Figure 2.3 - TxDOT Expenditures (1995)

The most significant changes in the cost structure between 1991 and 1995 occurred in the acquisition of right-of-way and in maintenance. As indicated by Figures 2.1, 2.2 and 2.3, right-of-way is expected to decrease almost 1.5 percent during this time period while maintenance is expected to increase approximately 1 percent. This appears to indicate a trend away from construction of new roadway locations and toward the maintenance and enhancement of existing transportation systems.

In addition, administration and support costs are expected to increase by 1 percent between 1991 and 1995, due to organizational changes in the headquarters offices.

Business Issues and Opportunities:

The following is a description of business issues and opportunities identified by the Management Team in the fall of 1993. These issues have been used as input into several Retooling TxDOT activities, including:

- Development of TxDOT critical success factors by the Senior Management Team
- Development of department objectives
- Establishment of the business model
- Identification of industry trends, and key business challenges and opportunities
- Identification of information needs
- Prioritization of business areas (discussed in Chapter V, Section A: Business Projects)

These business issues and opportunities have been categorized into four categories: culture, service oriented, business planning and transportation network.

Culture:

Accountability, Risk-Taking, and Innovation for a Changing TxDOT Culture:

The department will promote a culture which supports risk taking, provides innovation for change and instills accountability at all levels.

Becoming a Department of Transportation:

Emphasis is being placed, both externally and internally, on creating and supporting a balance in the development and implementation of all modes of transportation.

Changing the Work Force Culture: Diversity and Teamwork:

Through recruiting, hiring and training, TxDOT is striving to achieve and maintain cultural diversity within the workforce and use that diversity effectively in a team environment.

Communication, Openness and Trust in the Changing TxDOT Culture:

TxDOT is striving to make communications open, accurate, timely, relevant and done in the spirit of cooperation.

Internal Staff Development and Education for a Changing TxDOT Culture:

Emphasis is being placed on comprehensive internal staff development and education to allow for a successful transformation of TxDOT's culture.

Service Oriented:

Continuous Improvement:

Efforts are being made to fully utilize continuous improvement to ensure an increasingly effective work environment.

External Partnerships:

TxDOT is seeking to utilize external partnerships to provide the highest quality of service to its customers.

Public Involvement, Marketing and External Education to Promote a Service Orientation:

Through increased communication and involvement, the department can educate the public on the many services and activities that it provides.

Dealing With Aging Population:

TxDOT is providing services to the aging population to respond to their needs.

Business Planning:

Alternative Financing for Transportation:

The department continues to identify and use alternative financing to provide transportation services to the state of Texas.

Evaluating the Way We Do Business:

The department is evaluating the way it conducts business to increase the effectiveness of its operations through improved productivity and customer service.

Increasing Opportunities for New Partners:

The department is identifying and increasing opportunities for new partners, including historically underutilized and disadvantaged businesses.

Optimizing Resources:

The department is evaluating ways in which resources can be shared across traditional organizational lines and to effectively optimize the resources available to TxDOT, including contract labor.

Plan Driving the Budget:

The department has begun to lay the groundwork to ensure that it is driven by the needs of its customers versus the monetary resources of the government.

Transportation Network:

Application of New Technology in the Transportation Network:

The Business Information and Systems Plan will identify opportunities for the department to implement emerging technologies in a timely manner.

Environmental Sensitivity in the Transportation Network:

Each employee plays a critical role in establishing and maintaining environmental sensitivity in the transportation network and department operations.

Evaluating Corridor Alternatives:

Effective development of transportation systems in the future will include corridors for all modes of transportation.

Consistent Message:

Communications will be made in a clear, understandable, consistent manner to ensure customer satisfaction.

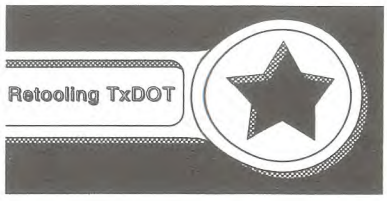
Many business issues, opportunities and recommendations have been submitted to the Retooling project team by TxDOT employees throughout the state by way of the Retooling TxDOT Issues and Opportunities Form. This form has been made available to employees throughout TxDOT for submitting their ideas concerning needed business improvements. The Retooling project team in turn has presented the issues and the employees' recommendations to the Senior Management Team for consideration. Many of the recommendations have been submitted to the appropriate TxDOT office for handling while many will be used for analysis during upcoming business process retooling efforts. The retooling team is currently working with personnel responsible for TxDOT's Employee Incentive Program to integrate the two processes by which employees can submit their ideas.

CHAPTER II

STRATEGIC ASSESSMENT AND DIRECTION

INTERNAL ASSESSMENT

SECTION C



Texas Department of Transportation

Section C
Internal Assessment

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OVERVIEW:

The objective of the Internal Assessment is to inventory and evaluate the business functionality and technical quality of current information systems, including applications, data, and technology, and to evaluate the history of spending for information resources. These evaluations are input into the development of the Information Resources, described in Chapter IV.

Application, database and technology evaluations were conducted through interviews and surveys with project leaders, offices of primary responsibility (OPR), management representatives, technical staff and users throughout the department. The business and engineering applications were evaluated for platform, programming language, age, functional quality and technical foundation. The database evaluation included a review of the data environment and database management systems. The technology assessment describes the existing hardware and software platforms used throughout the department.

This section also includes a summary of the overall level of user satisfaction with IS services. This assessment is based on a survey distributed to a sampling of users, representing all business areas of the department.

Finally, this section provides a historical perspective on TxDOT's IS expenditures. The IS budget has been analyzed to identify trends in technology, staff and training spending.

EVALUATIONS:

Application Evaluation:

There are 106 existing applications supported by the Information Systems Division (ISD). Brief descriptions of these applications appear in Appendix 2. Organizationally, these applications are divided into two sections: Business and Engineering. The business applications include the Financial Information Management System, Design and Construction Tracking, Transportation and Motor Vehicle applications, and other Management Information Systems. Engineering applications are primarily graphical applications used to design and analyze highway and bridge structures. Automated Plan Preparation and Roadway Design System are large applications supported by the Engineering section.

The general characteristics of these applications are described below. This summary is based on survey responses from end users and the ISD project leaders.

Business Area Support: Figure 2.4 represents the distribution of ISD applications among the department's business areas. Refer to Appendix 2 for a listing of the applications for each business area.

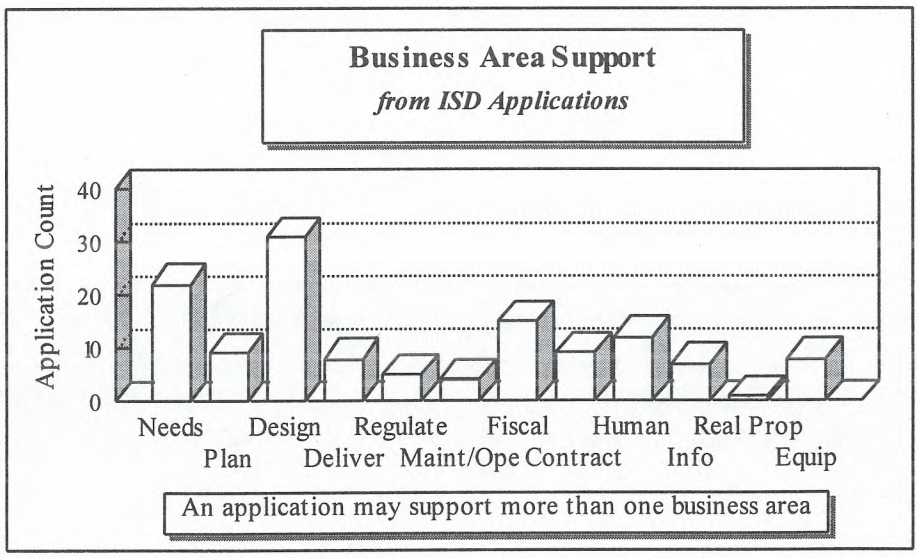


Figure 2.4 - Business Area Support

More than 60 percent of the ISD applications support the business areas of "Determine and Analyze Transportation Needs," "Design Transportation Systems," and "Fiscal Services." "Maintain and Operate Transportation Systems" and "Real Property" are the business areas least supported by ISD applications.

Platform: The Department of Transportation uses the mainframe platform for the majority of its processing. As depicted in Figure 2.5, 74 percent of the centrally supported applications are processed exclusively on a mainframe platform, 14 percent are PC-based, and 12 percent exist on both the mainframe and PC platform.

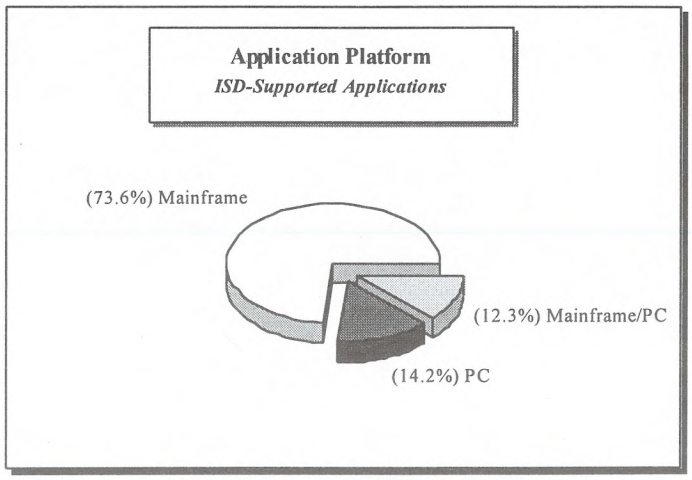


Figure 2.5 - Application Platform

The department trend, however, is towards increased development of PC applications. Of the 24 applications implemented since 1991, 17 are PC-based or incorporate PC processing for some procedures. As new development takes place on non-mainframe platforms, the need to interface with existing applications and/or enterprise data will continue to force application developers to utilize a mainframe platform for some processing and/or data access.

Processing Mode: Figure 2.6 illustrates the extent of online and batch processing for both update and inquiry processes.

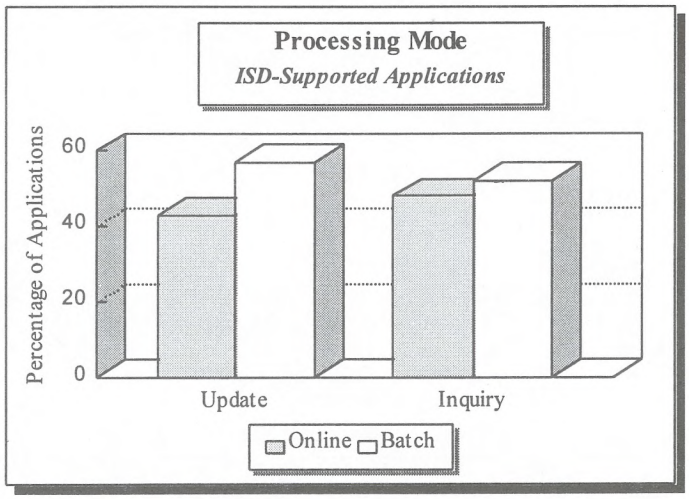


Figure 2.6 - Processing Mode

More than 50 percent of the applications process in batch mode. A critical factor in the batch environment is the Master Data Controller (MDC), which controls update, interface, and error recovery processing for twelve MIS applications.

The implications of a predominantly batch environment include:

- Increased technical and user support to submit jobs and monitor results
- Limited window of processing time
- Difficult to use applications
- Reduced productivity due to prolonged turn-around time

The transition towards graphical user interface (GUI) applications is quicker and smoother for applications already using online processing. Because more than 50 percent of the ISD applications operate in batch mode, this transition will require extensive planning and coordination.

Programming Languages: The predominant programming languages are COBOL, FORTRAN, and Natural. The Roscoe Programming Facility (RPF) is also used to provide a user front-end for batch job submission. The use of these programming languages is consistent with the high percentage of mainframe applications. The usage of programming languages is represented in Figure 2.7.

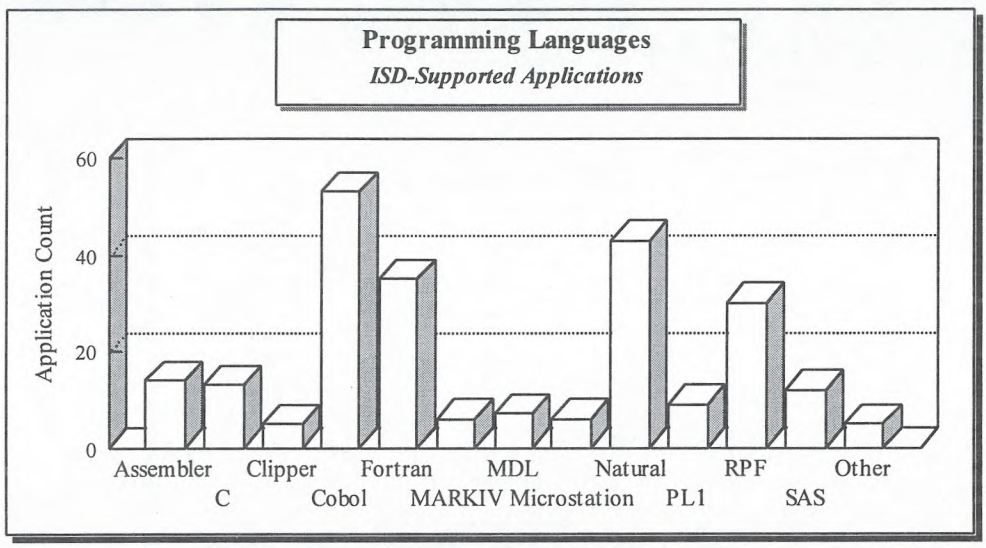


Figure 2.7 - Programming Languages

Twenty-six percent of the applications are written in programming languages considered to be obsolete (Assembler, Mark IV, and PL1). The maintenance of these applications will be increasingly difficult as the availability of programmers skilled in these languages

diminishes.

Proprietary Application Software: Only 10 percent of the department's applications use proprietary application software for some or all processing. Factors contributing to the low utilization of packaged software include:

- Unavailability of proprietary solutions, due to unique requirements of transportation business areas
- Long procurement process
- Historical problems with maintenance contracts and/or package customization
- Platform and integration problems
- Requirement to share data with other applications

Interfaces: The department's applications are highly interfaced and depend on data generated by other applications. Eighty percent of the applications interface with other applications by:

- Reading data from another application,
- Updating another application,
- Passing transactions to an application, and
- Sharing processes.

This level of interface makes it difficult to enhance or modify applications. Modifications to one application can have a snowball effect on other applications, resulting in long maintenance cycles and complicated programs. The single application/single database development strategy perpetuates application interfaces. When each application has its own database (or set of files), interfaces to update duplicate data in other databases are required.

Most of these interfaces occur among the business applications. There is virtually no automated communication between the business and engineering applications. Although there is data to be shared among these applications, interfaces have not been developed because:

- The systems operate on separate non-integrated platforms,
- Each development section is organizationally isolated,
- The systems use different database management technologies, and
- Original application design did not include the need for integration with other systems.

Age: Many of the department's first automated systems are still used today. Fifteen percent of the production applications have existed for over 20 years. The age of the ISD applications is graphically represented in Figure 2.8.

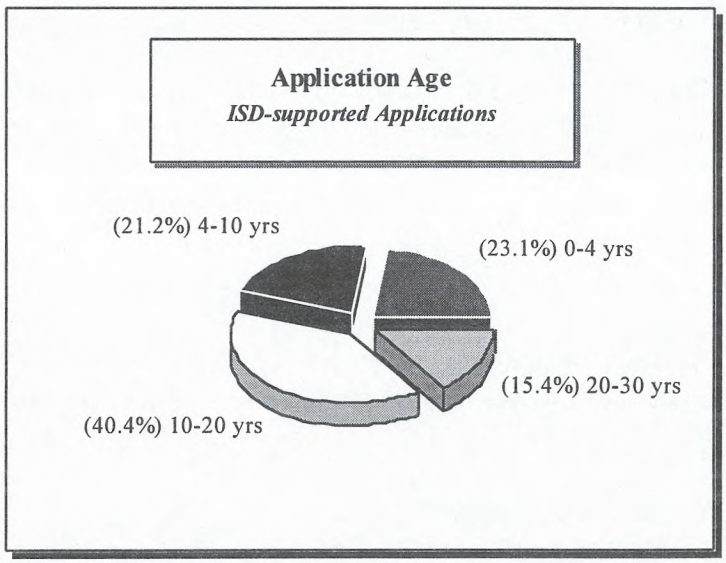


Figure 2.8 - Application Age

Most of these older applications have been modified to prolong their useful life. However, the age of these applications suggests that the applications are unstructured, difficult to maintain and use old technology. These conclusions are supported by the technical quality review (refer to the "Technical Quality" section for more information on the technical evaluation of these applications)

Functional Quality: The functional quality of the ISD applications was evaluated by the Office of Primary Responsibility (OPR) for each application and a sampling of end users. Applications were evaluated in the following five areas:

- Overall satisfaction
- Functionality
- Integration with other applications
- Useability
- Support

Overall satisfaction was rated as moderately satisfactory for the functionality, integration and useability of these applications. On a scale from 1 (unsatisfactory) to 5 (excellent), ISD applications were rated as 3 (satisfactory) in each of the above categories. In order to analyze these results in more detail, the functional scores were grouped by business area.

Clearly, some business areas are better supported than others. The business areas with the highest functionally-rated applications are:

- Regulate Transportation Systems,
- Fiscal Services, and
- Equipment, Materials and Supplies.

The business areas with the lowest rated applications are:

- Determine and Analyze Transportation Needs, and
- Plan Transportation Systems.

Some of the department's oldest applications are used to collect data in the Needs business area. The changing demands of this business area, which includes ISTEA mandates, and the antiquated data-input procedures for these applications are probable explanations for the low ratings. The low functionality rating in the Plan business area reflects the lack of solid decision-support modeling tools.

ISD application Functionality is only partially satisfying the users' business needs. Users are satisfied that the applications process correctly, but much functionality is missing from the applications. This is evidenced by the large number of local applications developed to fill the gaps left by ISD applications.

A common complaint is that applications need to have better Integration with other applications. Too often, users are having to re-enter data in two applications. A number of applications are considered to be incomplete because they do not link to a related application or use data owned by another application.

Many users have requested improvements in the Useability of applications by including graphical user interfaces (GUI). As users become more familiar with PC applications, they are asking for the same type of presentation from the mainframe applications. The useability of an application is also determined by data access and the availability of reports. Users are asking for more flexibility in the way in which data is presented.

Several users have been complimentary of the ISD Support provided by the project leaders and programmers. However, many are dissatisfied with the prioritization process and long wait-period before enhancements can be made to an application. This delay often forces users to use the application differently than it was designed, perpetuates data integrity problems, and hinders the user's ability to conduct business.

The training and documentation support for these applications is often inadequate.

Training is usually provided as new applications are implemented, but few applications offer on-going training. Additionally, users do not always know which applications are available, or what the applications are capable of doing.

Technical Quality: Technical quality of the ISD applications was evaluated on the following four criteria:

- Performance
- Ease of Maintenance
- Technical Foundation
- Quality of Design

The ISD project leaders were asked to evaluate each application. The following figures summarize the results.

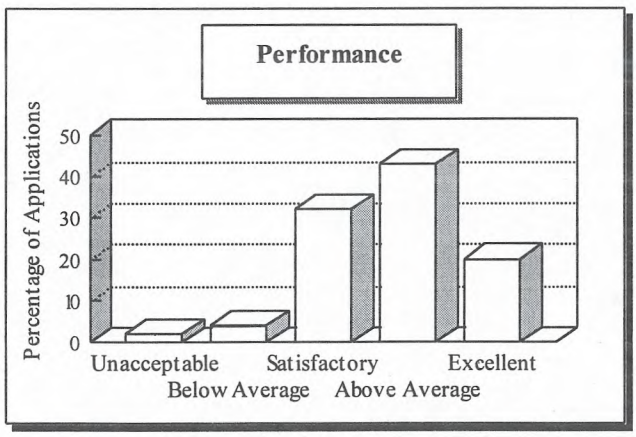


Figure 2.9 - Performance

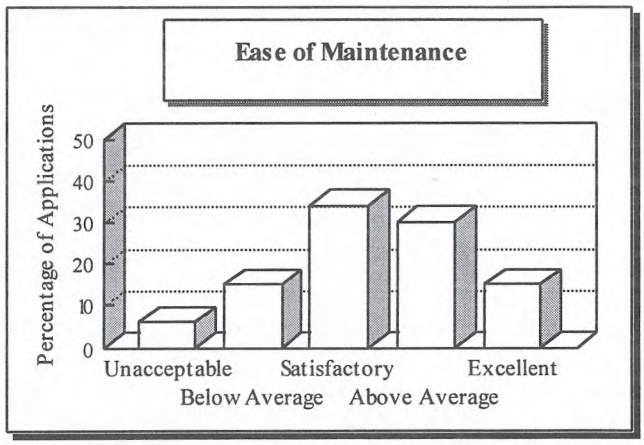


Figure 2.10 - Ease of Maintenance

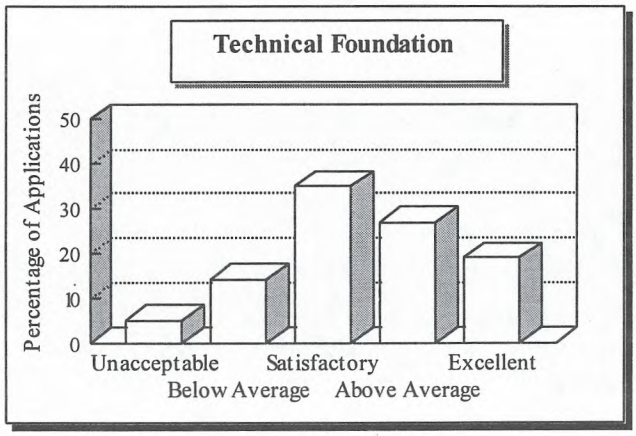


Figure 2.11 - Technical Foundation

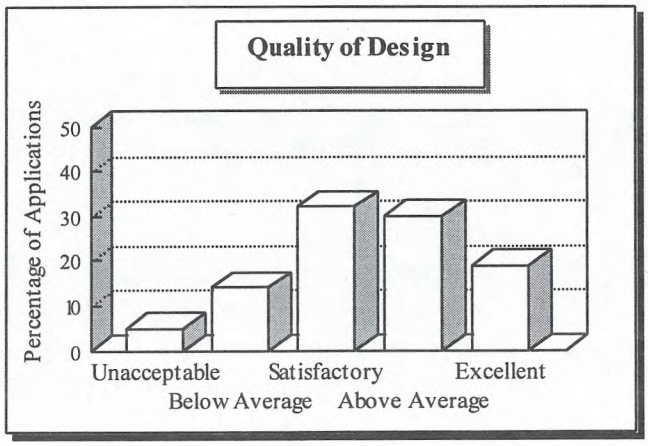


Figure 2.12 - Quality of Design

The Performance rating considers the rate of abnormal terminations, the amount of resources consumed, and the processing time for the application. The high ratings in this category are an indicator of the department's competence with mainframe processing. Ninety-four percent of the applications perform at or above satisfactory levels.

Ease of Maintenance considers the degree to which structured programming is used, the modularity of the design, the languages used, the age of the system, previous modifications and adherence to department standards. Twenty-one percent of the applications are difficult to maintain. Additional factors contributing to difficult maintenance include:

- Programmer turnover
- Lack of technical documentation
- Number of interfaces to other applications

Often, a maintenance change to a single program may be a relatively simple task. However, given the level of integration between programs and applications, most maintenance efforts require changes to multiple programs. This "domino effect" accounts for the lengthy time required to complete a maintenance request.

The Technical Foundation rating considers whether the application uses procedures, methods, techniques, equipment, and/or languages which are obsolete or which will soon become obsolete. The technical foundation is satisfactory (or better) for 81 percent of the ISD applications. However, only 46 percent of the applications have an excellent or above-average technical foundation. This is indicative of the widespread use of batch, mainframe processing.

The Quality of Design rating measures the overall technical design of the application. Eighty-one percent of the ISD applications have at least a satisfactory technical design.

Overall, 23 percent of the applications have an unacceptable or below-average technical rating. These applications may be candidates for replacement or technical modifications. Conversely, only 15 percent of the applications were evaluated as technically excellent. This suggests that functional modifications to the majority of the applications will be cumbersome and time-consuming.

Locally-Developed Applications: More than 250 applications have been developed by local automation staffs and end users, as identified through survey responses from the automation administrators. Most of these applications are used to support the following business areas:

- Design Transportation Systems
- Deliver Transportation Systems
- Maintain and Operate Transportation Systems
- Fiscal Services
- Human Resources

Figure 2.13 illustrates the distribution of locally developed applications among the department's business areas.

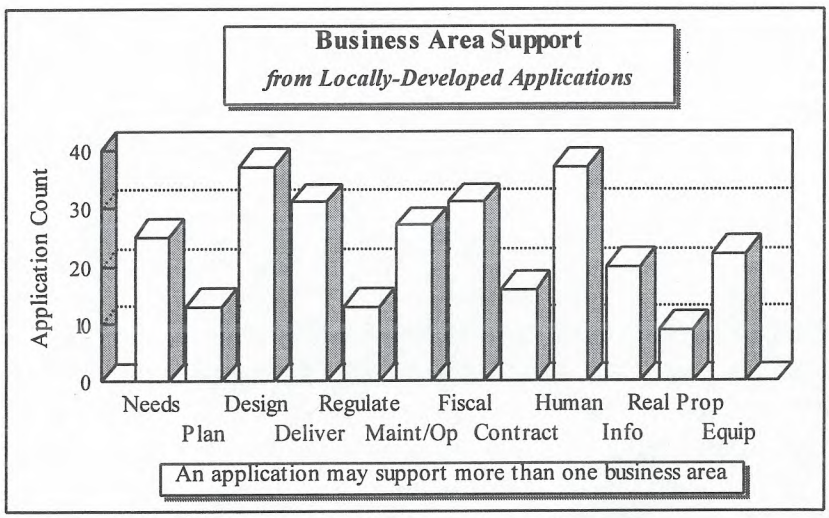


Figure 2.13 - Business Area Support

The following factors have caused this surge in locally-developed applications:

- Long wait time and cumbersome prioritization process for ISD applications
- Dissatisfaction with statewide applications
- Demand for easy-to-use GUI applications
- Emergence of fourth-generation programming languages
- Skilled non-ISD programmers
- Ability to dedicate resources and prioritize needs locally

Over 75 percent of the locally-developed applications are PC-based. This suggests that the district and division automation staffs have a skilled and experienced group of PC programmers. This will become an important resource for the migration towards GUI

applications.

There are several inherent issues with the development of local applications, including:

- Inconsistent procedures
- Duplication of effort
- Lack of enterprise data
- Duplication of data
- Support

When ISD fails to meet user needs, users turn to other sources for application development, including local automation staffs, contract services and other users. The local automation staffs and end users have proven that they are capable of providing the necessary automation tools for their users.

Database Evaluation:

Data Profile: Currently, the data environment at TxDOT is characterized by:

- Complexity,
- Centralized data administration,
- Traditional database technologies, and
- A lack of an enterprise-wide data model.

The data environment is made up of numerous hardware platforms, including mainframe, midrange, personal computer and workstation. In addition, data is stored in many types of databases, such as ADABAS, flat files, VSAM and dBase. As new tools and databases are introduced, the old tools and databases are not replaced, which creates increasingly complex data support requirements.

Currently, the Data Administrator (DA) provides support for ISD business applications only. No support is provided for the districts and other divisions or for engineering applications. Data administration activities are limited to ADABAS databases only and support is limited or non-existent for VSAM and flat file databases. No cross-application data models have been created, although the computer-aided system engineering (CASE) tool Excelerator is available. The use of relational databases is limited.

The databases supported by the ISD applications are listed in Appendix 3. The entity type(s) of each database are also listed. This summary is based on information provided by the ISD Data Analysts.

These databases are application databases rather than subject databases. Almost every application has its own unique set of files, and some of the data definitions and integrity rules are embedded in the application. Data describing the same entity type is sometimes scattered among several databases.

Database Technology: Figure 2.14 illustrates the use of database technologies by the ISD applications.

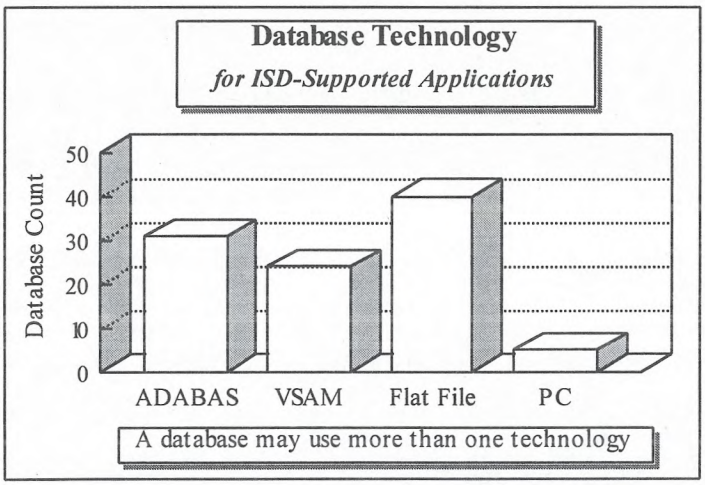


Figure 2.14 - Database Technology

The department's primary database management system is ADABAS. ADABAS is the principal Data Base Management System (DBMS) for more than 50 percent of the department's business applications. VSAM and sequential files are sometimes used in conjunction with ADABAS to process large quantities of data or for history purposes. VSAM and sequential files are also prevalent as the primary database technology in older business applications.

The engineering applications process flat (sequential) files stored on the user's workstation. There is very little centralization of these files.

The majority of the applications written by the district and division automation staffs are PC-based, using dBASE files.

Technical Quality: The technical quality of the centralized databases were evaluated on the following criteria:

- Quality of design
- Ease of access

- Ease of maintenance

The following figures summarize the results. The ratings for ADABAS databases were summarized independently of the VSAM and flat files, in order to analyze the impact of database management technology.

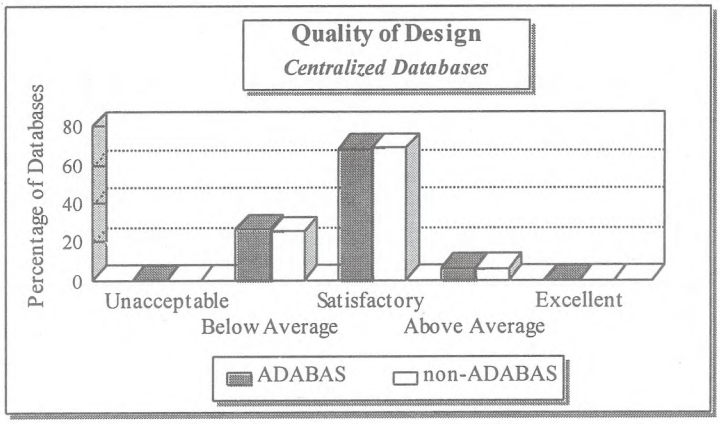


Figure 2.15 - Quality of Design

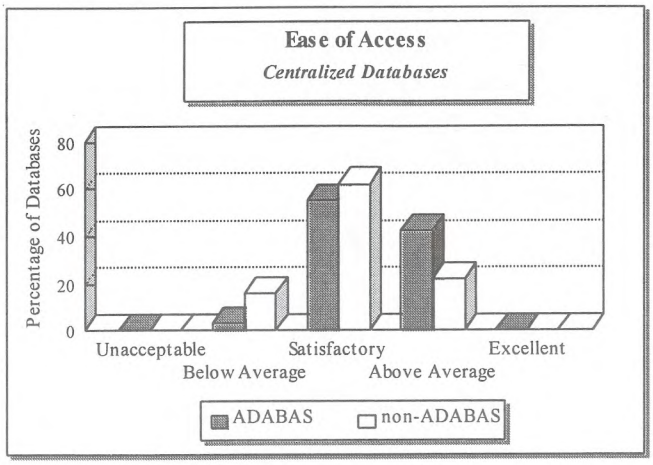


Figure 2.16 - Ease of Access

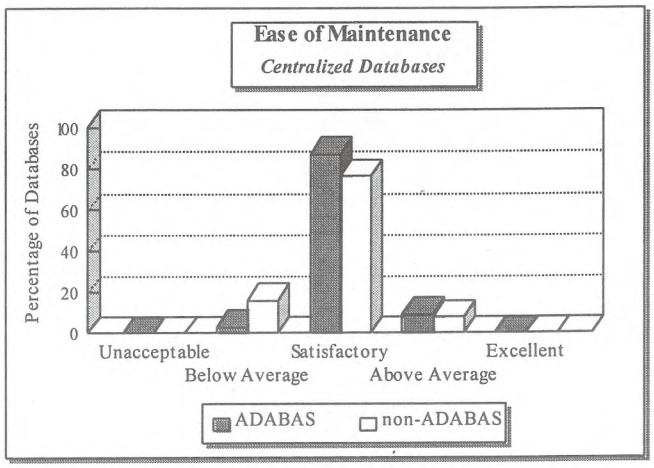


Figure 2.17 - Ease of Maintenance

Quality of Design considers the logical design of the database, the degree of normalization, redundancy and flexibility. Only 6 percent of the databases have an above-average design. This inadequacy of database design can also degrade application and program design, increasing maintenance problems (see Figure 2.15).

Ease of Access rates the ability to access the data within the database. Consideration

was given to the primary and secondary access keys, the record sequence query and report writer facilities. The ADABAS databases are significantly easier to access than the VSAM and flat files, but only 42 percent of the ADABAS databases were rated as above-average. This rating is supported by the user's complaints about the unavailability of data and complexity of ad-hoc reporting programs (see Figure 2.16).

Ease of Maintenance rates how easily changes can be made to the database structure. Almost all of the databases were rated as satisfactory as illustrated in Figure 2.17. Database structures must be easily modifiable to allow applications to respond to the business needs of the users.

The database architecture is the foundation for application development. In order to improve the quality of the department's applications, the database architecture must first be improved.

Technology Evaluation:

Desktop Hardware: CRTs, general-purpose microcomputers, graphics microcomputers and engineering workstations have been categorized as desktop hardware; this equipment is used directly by the department's employees. The CRTs are located primarily in the districts and can be used only to establish connections to the mainframe. The general purpose microcomputers (PCs) are used for PC and mainframe administrative applications. The graphics microcomputers and engineering workstations offer graphics support for highway and bridge design and map base generation. The inventory counts for desktop hardware are depicted in Figure 2.18. The 2,200 machines for the Registration and Title System (RTS) are not included in these counts.

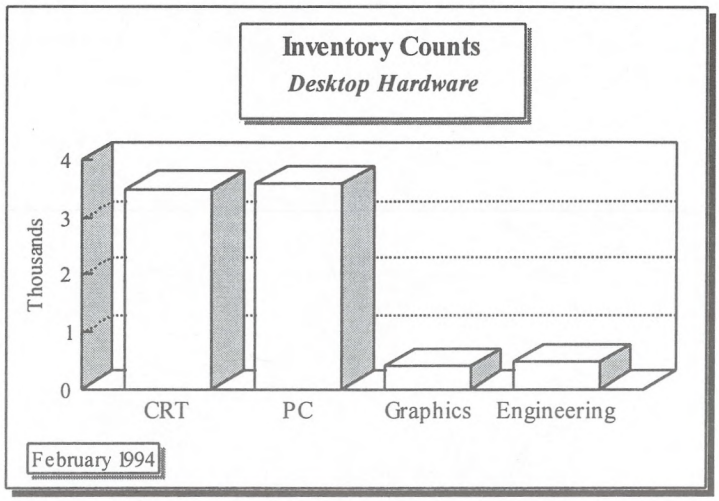


Figure 2.18 - Inventory Counts

Figure 2.19 illustrates the breakdown of the microcomputer inventory by processor type. The current microcomputer standard is a 486/33 machine. Only 20 percent of the department's current inventory meets that standard. The Information System Division (ISD) plans to upgrade all equipment to a 486 processor by the end of FY 1995, dependent on the availability of funds.

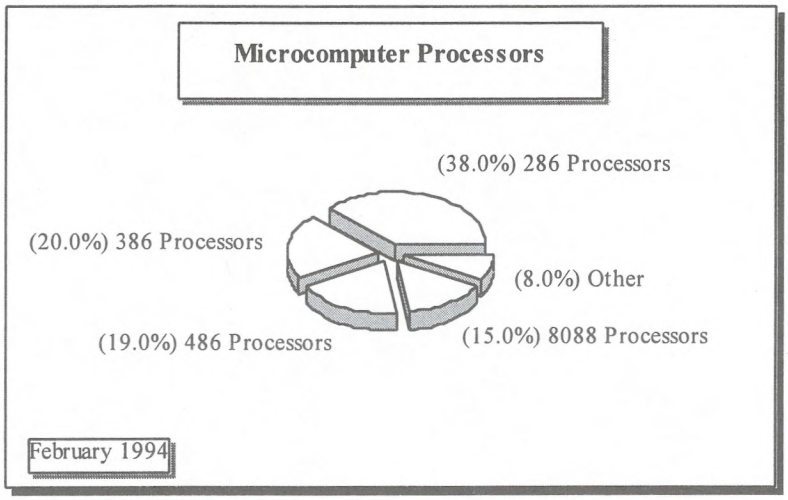


Figure 2.19 - Microcomputer Processors

There are approximately 8,000 automation users in the department who need a CRT, general purpose microcomputer, graphics microcomputer or engineering workstation to do their job. In the districts, the ratio of users to microcomputers is 2.2 (2.2 users per microcomputer, including engineering workstations). The microcomputer inventory is

much more concentrated in the divisions and special offices, as evidenced by the 1.3 "saturation" level. Figure 2.20 and Figure 2.21 illustrate the gap between users and microcomputers in the districts and divisions.

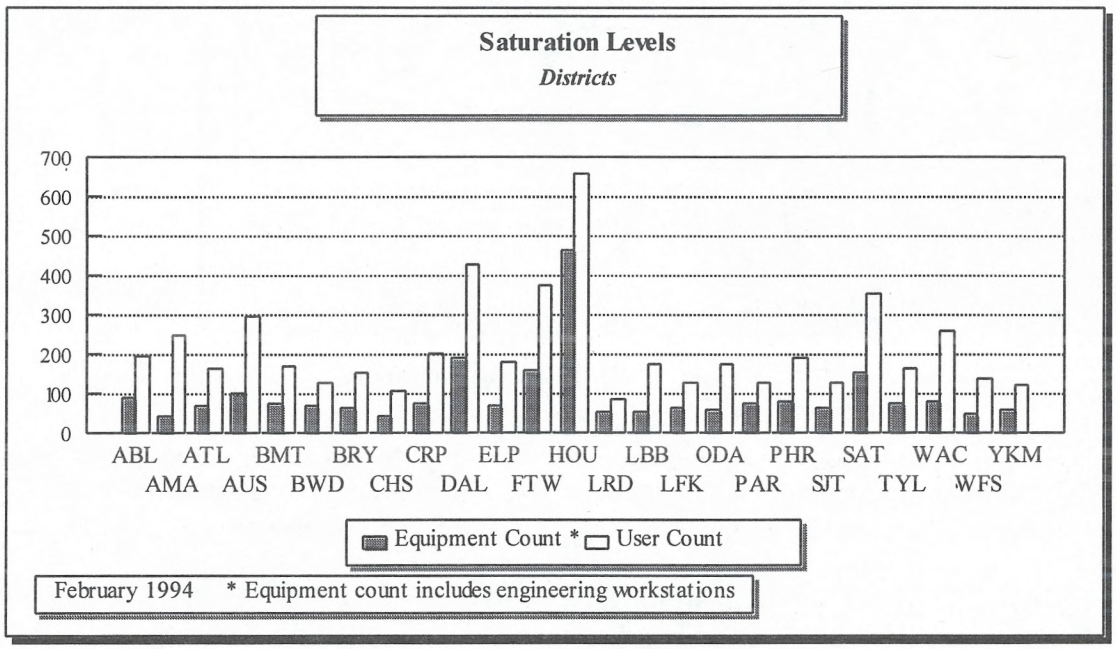


Figure 2.20 - Saturation Levels (Districts)

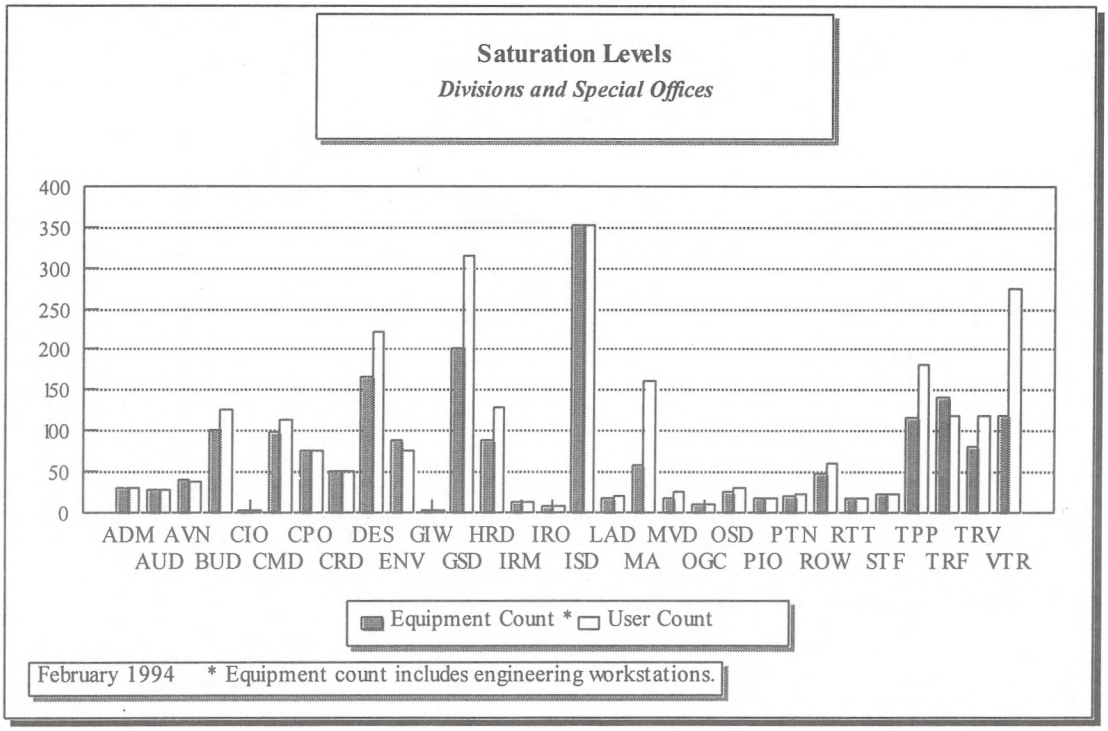


Figure 2.21 - Saturation Levels (Divisions and Special Offices)

Given current funding allocation levels, the Automation Advisory Committee (a group of peer-elected Automation Administrators who formulate recommendations to IS management) estimates that it will take three or four years to reach total saturation.

The lack of high-level processors for every automation user will severely affect the department's:

- Transition to a distributed processing environment,
- Development of easy-to-use Graphical User Interface (GUI) applications,
- Networking capabilities,
- Office automation, and
- Productivity.

Microcomputer Operating Systems Software: The distribution of microcomputer operating systems software is illustrated in Figure 2.22.

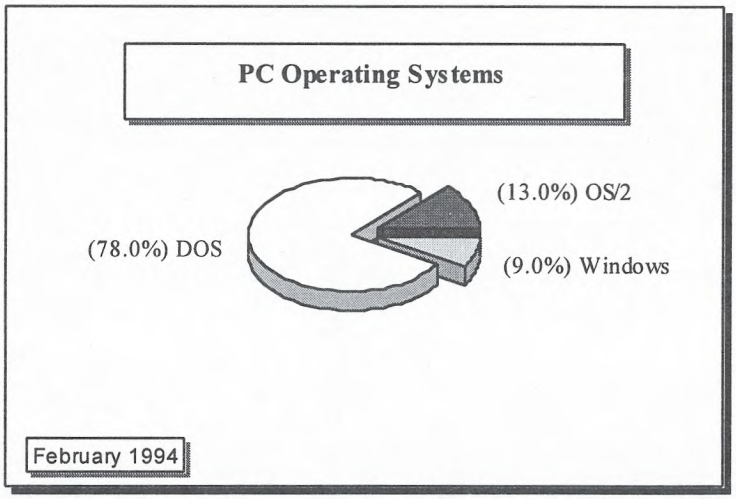


Figure 2.22 - PC Operating System

The DOS machines will need to be upgraded to Windows or OS/2 to support Graphical User Interface (GUI) applications and multi-tasking. This upgrade will impact over 3,000 users, increasing the need for operating system support and training.

Mainframe Hardware: The Austin Central Site has three mainframe processors:

- Amdahl 5995-3550M
- VAX 11/785
- Intergraph 350

The Amdahl 5995-3550M is the main processor which stores and executes all TxDOT administrative applications. It has 96 parallel channels and 16 escon channels, 384 megabytes of main memory, 384 megabytes of expanded memory and is supported by 320 gigabytes of disk storage. This processor is the focal point of a statewide communications network supported by 25 remote and two local IBM 3745 communication processors serving over 8,000 department users, the Department of Public Safety, the Federal Highway Administration and other state agencies.

The Central Site VAX mainframe is a graphics-oriented processor that supports the mapping and engineering sections of the Design Division, the Transportation Planning and Programming Division, and the engineering sections of the Information Systems Division. The VAX 11/785 has 16 megabytes of memory.

The Intergraph 350 and VAX 11/785 are part of an ETHERNET Wide Area Network composed of thirty-eight local area networks connected by Intergraph routers.

Mainframe Software: The operating system employed on the Amdahl (CPU) is the MVS/Enterprise Systems Architecture (MVS/ESA) which contains the MVS/System Product (MVS/SP) and MVS/Data Facility Product (MVS/DFP). The operating system provides system control, data handling and access, application development services, and system expansion capabilities. Also used in this system are Computer Associates/TOP SECRET for the protection of information resources, Software AG/ADABAS for the storage of data, IBM/CICS for the enabling of the development of network accessible applications, and Computer Associates/ROSCOE for data entry and job submission. The VAX system is controlled by the Digital Equipment Corporation Virtual Memory System (VMS).

USER SATISFACTION SUMMARY:

Overview:

A user satisfaction survey was created and distributed to a sampling of users which represented all business areas of the department in order to ascertain the overall level of satisfaction with IS services. The survey also solicited comments regarding each of the areas surveyed. As Figure 2.23 indicates, the level of satisfaction in all categories was moderate at best.

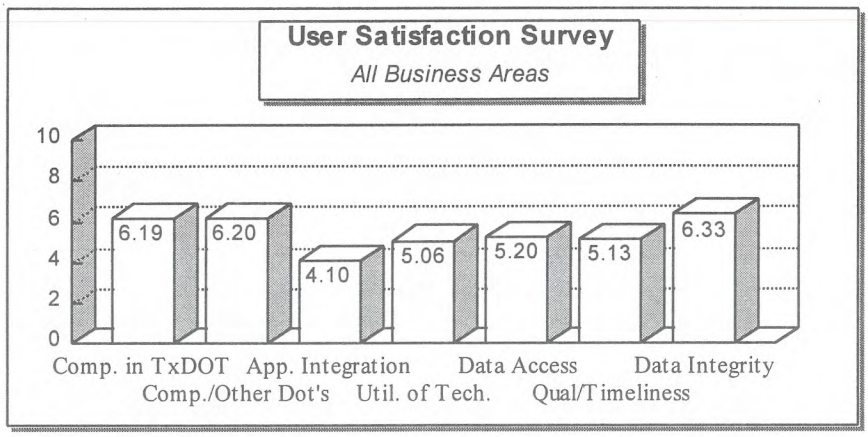


Figure 2.23 - User Satisfaction Survey

Questions:

The following seven questions were asked of users representing a wide range of districts and divisions within the department.

"Degree of Computerization Within the department" asked users to indicate the level at which processes that could be automated were automated within TxDOT.

"Degree of Computerization Relative to Other DOTs as a Whole" asked users to indicate how the level of computerization within TxDOT compared to their experience or understanding of computerization at other transportation departments.

"Level of Application Integration" asked users to indicate how well related applications work together.

"Utilization of Technology" addressed how well the technology the department has deployed is used.

"Access to Data" asked users to indicate how accessible the data they need is actually available to them.

"Quality and Timeliness" asked users to rate the overall quality and timeliness of information services provided to them.

"Integrity of Data" asked users to evaluate how the accuracy of the data available to them.

Results:

Several of the questions on the survey addressed the access, integrity and redundancy. On a scale of 1-10, with 10 meaning highly satisfied, Data Access received a score of 5.2 and Data Integrity received 6.33. Data redundancy was cited as a common problem.

Several questions addressed technology and its use within TxDOT. The overall response indicated that users did not believe that technology was efficiently used and cited a lack of training as one cause of the underutilization.

The level of application integration received the lowest score on the survey, 4.1 out of a possible 10. Legacy systems, which are not integrated, and system planning, not done from a "global" perspective, were cited as reasons which may explain the low score.
The survey did point out that users believe TxDOT has achieved the same overall level of computerization as other transportation departments.

INFORMATION SYSTEMS SPENDING HISTORY:

In order to understand how the Information Systems (IS) organization has historically spent funds, this analysis identifies and documents historical IS spending levels and trends, and describes how and where the resources have been spent.

Background:

The Information Resources Act of 1991 changed the way the department's operating plan is developed. Information resources by definition are procedures, equipment and software that are designed, built, operated and maintained to collect, record, process, store, retrieve, display and transmit information, including associated personnel. Information resource expenditures that were previously reported outside the IS operating plan (e.g. traffic and radio equipment) are now included in the Biennial Operating Plan (BOP). Expenditures for radio and traffic management equipment were not considered in this analysis because they do not allow equitable comparison to industry figures. The historical IS expenditures used in this document are derived from the BOP with the following exclusions:

- All costs related to Research Projects, Private Branch Exchange, Key Systems, Traffic Data, Traffic Management, Lanser, Pave Data, Texas Mobile Load Simulator and Radio; and
- All cost related to Photogrammetry, Satellite Surveying, Aerial Photography, Field Salaries, Graphics Services, Process Controls and Equipment for use in the field.

Total Expenditures:

In fiscal year 1993, 1.9 percent of the total TxDOT expenditures was budgeted for information resources. This percentage increased to 2.3 percent for fiscal year 1994. TxDOT's ratio of total IS spending to total agency spending is less than the government organization ratio (4.3 percent) and slightly higher than the rail and bus transportation ratio (2.1 percent). Figure 2.24 illustrates TxDOT's IS spending to total agency spending ratio.

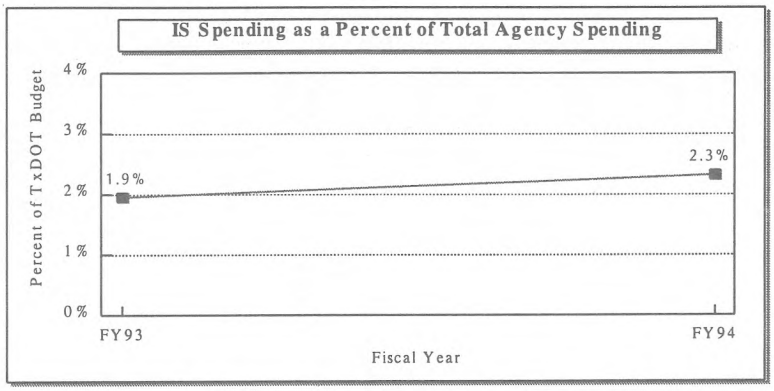


Figure 2.24 - IS Spending as a Percent of Total Agency Spending

The TxDOT IS budget increased from $55.9 million in fiscal year 1993 to $73.4 million in fiscal year 1994, which resulted in a 31.3 percent growth rate. This increase is mostly due to an

increase in expenditures in hardware/software maintenance and services.

Technology Expenditures:

Component	1993 (bud.)	1994 (est.)
Staff Salaries and Fringes	42.2%	35.5%
Services	8.8%	14.8%
Maintenance	24.1%	38.7%
Planned Procurements	21.5%	8.5%
Operating Supplies	0.6%	0.3%
Other	2.8%	2.1%

Figure 2.25 - TxDOT IS Budget by Category (1993 - 1994)

Figure 2.25 indicates TxDOT IS spending by category for fiscal years 1993-1994. Staff salaries, maintenance and planned procurements occupy the largest percentages of the total IS budget. Maintenance and service expenditures increase from fiscal year 1993 to 1994 while staff salaries and planned procurements decrease from fiscal year 1993 to 1994.

IS Staff Expenditures:

TxDOT IS staff has decreased from fiscal year 1993 to 1994. Figure 2.26 illustrates the percent of the TxDOT IS budget allocated to staff salaries. Although this component of the budget decreased in fiscal year 1994, it still occupies approximately 35.5 percent of the IS budget. This decrease is due to the loss of personnel to retirements and job turnover.

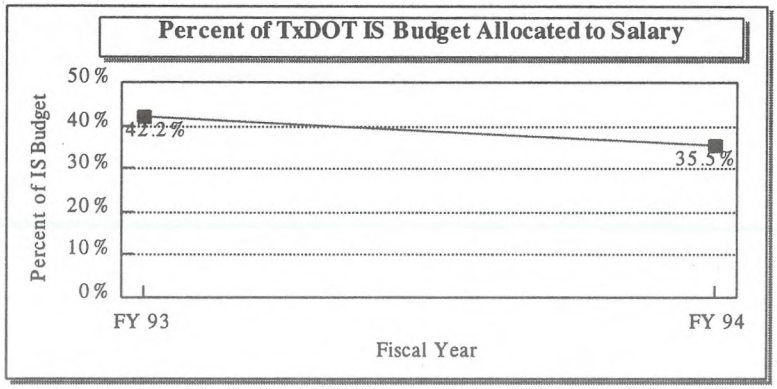


Figure 2.26 - Percent of TxDOT IS Budget Allocated to Salary

A Gartner Group survey indicates that IS managers are allocating personnel to those activities most directly linked to end-user needs and to fulfilling the organization's current and future information technology requirements. The survey also indicates that the functions that will benefit from staff increases over the next two years are development, database administration, education and training, help desks, end-user computing and research and development.

Education and Training Expenditures:

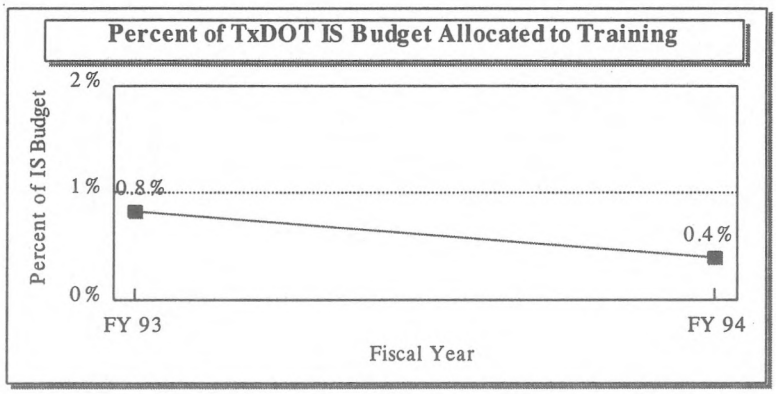


Figure 2.27 - Percent of TxDOT IS Budget Allocated to Training

Figure 2.27 illustrates the spending trends for TxDOT's training expenditures. These percentages do not include travel for training. These training percentages are approximately one-half or less of the budgets spent by other government organizations. This is partially due to education and training costs which are not reflected in the IS budget because districts and divisions allocate expenditures for IS training from their own operating budgets. Gartner Group research suggests that to develop and maintain the increasingly complex networked environments unfolding in most IS organizations, the typical organization will need to increase its spending on education

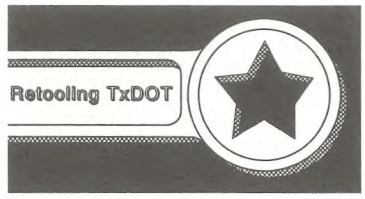
and training twofold to fourfold just to reach the minimum level of proficiency necessary to support these environments.

CHAPTER II

STRATEGIC ASSESSMENT AND DIRECTION

EXTERNAL ASSESSMENT

SECTION D



Texas Department of Transportation

Section D
External Assessment

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OVERVIEW:

This section provides an external perspective on the quality of TxDOT's information systems support relative to that of other transportation departments and significant information system trends which may impact TxDOT in the future.

Seven DOTs, including TxDOT, were surveyed to determine their effectiveness and efficiency at deploying IS strategies. The external DOTs surveyed are considered to be peers of TxDOT and thought to be leaders in business process reengineering and the utilization of technology as an enabler of change.

In addition, general and industry-specific trends were identified which may impact the way TxDOT conducts business. Identified trends will assist in the identification of the data, application, technology and organization migration approaches.

EXTERNAL DOT ASSESSMENT:

Overview:

Information Services Divisions from seven transportation departments were surveyed, including the Texas Department of Transportation (TxDOT), to gain an external perspective on TxDOT's quality of information systems support. The seven DOTs surveyed included Florida, Michigan, Minnesota, Oregon, Pennsylvania, Wisconsin and Texas.

The 16-page survey was divided into the following five sections:

- **Common Measures** - measured the general size of each DOT so that all respondents could be compared on an equal level. Size was measured in several different ways including number of employees, lane miles, services offered and total budget.

- **Application Portfolio Assessment** - evaluated the extent of computerization and the nature and quality of the applications planned and in place.

- **Data Portfolio Assessment** - evaluated the nature of the data systems, tools and standards planned and in place.

- **Technology Assessment** - evaluated the nature and extent of information technology employed, as well as future technology directions and strategies.

- **Resource Strategies Assessment** - evaluated the level of investment in information systems technology and the major components of that investment.

To determine the deployment levels of the application, data, technology and resource strategies for each DOT, a weighted scoring system was developed. A series of attributes was identified for each strategy, and scores were established for each possible answer. A weight factor was then assigned to each attribute based on its importance to the strategy. The strategy's deployment level was determined based on the score and the assigned weight of each attribute.

Although a significant amount of data was collected and analyzed, the following assessment highlights the major findings.

DOTs Surveyed:

The transportation departments selected to participate in this survey are considered to be peers of Texas and leaders in providing transportation services. In terms of total number of employees, Texas, at 15,000 employees, outnumbered Florida by 5,000, including 8,000 information system (IS) users vs. Florida's 5,000. Total operating budgets seemed to split logically into two tiers. Florida, Texas and Wisconsin fell within the top tier at $3 billion and Michigan, Minnesota, Oregon and Pennsylvania fell within the second tier at approximately $1.5 billion.

It is important to note that neither the Michigan DOT nor the Minnesota DOT offer motorist services. Otherwise, all of the other DOTs offer a full range of services including aviation, public transportation, permits, travel information and the operation of waterways, roads and roadside facilities.

Application Strategies:

The following attributes were considered in evaluating application strategies:

- Extent of automation
- Use of modern application development tools
- Percent time spent on maintenance vs. application development
- Extent of integration
- Average number of years required to develop new applications
- Current backlog
- Percent of applications which process transactions on-line (vs. batch)

- Percent of packaged software applications (vs. custom programmed applications)
- Average age of applications

This section was divided into four areas to more specifically assess the condition of the application portfolio of each key business service area. Business service areas included Transportation Planning and Development, Field Operations, Administrative Services and Motorist Services. A more detailed description of these business service areas is listed in Appendix 3.

Results: Overall, it appears that Texas falls in the middle of its peers when examining the ratio of applications executed on a mainframe versus a personal computer (PC). However, Figure 2.28 below indicates that Texas has the highest level of automation of any of the DOTs surveyed.

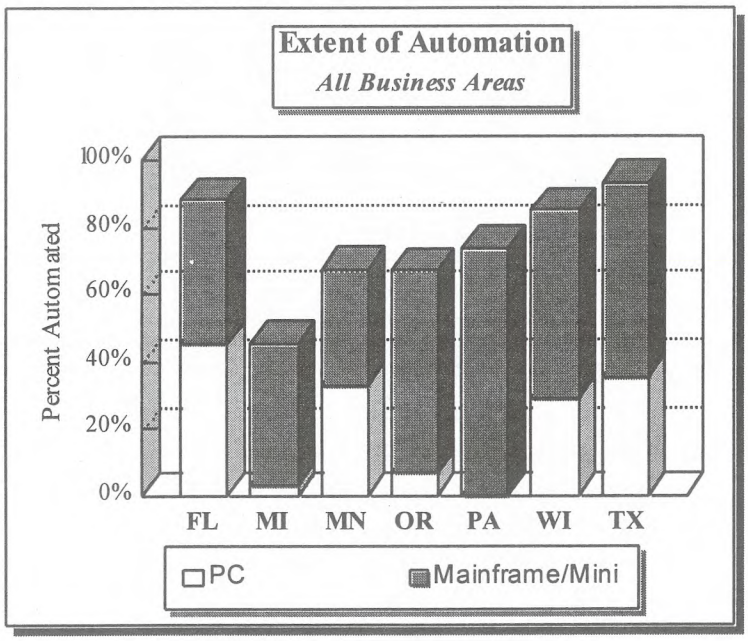


Figure 2.28 - Extent of Automation

The results also indicate that the use of package applications within the industry as a whole may be very low (20 percent). In fact, only Texas and Wisconsin are utilizing package applications for Motorists Services and Administrative Services, respectively. In addition, it appears that newer application technologies and development tools have had a relatively minor effect on the industry's aging legacy systems, as the average age of existing applications is currently over nine years.

With regard to application development time and development backlog, the results of

the survey indicate that Texas is behind its peers in both categories, requiring an average of four years to develop an application system while maintaining a development backlog of more than four years (see Figure 2.29). It is important to note that although Michigan's backlog is equally high, they have just implemented rapid application development (RAD), which has already driven the average development time to under a year and is expected to drive their backlog down as well.

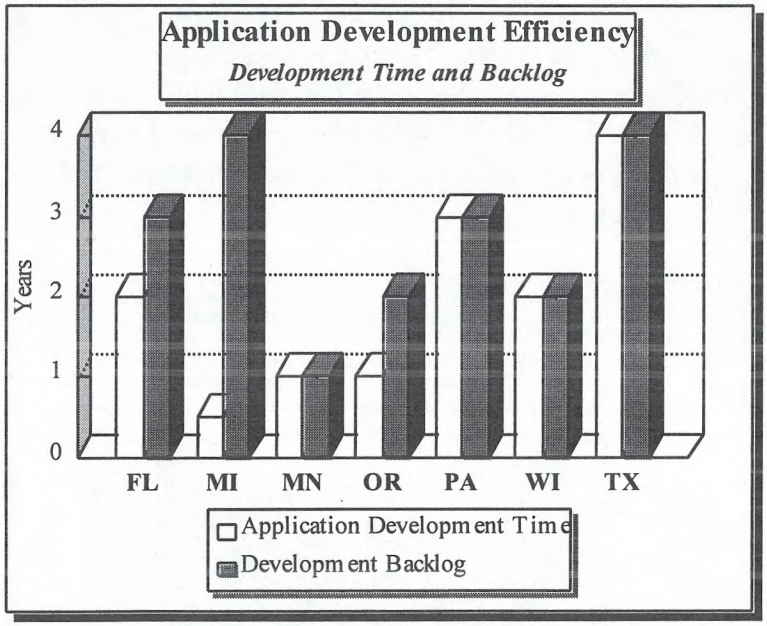


Figure 2.29 - Application Development Efficiency

Based on the attributes described above, it appears that Florida, Wisconsin and Texas are the most effective at deploying application strategies (see Figure 2.30). This is mainly due to the high level of automation and integration of applications and the utilization of modern technology such as on-line and package systems.

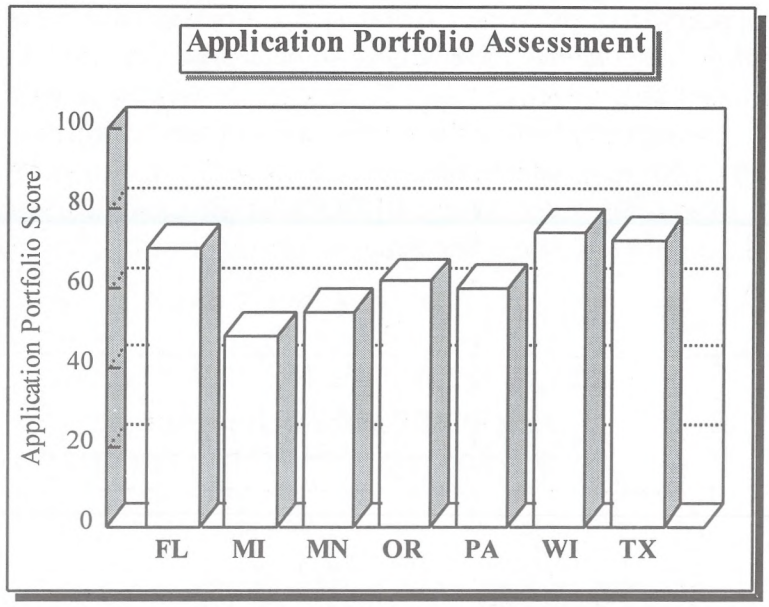


Figure 2.30 - Application Portfolio Assessment

Application Development Issues and Opportunities: Recurring themes emerged among IS administrators when asked to identify key issues and opportunities. Most prominent was the concern over the effects of ISTEA and the high volume of modifications to current application systems which will be necessary to meet the new legislation requirements.

Other commonly noted issues include implementing metrication and geographic information systems (GIS), migrating applications from mainframe technology to client/server, and decentralizing responsibility for specific applications to users while the IS department remains focused on department-wide systems.

Data Strategies:

The following attributes were considered in evaluating data strategies:

- Data managed as an asset
- Use of data modeling & development tools
- Employment of a database administrator
- Employment of a data administrator
- Extent of database integration
- Extent of database centralization

Results: It appears from the survey that data is not being managed as an asset, as almost half of the respondents have neither an enterprise data model nor utilize any type of automated data modeling tool. Texas has not utilized an enterprise data model in the past but is currently testing the functionality of the Information Engineering Facility (IEF) CASE tool, which includes data modeling and model management capabilities. In addition, even though all DOTs have formal database administrators, only half utilize a formal data administrator. Texas, however, has both but not at an enterprise level.

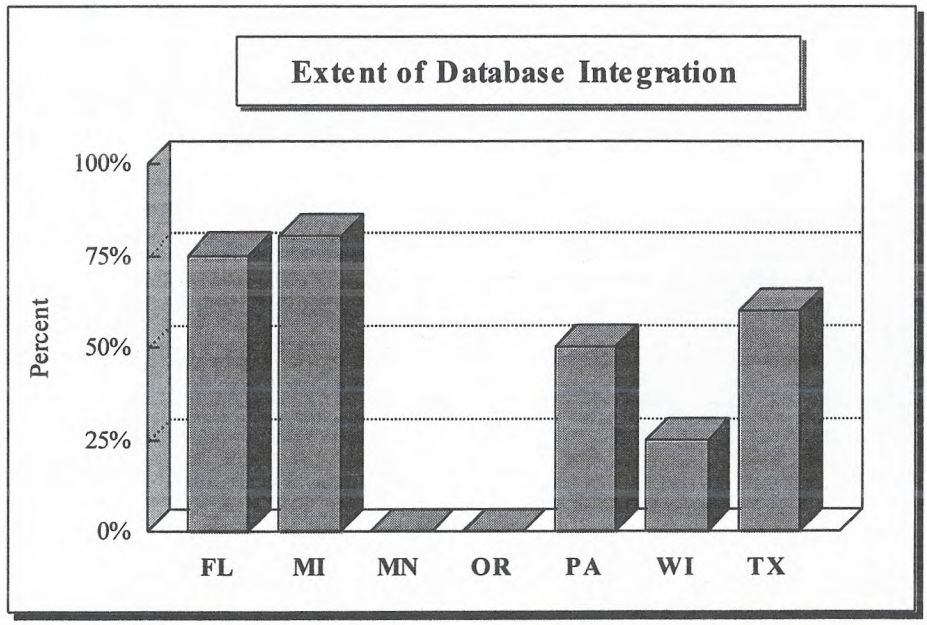


Figure 2.31 - Extent of Database Integration

As indicated from Figure 2.31 above, there are large variations in the perceived level of database integration between the respondents. Generally, Texas appears to be in the upper tier of departments providing integration among databases.

Overall, there seems to be a wide dispersion of effectiveness in the deployment of data strategies. As Figure 2.32 indicates, Texas ranks in the middle of its peers, having moderately integrated databases and utilizing modern data management tools, but leaves room for improvement due to the lack of an enterprise data model.

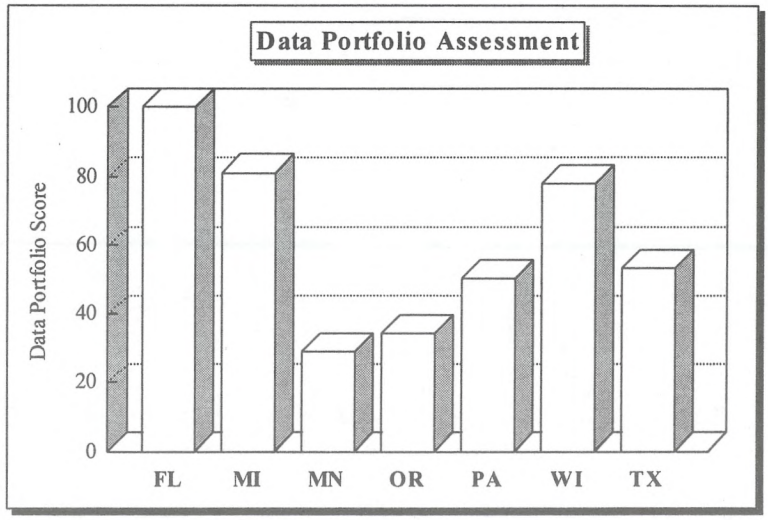


Figure 2.32 - Data Portfolio Assessment

Data Strategy Deployment Issues and Opportunities: Several issues were provided by the respondents with regard to the deployment of data strategies. Most commonly noted were the challenge of selecting adequate database software for a client/server environment and migrating existing databases from a centralized mainframe environment to a distributed environment.

Technology Strategies:

The following attributes were considered in evaluating technology strategies:

- Utilization of personal computers (PCs)
- Satisfaction with current technology
- Utilization of advanced technology
- Standardization or "openness" of hardware platforms

Results: As indicated by Figure 2.33 and Figure 2.34 on the following page, there has been tremendous growth in the use of microcomputer technology over the last several years. Texas has increased the utilization of PCs by 170 percent over the last four years, ranking above the average DOT rate of 150 percent. In addition, almost every DOT now has approximately one IS user per PC. These two facts indicate a significant trend toward decentralization of computing power to the user's desktop.

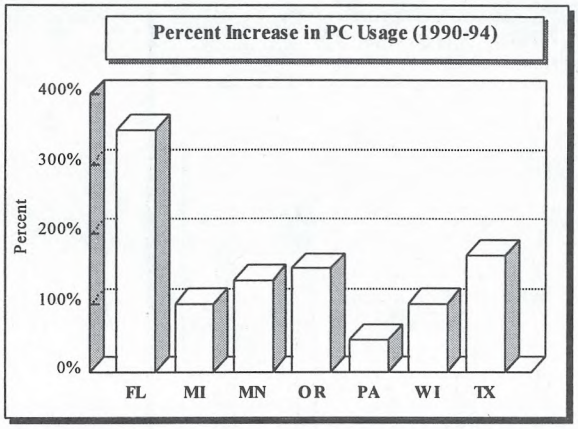


Figure 2.33 - Percent Increase PC Usage (1990-94)

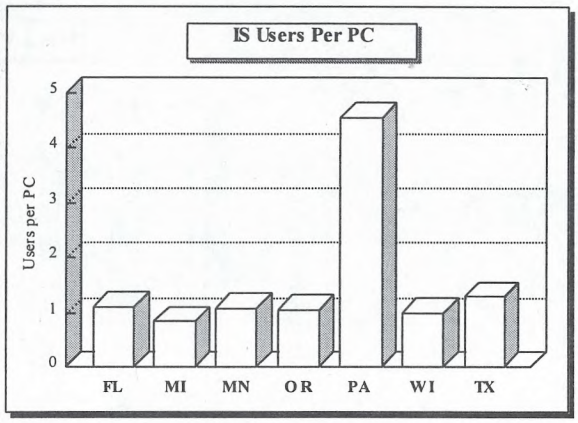


Figure 2.34 - IS Users Per PC

With respect to the level of satisfaction with the technology currently in place, almost every DOT indicated only a moderate level of satisfaction. This may be attributed to lower funding levels and a rapidly changing technology environment, resulting in IS never being able to fulfill its requirements.

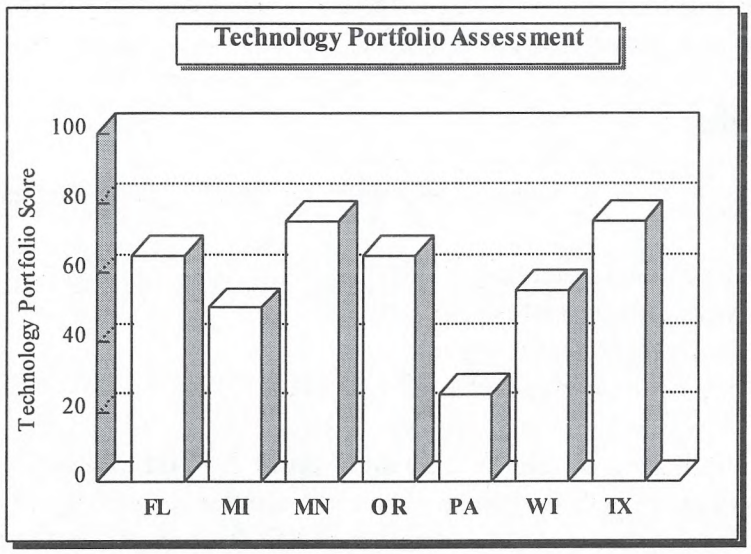


Figure 2.35 - Technology Portfolio Assessment

Overall, Texas and Minnesota appear to be the most effective at deploying technology strategies as indicated in Figure 2.35. Texas achieved a high score due to its extensive use of PCs and advanced technologies (e.g., GIS, bar coding, voice response, etc.), which appears to be consistent with the increased funding for hardware over the last several years.

Technology Strategy Deployment Issues and Opportunities: The following issues were identified by the respondents as challenges to the deployment of technology strategies:

- Technology is changing at a rapid pace, causing uncertainty and delays in the decision to procure and implement these technologies
- It is increasingly difficult to recruit and retain personnel trained in advanced technologies
- Conflict exists between technology standardization to minimize support efforts and non-standardization of technology to maximize user satisfaction and productivity

Resource Strategies:

The following attributes were considered in evaluating resource strategies:

- Managerial experience
- IS budget as a percent of DOT budget
- IS personnel turnover
- User satisfaction with IS support
- Non-IS personnel performing IS functions
- Strategic planning policies
- Growth in IS budget

Results: The survey shows that Texas and Oregon have the least managerial experience within their IS departments, with managers having an average of approximately seven years of experience. All other DOTs have IS managers with experience ranging from 10-20 years.

With respect to turnover within the IS department, rates varied widely between the respondents, with Florida incurring an average of 15 percent turnover per year down to 2 percent per year for Wisconsin. Texas falls in the middle of its peers with a turnover rate of 8 percent.

As indicated by Figure 2.36 on the following page, most IS budgets grew approximately 25 percent between 1991-93 (12.5 percent annually), including Texas, which is well above the industry average of 4 percent (*Industry Service,* Gartner Group, July 14, 1993). It is important to note, however, that Wisconsin's IS budget was cut in half over the same period.

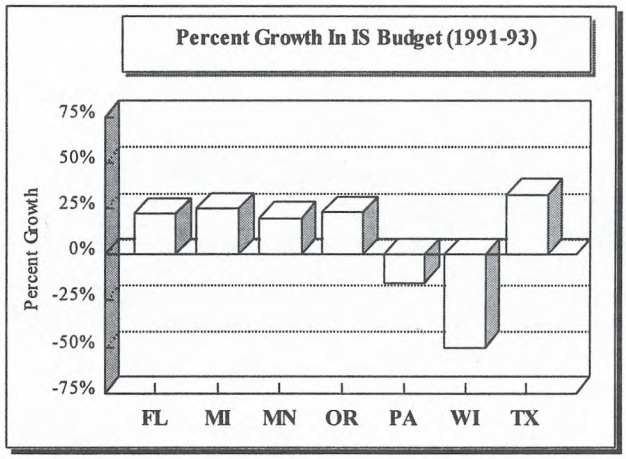


Figure 2.36 - Percent Growth In IS Budget

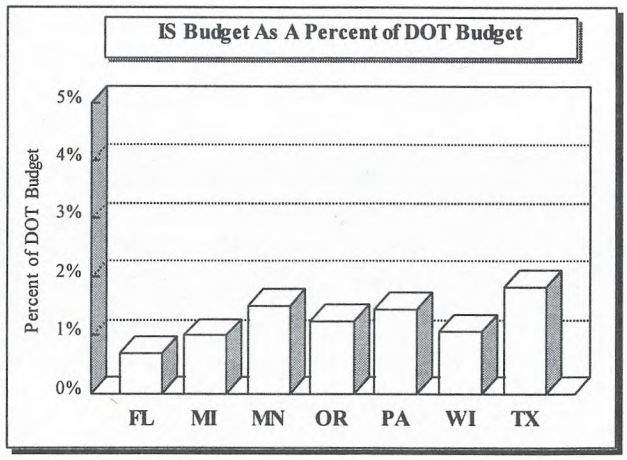


Figure 2.37 - IS Budget as a Percent of DOT

In addition, it appears that most of the respondents IS budgets, except Texas's, have been averaging 1 percent to 1.5 percent of the total DOT budget. As Figure 2.37 indicates, Texas's IS budget is almost 1.8 percent of the total budget. Although IS budgets have been growing at a rapid pace, the ratio of IS budget to total operating budget for every respondent still lags behind the government average of 4.3 percent (*Industry Service,* GartnerGroup, July 14, 1993).

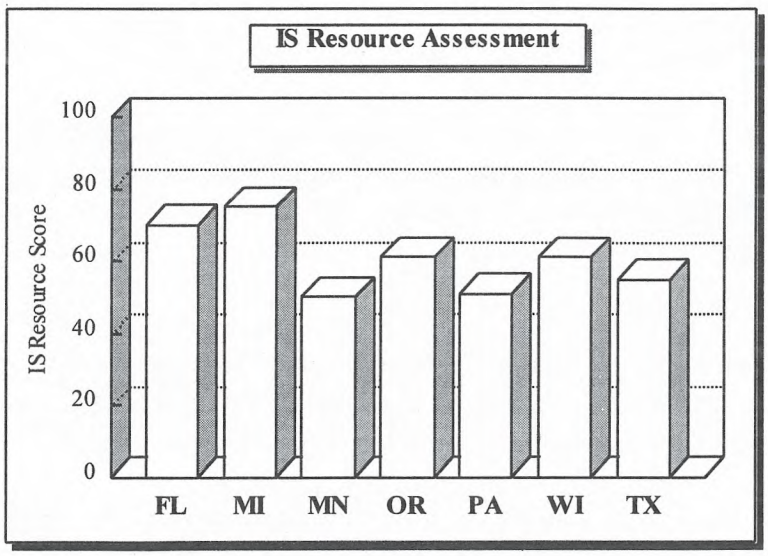


Figure 2.38 - IS Resource Assessment

Based on the attributes discussed in Figure 2.38, Texas appears to be in the bottom tier of its peers overall. Although Texas is experiencing strong growth in its IS budget, the lower resource score is due to the low level of satisfaction with IS support.

Resource Strategy Deployment Issues and Opportunities: Several issues were identified by the respondents as challenges to executing IS resource strategies, including:

- Budget limitations prohibit or limit DOT's ability to hire and retain the necessary skillsets
- Turnover of experienced personnel is high due to large salary discrepancies between the public and private sector
- Headcount is fixed and expected to be downsized - DOTs are increasingly resorting to contract staff and temporaries to overcome workload variances

Conclusion:

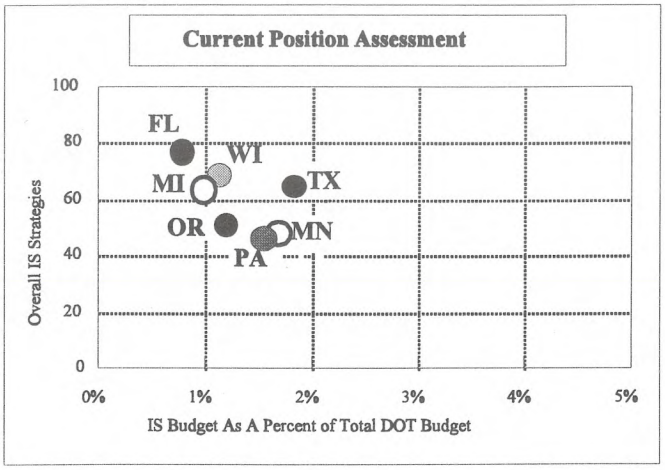


Figure 2.39 - Current Position Assessment

When considering the four areas of the evaluation (application, data, technology, IS resources) in total, Texas's "performance" ranks slightly above average as depicted in Figure 2.39. Texas seems highly effective in deploying the application and technology components, due to the higher level of automation and application integration; widespread use of PCs; and use of advanced technologies. Texas seems less effective, however, in managing the data and IS resource components, highlighted by the lack of an enterprise data model and the low level of satisfaction with both the current technology being utilized and the overall level of IS support.

It is important to note that although Texas ranked in the middle of its peers in deployment *effectiveness*, its IS budget, as a percent of the total operating budget, is approximately 50 percent higher than that of its peers. This may indicate that Texas is less *efficient* in delivering service to its customers.

INFORMATION SYSTEMS TRENDS:

Overview:

The Texas Department of Transportation faces many challenges in the deployment of information systems resources which effectively provide the support required to meet business objectives. The need for faster application development and an increasing need to share data between business areas is highlighted by the expanding backlog of application systems required by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and metrication conversions. These demands also come at a time when workloads are on the rise and the size and complexity of projects continues to grow.

Advancements in information technology and computing power have been increased by a factor of 10 every three years over the past decade. By the increases in processing speed and storage capacity and in the reduction of physical component size, these advancements are evident. In addition, several trends are changing the way Information Systems Departments are doing business, such as the decentralization of technology and constantly decreasing application development life cycles.

The effect of these advancements has been significant to business in general, but has been particularly high to departments of transportation where there is a heavy reliance on information technology. As a result, information technology is becoming an increasingly critical component in achieving the goals of the department. Refer to Appendix 3 for bibliography covering IS trends.

General Industry Trends:

An analysis of industry literature reveals business enterprises are employing new technologies to reduce the time required to develop applications and to support the changing needs of the agency or company. Among these trends are new application development tools and methods, growing IS budgets due to increased business requirements and decentralization through downsizing with client/server technology.

> ***Increasing IS Budgets:*** Research of large U.S. based enterprises reveals that IS budgets are averaging 5.5 percent of revenues in 1994 and are expected to increase to 8.3 percent by 1998. In addition, businesses which are undergoing business process reengineering (BPR) and decentralization resulting in downsizing and migration to client/server, are experiencing a shift in the component expenses of their IS budgets.
>
> Spending growth for centralized IS is down to 2 percent while spending for decentralized IS support is growing at a rate of 14 percent. The cost to decentralize

support is the fastest growing component of the IS budget, increasing at a rate of 26 percent. This is followed by spending for outsourced IS services, which was 12 percent in 1991, and is expected to be 18 percent by 1994.

Another interesting note is that, by 1998, it is estimated that 90 percent of new applications will require a mixture of skillsets not prevalent in today's application development organizations. This will have a significant impact on the TxDOT training budget for IS professional and support personnel.

Based on an analysis of companies committed to reengineering their organizations, TxDOT could experience significant IS budget growth to implement business process reengineering.

Decentralization: The trend toward decentralization is evolving through the migration of enterprise critical IS applications, data and support from a centralized mainframe environment to a decentralized environment. Driving this trend is the increasing availability of affordable computing power, speed, storage, connectivity and development tools. This trend is also being driven by users who see IS as too autonomous, too expensive, and out of touch with user needs.

It is estimated that by 1998, at least 60 percent of new applications will be built under the direction and control of business units. Centralized IS is expected to shift its role from sole application developer to facilitator and provider of infrastructure, architecture, specialty skills, technical support, training and enterprise data management.

Client/Server (C/S) Migration And Downsizing: In the simplest terms, downsizing by migrating from mainframe-based applications and data to microcomputer-based client/server applications is the movement of applications from a mainframe to a network of PCs where data and applications are distributed among the clients and the server. The trend to migrate application development and data is being driven by a two primary forces. First, client/server applications collectively have the potential to deliver more computing power and flexibility than a mainframe can alone. Additionally, capital outlays for client/server hardware and software and contract maintenance can be one-third to one-fifth mainframe costs for comparable performance.

Development tools for client/server applications are less complex and generally contain more features than tools available for mainframe application development. This factor alone has spawned a proliferation of applications development in organizations that have decentralized and moved the responsibility for business applications into business areas. This trend fosters an increasing need to institute uniform enterprise wide

architectures and methods, a distributed applications development support infrastructure, and new organizational roles and responsibilities.

Computer Aided Systems Engineering (CASE): While computerized automation of business processes has evolved over the last 30 years, only in the past five to seven years have computerized tools and methodologies evolved to facilitate the development of new systems.

Computer Aided Software Engineering (CASE) products are tools that provide automated graphics and analysis support for computer systems developers. These tools exist for virtually every phase of the systems development life cycle. The implementation of CASE technology offers data processing professionals a complete diagramming, analysis and reporting system to help automate the production of information systems.

It is expected that by 1998, at least 85 percent of applications development organizations will achieve portability and interoperability through ported proprietary fourth-generation languages (4GLs), cross-platform application generators, and CASE-driven generators, rather than through "open systems" standards. CASE tools affect application development in the following ways:

- Planning - Provide the capabilities to formally document and report business functions, organizational entities, critical success factors, applications and the relationships which can be defined among this data.

- Design Aids - Support capturing and documentation of system functional requirements, functional process descriptions, data descriptions, screen/report layouts and facilitate prototyping. These utilities will assist the development teams in communicating the functional specifications of an application early in the development cycle.

- Analysis Tools - Provide substantial analytical approaches to ensure the development of highly structured application designs.

- Database Tools - Provide a set of comprehensive facilities which support the design, development, prototyping and tuning of an integrated database management system.

- Programmer Productivity Aids - Automate the generation of computer program code.

- Testing - Provide a series of programs designed to supplement, enhance, audit and document the programming and systems test phases of a project.

- Documentation - Provide a comprehensive set of utilities which automate the documentation of the entire system.

DOT Specific Trends:

TxDOT has widespread geographical responsibilities and is accountable to customers ranging from the general public to the state Legislature. As access to additional data sources and telecommunications becomes increasingly important to TxDOT's customers, the need to assemble and quickly deliver the accurate business information they desire will become critical to satisfying their needs. The following technology solutions are examples of advanced information technology which may help meet these needs.

Document Management/Imaging Systems: Document management systems are composed of four fundamental ingredients: Workflow software, Scanning, Optical Character Recognition and Full Text Storage and Retrieval.

Workflow software: As a concept, work-flow is the sequence of activities that are performed in accordance with business processes. The latest versions of workflow software are highly intuitive, object-oriented programs which allow users to assign tasks to a series of work events, and trigger additional events based on the action taken by the worker. Workflow software tools enable employees to focus on the work, while the software takes care of the process.

Scanning: The second system ingredient allows workers to share images instead of paper documents and enables the same piece of information to be processed simultaneously rather than serially. Image files, however, contain no alphabetic or numeric information that applications can recognize.

Optical Character Recognition (OCR) Technology: Converts the information in an image to any format an application requires.

Full Text Storage and Retrieval: The rate that the above technologies can acquire and store information can create an information overload without *Full Text Storage and Retrieval* technology. This technology allows any document to be retrieved within seconds, no matter where it resides in the system.

Together, the document management/imaging processing technologies that compile a

document management system can be a "technology enabler" which supports business process reengineering. This technology can be used to build and maintain a central inventory of official documents and provide timely information that is consistent and accurate to employees and TxDOT customers alike. Existing TxDOT documents, as well as those of customers can be incorporated into a digital inventory and the business work flow with little or no key entry. The strategic benefits of an effective document management system include improved access to cross-functional data and a significant reduction in labor and communications costs.

Electronic Data Interchange (EDI): Electronic Data Interchange (EDI) is the electronic transfer of information from one system to another in a format understood by both systems. EDI allows for the rapid transfer of information and reduces paperwork, processing time and the number of errors associated with key entry. EDI brings a significant advantage to any enterprise where information timing and accuracy is a critical asset.

Three primary issues have generally slowed the implementation of EDI in state government and particularly at TxDOT:

- It is difficult to get approval for the implementation of a technology solution to a business problem which has little or no known statewide benefit. One reason for this difficulty is the significant backlog of prioritized projects which do address statewide needs.

- It is difficult to rationalize the payback time for this type of investment in the absence of well-documented statewide needs.

- State agencies lack the procurement flexibility that is inherent in private industry. Companies, often by virtue of long-standing contractual agreements, can persuade vendor and contractual partners to implement EDI.

Although TxDOT faces these challenges, the use of its distributed inventory of microcomputer technology and potential partnerships with other government agencies, utility companies and businesses which depend on TxDOT to provide services offers a unique opportunity to realize the benefits offered by EDI. Examples of relationships which require mail or personal visits and may benefit from EDI include utility and access permits, map sales, public hearing documentation, environmental impact studies and Texas Highways subscriptions.

Geographical Information Systems (GIS) And Global Positioning Systems (GPS): Geographical Information Systems (GIS) are becoming increasingly critical for

application developers and users who need a Graphical User Interface (GUI) for applications which deal with location sensitive information. GIS applications and Global Positioning Systems (GPS) which use satellites to acquire topographical data, combined with the much greater speed and storage capacity of today's equipment, promise a significant reduction in the cost of three-dimensional geographical data.

GPS technology, which now provides five-meter accuracy at highway speeds, can reduce the costs of capturing bulk geographical data which is fundamental to GIS applications and system components. Another GIS enabling technology is dynamic segmentation. Dynamic segmentation provides the tools to analyze segments of an entire transportation network by database queries on two or more geographical attributes. These attributes may include combinations of land use, parcel data, transportation system class, jurisdictional boundaries, environmental zones, traffic data and other information which describes the associated topography.

GIS technology is being pursued in several state DOTs to integrate individual pavement evaluation systems, safety, traffic management systems, and statistical data regarding the locations of accidents, speed limits, maintenance locations, and transportation facilities into a single Transportation Management System.

Using GIS to integrate geographical coordinates with engineering and business data can streamline the analysis of event "causes" and event "affects." The ease with which planners can view GIS topographical features in color can reduce the time for planning and increase its value. GIS visualizations of data also enable planners to see trends and identify problems much earlier.

Intelligent Transportation System *(ITS):* ITS is composed of a number of technologies, including information processing, communications, control and electronics. Joining these technologies to our transportation system can save lives, time and money by improving safety, reducing congestion, enhancing mobility, minimizing environmental impact, saving energy and promoting economic productivity.

First-generation ITS systems generally:

- Collect and transmit dynamic information on traffic conditions and transit schedules for travelers, whether they are at home, in the office or en route.

- Expand the capacity of highways by reducing the number of traffic incidents, clearing them more quickly when they occur, rerouting traffic around them, and automatically collecting tolls.

- Improve the productivity of commercial, transit and public safety fleets by using automated tracking and dispatch systems that dynamically reroute vehicles to accommodate changes in customer needs.

- Help drivers in reaching a desired destination with navigation systems enhanced with pathfinding or route guidance.

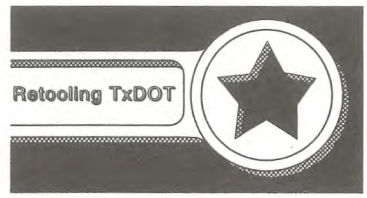
Planned research and development promises even more advanced products and services such as collision avoidance systems, in-vehicle display of road and congestion information including curves, speed limits and construction projects. Research projects underway include guidance systems to automatically provide direction to shortest or quickest routes; enhanced vision systems to improve safety during darkness or dusty conditions; and systems that automatically weigh trucks and identify them as they pass state and international borders.

CHAPTER II

STRATEGIC ASSESSMENT AND DIRECTION

INFORMATION RESOURCE MANAGEMENT

SECTION E



Texas Department of Transportation

Section E
Information Resource Management

OVERVIEW:

Reviewing the current Information Systems (IS)/Information Resources (IR) organization and management approach enables TxDOT to begin migration development for a new approach. In order to develop an IS/IR structure which will meet the requirements of TxDOT, the IR organization structure, roles and responsibilities were reviewed. In addition, workshops were conducted with IS/IR Management to define the Information Resources mission, vision, goals and critical success factors.

IS ORGANIZATION AND MANAGEMENT:

Responsibility for the department's information resources is distributed among three organizations:

- Information Resources Management (IRM) Office
- Information Systems Division (ISD)
- District/Division/Special Office Automation Administration (AA) sections

The roles and responsibilities of each organization are described below.

Information Resource Management Office:

The Information Resource Management Office is responsible for the development of information resource strategic directions. The Information Systems Division supports the strategic directions for information resources through the development of plans, policies and procedures and the associated implementation. Other information resource directions relevant to Traffic Management are implemented by the Traffic Operations Division.

The Information Resource Manager is responsible for reviewing the Biennial Operating Plan and is TxDOT's liaison to the Department of Information Resources. The IRM office also works to improve TxDOT business processes through Retooling TxDOT in accordance with Senior Management Team direction and timeframes. TxDOT's Executive Information System (TExIS) is sponsored by the IRM Office to provide executive information to the Executive Director and the Senior Management Team.

Information Systems Division:

The Information Systems Division (ISD) develops policies and procedures for the implementation of automation in all functions of the department. ISD also ensures that the department's information resources are secured from unauthorized access and abuse and coordinates telecommunications services statewide. In February 1994, the Information Systems Division was organizationally re-structured to facilitate improved coordination and customer service. The major organizations of the division are:

- Operating Systems and Telecommunications
- Information Resource Planning, Security and Quality Assurance
- Administrative Support
- Systems Coordination and User Support
- Engineering and Survey Systems
- Business Systems Development and Support.

The Operating Systems and Telecommunications section is responsible for the development and support of the department's operating systems, wide-area network and voice telecommunications. This section also operates the central computer and provides capacity planning and management of the computer resources.

The Information Resource Planning, Security and Quality Assurance section develops, maintains and monitors the department's Biennial Operating Plan (BOP) for Information Resources and the department's Contingency Plan. This section also provides automated information security and integrity, and quality assurance.

The Administrative Support section provides internal support for ISD personnel. Support services include human resources, procurement, fiscal services, graphics and information systems support.

The Systems Coordination and User Support section provides support for all automation users. Support is provided for engineering applications and graphics, Management Information Systems and microcomputer development.

The Engineering and Survey Systems section coordinates all engineering/surveying related functions, including engineering research, development, and administration, GPS/Satellite technology, and photogrammetry.

The Business Systems Development and Support section develops and maintains business, transportation, and registration and title applications. The data administration, database management, methodology support and development support functions are also performed in

this section.

District/Division/Special Office Automation Administration:

There is an Automation Administrator in every district and division to act as a direct liaison between the district/division and the Information Systems Division and the Information Resource Management Office. The Special Offices are supported by Resident Analysts. The following is a brief list of Automation Administrator responsibilities:

- Ensures effective allocation and utilization of hardware and software resources
- Recommends, develops and implements district/division policies and procedures regarding information resources
- Provides support to mainframe, PC and graphics end users
- Provides informal training for a variety of information resource systems
- Performs local-area network (LAN) administration
- Ensures compliance with data security policies

In a typical automation staff, the Automation Administrator is assisted by a security administrator, microcomputer advisor, graphics coordinator and programming and support personnel.

IR MISSION:

To enable the department to provide effective operations and continuously improve through the timely application, implementation and support of well-developed information resources.

IR VISION STATEMENT:

We envision providing our customers, the people of Texas and our employees, information resource capabilities that promote cost-effective and efficient information sharing and provide information that is relevant, accurate, timely and easily available.

IR GOALS:

1. **Establish an infrastructure which will support the implementation of the Business Information and Systems Plan.**

    - Adopt an investment strategy which encourages the replacement of antiquated technology.
    - Implement the necessary tool sets to provide rapid automation delivery capabilities.
    - Implement the necessary tool sets to ensure user-friendly access to information by our customers.
    - Establish a mechanism which provides for the proactive communication of unique technology needs to industry leaders.
    - Adopt an operating philosophy which encourages a technology leadership position.
    - Establish procedures and implement technologies which ensure an effective coordination of shareable resources.
    - Adopt and apply standards and guidelines to ensure necessary interoperability and connectivity among the department and governmental entities.
    - Establish an organizational infrastructure that supports the implementation of the Business Information and Systems Plan.

2. **Partner with our customers to meet department business needs.**

    - Maintain a planning process which facilitates the alignment between the business and the information resource strategies.
    - Make effective, coordinated use of shareable information resources.
    - Improve the responsiveness and coordination of application delivery.
    - Provide information to customers which is relevant, accurate and timely in support of business and business decision making .
    - Maintain centralized coordination of the information resources infrastructure.
    - Establish decentralized procurement procedures for information resources.

3. **Establish an Information Resources environment which is effective in meeting information needs.**

    - Provide for the privacy and security of information resource capabilities.
    - Recruit and retain diversified, qualified information resources personnel.
    - Adopt an application delivery approach which considers a "buy (versus build) decision".
    - Provide the required education to all information resource providers to

adequately support the implementation of the Business Information and Systems Plan.

- Provide for the continuous availability of information resource capabilities.
- Educate all information resource users in the appropriate use of information resources.
- Provide an effective means for communicating changing business needs.

Information Resources Critical Success Factors:

Critical success factors are those operating characteristics which must be an integral part of all activities of an organization. Through a series of interviews with ISD, IR management and the Deputy Executive Director of Administrative Services, the following areas were identified as critical to the success of information services delivery at TxDOT.

Efficiency: Improving the application development lifecycle, improving the speed and efficiency of the procurement process and improving the accuracy and efficiency of the project planning process are examples of management efficiency issues. Overall efficiency within the department has been identified as a major factor in the future success of the department.

Education: The rapidly decreasing lifecycle of new technologies combined with the department's desire to identify and implement emerging technologies will require improvement in the delivery of staff and user technology training. It will be critical for management, IS staff and employees to be willing to accept and learn new technologies as they become available.

Products: For IS to be successful, timely delivery of quality products will be critical. To improve quality of IS products and services, they must meet business requirements and respond to business needs while the need still exists. Examining all alternatives available for product delivery, such as package solutions should become part of the standard product delivery strategy.

People: The retention of qualified IS professionals, and their career development, will be critical to the future success of the department. Managing staff turnover, increasing career opportunities and providing a challenging work environment will be crucial to retaining staff.

Communication: An important aspect of each critical success factor is communication. IS management recognizes that improving communications between users, management and IS staff is a key element in delivering IS services. Communication includes informing all interested parties when decisions are made regarding projects and

technology direction.

Responsibility: Increasing the accountability among the various parties involved in managing IS service delivery and the recipients of IS services will be critical to long-term success. This includes establishing common priorities among management, users and IS. In addition, the correct parties must take responsibility for projects from inception to completion.

Research: Continual research and evaluation of new technology based on legitimate business needs will be necessary in order to efficiently take advantage of new technologies where appropriate.

Environment: Creation of a computing environment which promotes cross platform migration, uniformity in the development environment, and establishment of a comprehensive technology infrastructure will be necessary. Controlling the proliferation of new technology and tools will be an important aspect of creating an improved computing environment.

ISD SKILLSET ASSESSMENT:

Given the department's success in information resources, particularly its proficiency at mainframe application development and support, it is obvious that ISD possesses a wide range of development, maintenance, telecommunication, database and support skills. However, as the department shifts away from the mainframe platform and implements new technologies, different skillsets will be required. A Skillset Survey was used to assess the current and optimal level of information technology skills expected to be predominant over the next few years. This assessment addresses only the skills of the ISD personnel and is based on responses from ISD staff.

Overall, there is a gap between current and optimal level for every skillset category, indicating the need and desire to improve all IS skills. Although there is room for improvement, the current skill level was evaluated to be close to the optimal level for the following skills:

- PC Support
- LAN/WAN Support
- Methodology Support
- End-user Support - applications

Since the following methods and technologies have not been fully implemented at ISD, there is a large discrepancy between the existing and desired skill level for these skillsets:

- Rapid Application Development
- Distributed Processing Design
- Object Oriented Programming
- Client/Server Design/Development
- Platform/Systems Integration
- Relational Database Design
- GIS
- Document Management

These skills will be critical for the implementation of new technologies and the development of more functional, easier-to-use applications. On-going training will need to be provided to IS personnel to change from the current development environment.

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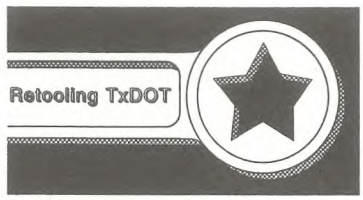
CHAPTER III

ENTERPRISE BUSINESS MODEL

BUSINESS INFORMATION AND SYSTEMS PLAN



Texas Department of Transportation

Chapter III - Enterprise Business Model

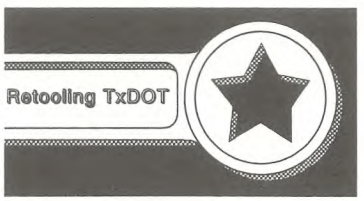
NOTES

CHAPTER III

ENTERPRISE BUSINESS MODEL

BUSINESS MODEL DEVELOPMENT AND PURPOSE

SECTION A



Texas Department of Transportation

Section A
Business Model Purpose and Development

OVERVIEW:

The business model provides a recognizable and accurate depiction of what the department does to deliver products and services to its customers. The business model is developed for the future (not the present) by defining what *should* be done to accomplish delivery of products and services. TxDOT's strategic plan is an essential component to assure appropriate direction for the model and consistency with departmental mission, vision, goals and objectives.

The TxDOT business model represents *what* the department does; the *actions,* or activities are the focus. Business models are not organization charts. Organization charts depict *who* is responsible for functions. Business models depict the processes and activities involved in performing functions. The processes and activities are grouped into business areas and functional areas (see Figure 3.1).

Business Model	A representation of the actions performed in the course of conducting business.
Functional Area	The highest level of action in the business model. Consists of a set of business areas (e.g., Operations, Business Services).
Business Area	A set of logically-related business processes, usually directed towards a common result or set of results (e.g., Determine and Analyze Transportation Needs).
Business Process	A set of activities that are performed continuously and produce one or more major outputs (e.g., evaluate current and future system conditions).
Activity	The lowest level of action in the business model. Detailed descriptions of work performed within the business process (e.g., evaluate the level

Figure 3.1 - Hierarchy of Business Model Terms

The model includes definitions and information requirements for each business area and process. Information requirements are reflected by *inputs* and *outputs*. Inputs are pieces of information that are necessary to perform the process. Outputs are the results and/or products of the process. The model shows dependencies between business areas by shared inputs and outputs (see Figure 3.2).

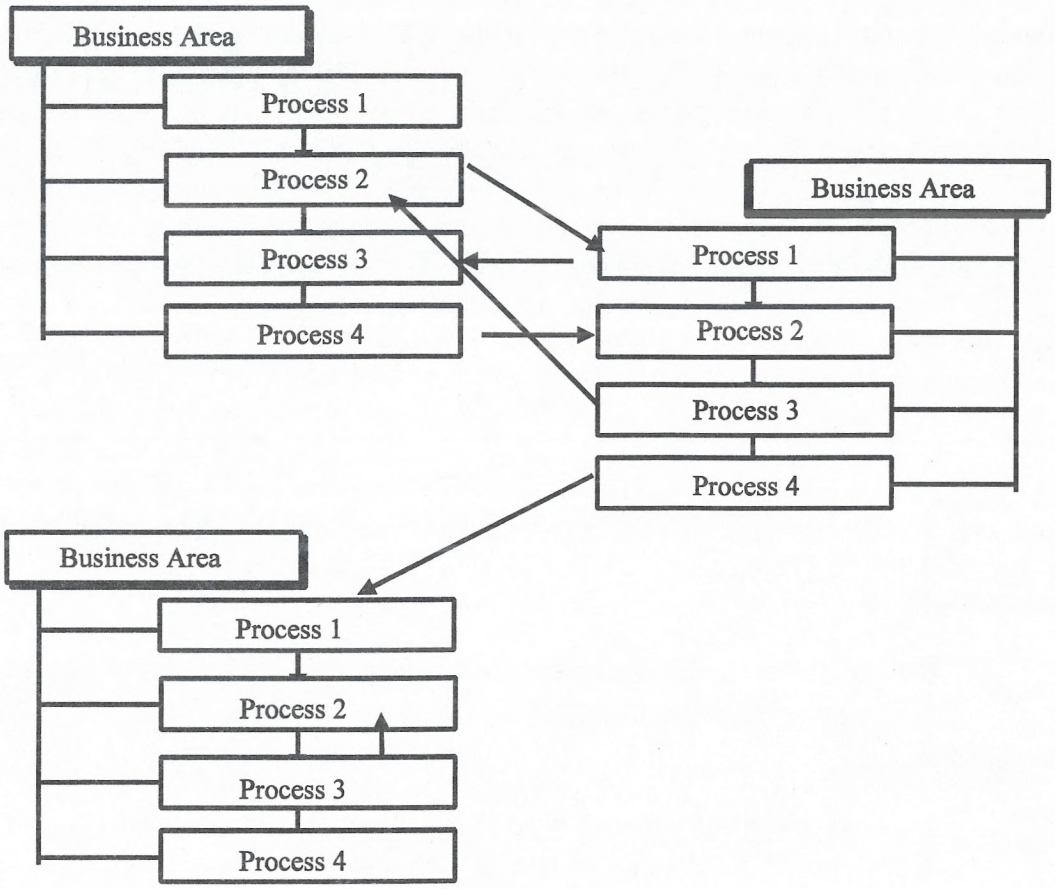


Figure 3.2 - Information Flows Between Business Areas

MODEL USE AND DEVELOPMENT:

How the model can be used:

Business Process Improvement: By comparing the model to current operations, process improvements can be readily identified. Process improvements can be simple improvements to increase efficiency or major revisions in the way we do business. Depending on the ease of transition from the current process to a future one, some improvements can be identified as "quick fixes" for the organization. Other potential improvements will require additional analysis before implementation.

Impact assessment: Recommended process improvements can be tested within the model, allowing assessment of efficiency and time savings for the involved organization units. For example, if an improved process reduces the amount of time required to perform the activity from 23 days to nine, the impact on the organization can be estimated.

Compare to strategic direction: Comparison of processes to the strategic direction can identify process improvements to better achieve strategic goals and objectives.

Strategic planning for information systems: The business model defines not only the processes, but the information that is necessary to perform processes. Technology, including information systems, can be planned and developed to effectively provide support for the business.

Development of the model:

Several preliminary models were developed by the Retooling business analyst team. Models from other states and previous TxDOT business studies were reviewed for potential business areas. Retooling coordinators (department employees assigned from each district, division and special office) refined the business model in a preliminary workshop.

To develop the final business model, facilitated workshops were conducted with the following objectives:

Develop a detailed business model representing the actions that TxDOT performs in the course of conducting business.

Collect business improvement ideas providing the basis for improving business processes.

Collect information systems improvement ideas providing the basis for developing information systems (IS) strategies and architectures.

Business modeling workshops included participation of 80 employees from districts, divisions and special offices. Each workshop was limited to eight participants. However, an additional 97 employees reviewed workshop results. All participants had expertise in the subject matter of the workshop. In several workshops, external partners to TxDOT were invited to participate either within the workshop or by reviewing workshop results. Workshop topics were defined by the preliminary workshop and draft business areas.

Workshop participants were charged with identifying processes (including inputs and outputs) and business process and information system improvement opportunities. Because workshop participants focused on the actions of TxDOT, organizational boundaries and current business practices did not constrain participants and did not influence the results of the workshops.

Reconciliation of the model was necessary to eliminate overlaps and avoid gaps between business areas and processes. The business analyst team identified the overlaps and gaps that developed because workshops were conducted independently (and often, concurrently) by business area. Focus groups made up of several workshop participants reviewed the major changes to the model that were necessary to clarify and refine the business areas and processes.

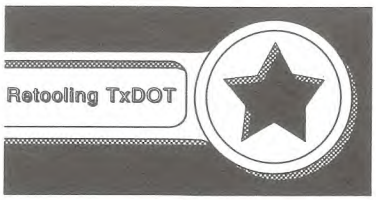
Retooling coordinators, the TxDOT Management Team and business modeling workshop participants reviewed the final business model. All comments and suggestions were placed with the project files. These comments, suggestions and workshop results will be considered in upcoming analyses of the business areas.

CHAPTER III

ENTERPRISE BUSINESS MODEL

THE TXDOT BUSINESS MODEL

SECTION B



Texas Department of Transportation

Section B
The TxDOT Business Model

●●●●●●●●●●●●●●

OVERVIEW:

The TxDOT business model is described by processes that depict what the department does. *Business areas* group processes by related products and services delivered to TxDOT customers. *Functional areas* in turn group business areas into larger categories of related products and services. Most organizations (including TxDOT) have processes and activities that fall into three categories or *functional areas*:

Management:	related to direction for the entire organization
Operations:	related to the product or service life cycle
Business Services:	necessary activities to support management and operations

Figure 3.3 below represents the fourteen business areas that form the TxDOT business model within the previously described functional areas. Each functional area will be presented with the accompanying business areas and processes in the following discussion. In Appendix 5, each business area and process is presented in more detail with sample activities, inputs and outputs. These samples are provided to help clarify the scope of each business process.

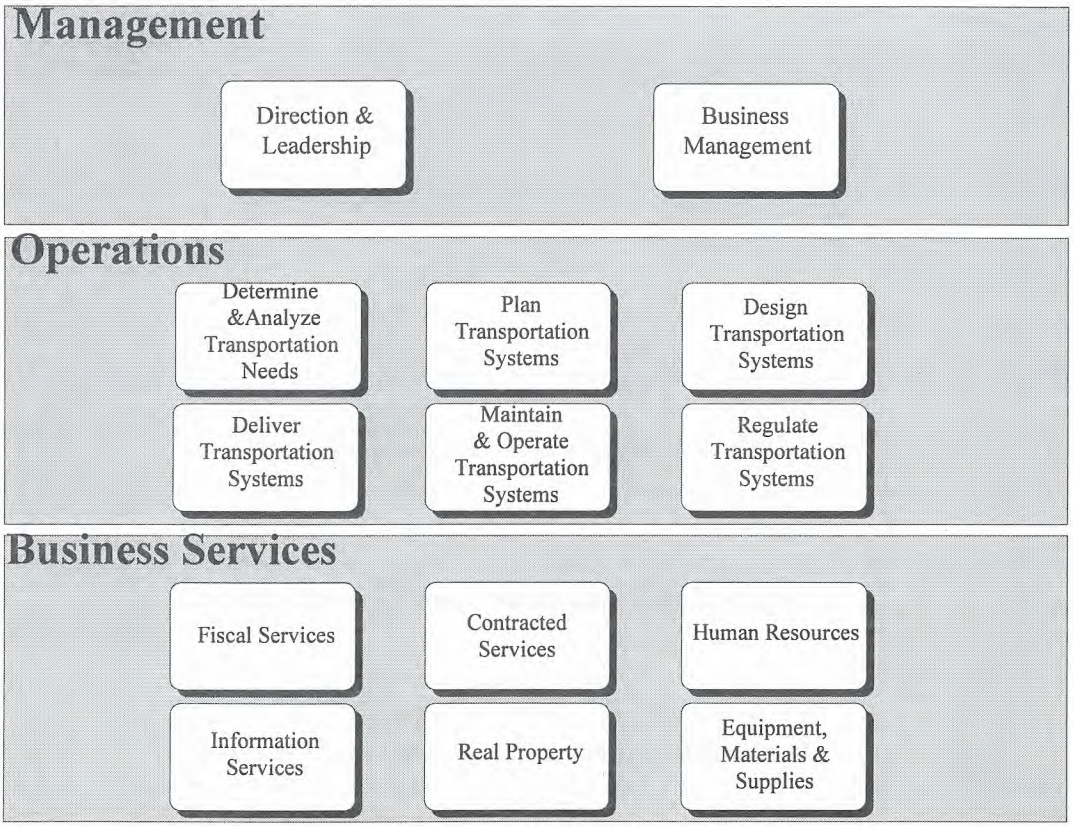


Figure 3.3 - The TxDOT Business Model

Closer observation of the business model indicates that each business area involves multiple organizational units. By reviewing the sample activities, inputs and outputs in Appendix 5 for each process, all TxDOT organizational units can be identified as participants in various parts of the model. No one process or activity belongs exclusively to only one part of the organization. To deliver products and services to TxDOT customers, everyone in the organization must contribute. The model only represents what must happen, not who.

For example, maintenance office activities are described in the following business areas: Determine and Analyze Transportation Needs, Deliver Transportation Systems, Maintain and Operate Transportation Systems and Regulate Transportation Systems. Maintenance office participation can also be observed in other business areas, including those in the Management and Business Services functional areas. This concept is important because it demonstrates the

model as a working picture of the services provided by the department, not the organizational chart.

MANAGEMENT FUNCTIONAL AREA:

It is important to realize the distinction between the management functional area and the management of the organization. Management *for the organization* establishes hierarchy ("chain of command"). The management *functional area* encompasses the processes necessary to provide direction for other business areas and processes within the model. Direction, guidance and coordination for and evaluation of the organization as a whole are the result of processes within this functional area.

Two business areas have been defined, Direction and Leadership and Business Management. The functional area, business areas and processes were developed based on workshop results for the Operations and Business Services functional areas. It is anticipated that the business areas will be refined through further analysis because these areas were defined without the benefit of workshops. The management functional area with two business areas is represented in Figure 3.4 below.

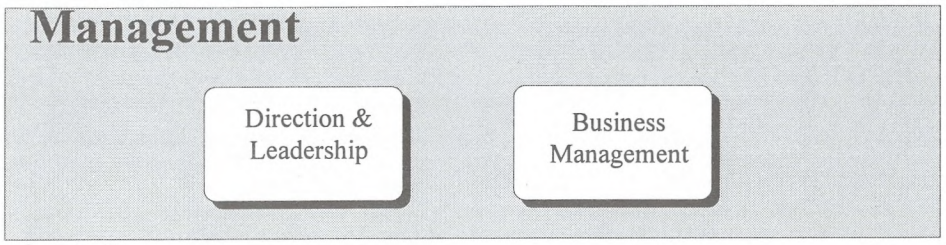


Figure 3.4 - Management Functional Area

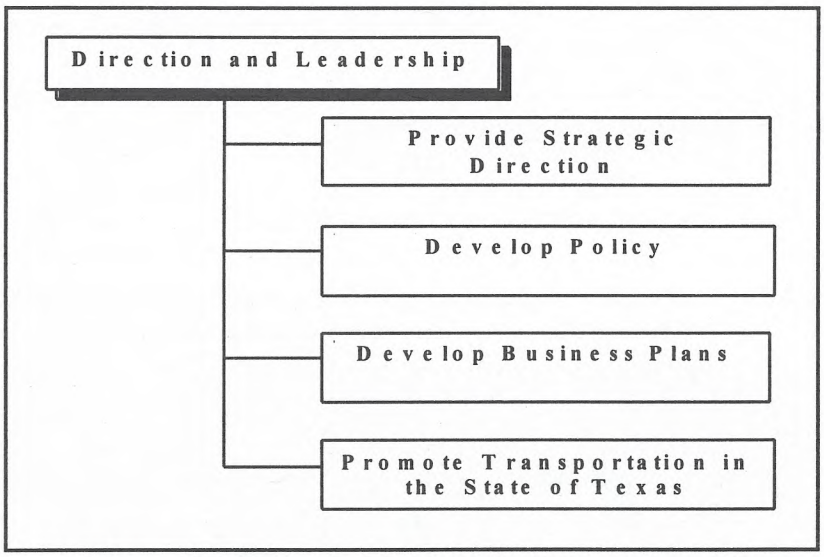


Figure 3.5 - Processes within the "Direction and Leadership" Business Area

Direction & Leadership: Establishes the strategic direction for the department and its operations and includes producing business plans to achieve this direction (see Figure 3.5).

It is important to remember that all segments of the organization, not just upper management, are responsible for carrying out activities within this business area. This business area is composed of four processes.

> ***Provide Strategic Direction:*** Sets the future direction, mission and goals for the department and establishes strategies for achieving them.
>
> ***Develop Policy:*** Provides for internal leadership by establishing mandates which department offices are to follow when conducting their business.
>
> ***Develop Business Plans:*** Produces operating plans that enable the department to reach its strategic mission, goals and objectives.
>
> ***Promote Transportation in the State of Texas:*** Provides a proactive look at marketing the different products and services available to individuals and businesses using the transportation systems to move either people or goods.

Note that business plans include resource plans (financial, personnel, equipment and information and systems plans), communications plans, marketing plans, etc. These plans are tactical in nature, as opposed to the strategic plan.

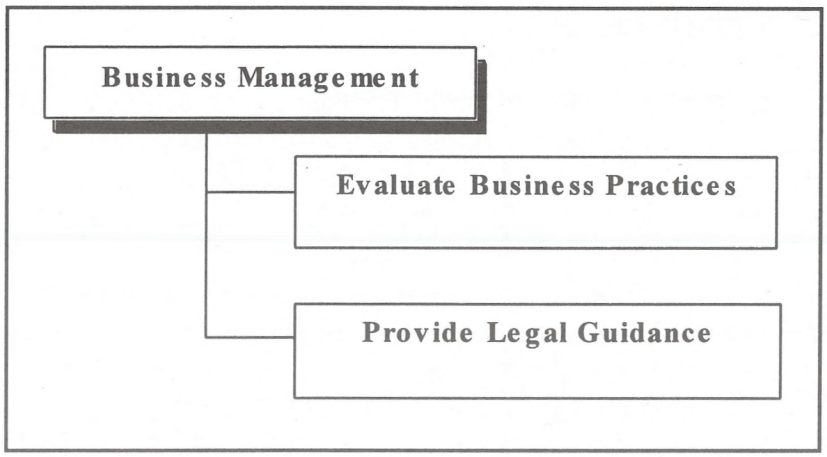


Figure 3.6 - Processes within the "Business Management" Business Area

Business Management: Oversees department operations by reviewing, evaluating and recommending actions to improve the way the department does business (see Figure 3.6).

The effectiveness and performance monitoring of the business plans would be carried out within this business area. Two processes make up this business area:

Evaluate Business Practices: Evaluates the way the department conducts business and recommends business improvements or courses of action to ensure compliance with policies and legislation.

Provide Legal Guidance: Provides for legal advice when performing department responsibilities and operations.

OPERATIONS FUNCTIONAL AREA:

The product or service life cycle is often described in business models by an operations functional area. The business areas and processes described within the operations functional area are those which plan, develop, produce and maintain the products and services unique to TxDOT.

Within TxDOT, most organization units perform activities in more than one business area. In contrast, no one organization unit is singularly responsible for a particular business area. The processes and activities within the business model include the actions performed by department personnel or by external entities with oversight by department personnel.

Note that "transportation systems" is a common term to all six business areas. All modes of transportation are included in this term. Another assumption throughout the model is that actions reflected in the model comprehensively address the delivery of all TxDOT products and services. In some areas, such as public transportation and aviation, TxDOT's role is not as direct in the delivery of services. TxDOT is, however, responsible to assure that the services are delivered, so the model has been customized to accommodate those roles. The operations functional area with six business areas is represented in Figure 3.7 below.

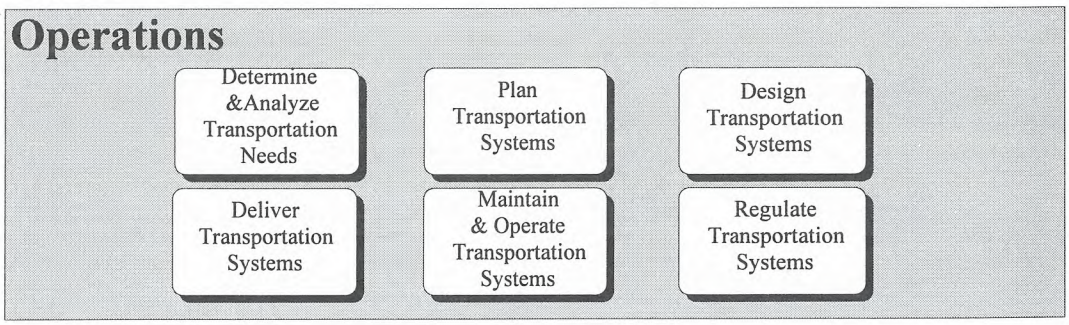


Figure 3.7 - Operations Functional Area

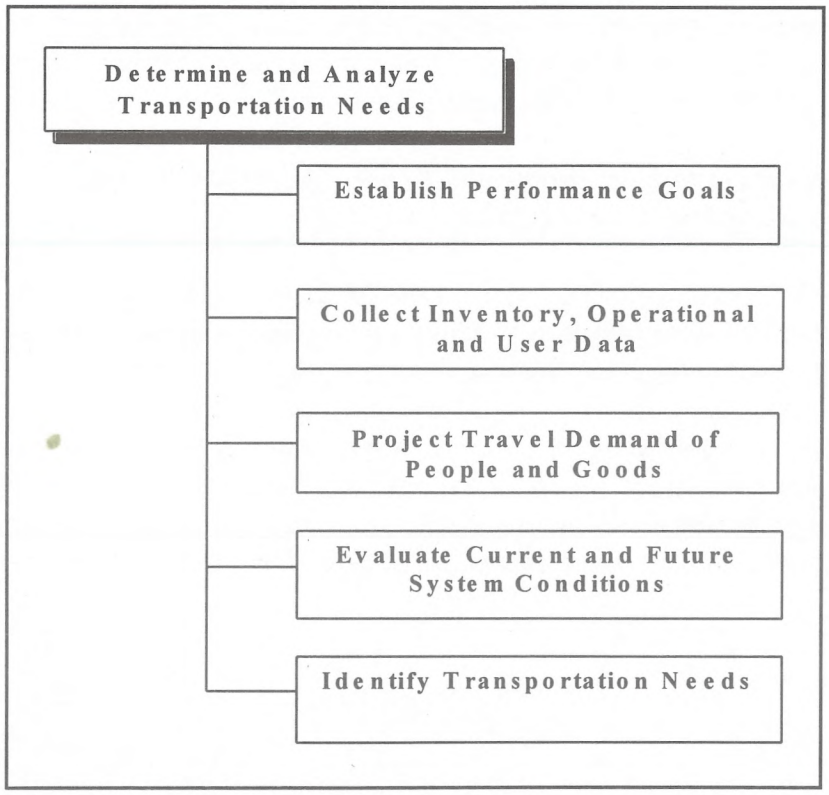


Figure 3.8 - Processes within the "Determine and Analyze Transportation" Business Area

Determine and Analyze Transportation Needs: Considers the expectations and transportation needs of our customers to identify and analyze transportation needs (see Figure 3.8).

This business area reflects the beginning of the business life cycle and results in a list of transportation needs, not solutions. In planning transportation systems, TxDOT has historically been limited by financial constraints and limited alternatives in some cases. A goal of TxDOT's management has been to evolve to the "plan driving the budget," rather than vice versa. The same goal applies within this business area in developing a comprehensive list of all needs. Constraints and feasibility are applied within the Plan Transportation Systems business area. The business area is defined by the following processes:

> ***Establish Performance Goals:*** Provides the means to identify, on a proactive basis, multimodal transportation performance objectives. A key to establishing these objectives is obtaining the input of the traveling public and understanding their service level expectations.

Collect Inventory, Operational and User Data: Data collection activities that provide the necessary information to project travel demands and evaluate the current and future condition and service level of the state's transportation networks.

Project Travel Demand of People and Goods: Activities that result in the forecast of travel demand by transportation mode.

Evaluate Current and Future System Conditions: Provides for a comprehensive assessment of the transportation system's current and projected performance, physical deficiencies and multimodal characteristics.

Identify Transportation Needs: Activities that result in the generation of a comprehensive multimodal view of the state's transportation needs. Considers the transportation performance goals (largely set by public opinion), the projected travel demand and the current and projected condition of the transportation networks.

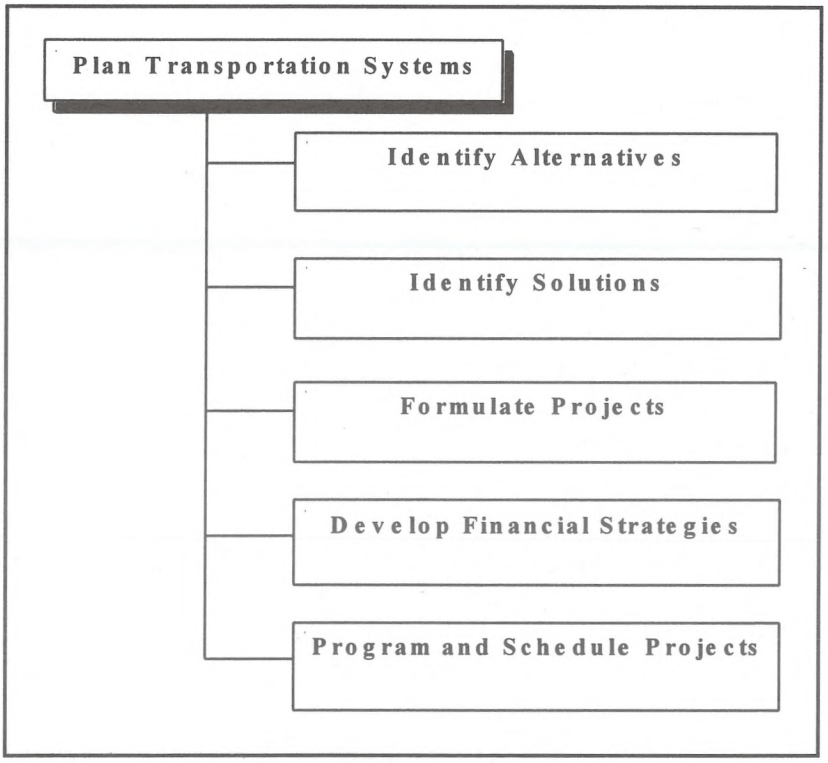


Figure 3.9 - Processes within the "Plan Transportation Systems" Business Area

Plan Transportation Systems: Addresses transportation needs by identifying, prioritizing and scheduling transportation solutions/projects (see Figure 3.9).

This business area begins with transportation needs and results in funded projects. The planning approach outlined in this business area addresses needs based upon a statewide transportation plan, including statewide goals. The plan should drive the funding and scheduling of projects for all transportation systems. The processes within this business area are iterative and dependent on other processes within the model. Iterations through the processes may be driven by factors such as changing needs, mandates, revised project circumstances, etc.

A solution may consist of one or many projects. The projects may be mode specific or incorporate the use of more than one mode to meet the identified need. This planning approach emphasizes the use of multiple modes to move people and goods in the most feasible and effective manner. Planning is currently done by mode with very little integration. Life cycle planning for systems is also essential. The planning is not only for initial implementation of a transportation solution but the preservation and continued operation of the solution as well. Long-term costs of preservation are not always considered with current

project alternative and solution selection.

Identify Alternatives: Takes identified transportation needs and seeks different ways the needs can be met. These alternatives can be viewed as unconstrained.

Identify Solutions: Determines which previously identified alternatives are feasible based upon external input, cost estimates, data, socioeconomic and environmental issues.

Formulate Projects: Transforms solutions for identified needs into projects. Projects may be mode specific or may incorporate the use of more than one mode to meet the identified need. This process includes the scoping of projects and preliminary prioritization.

Develop Financial Strategies: Matches available funding to prioritized projects. Funding apportionments are made to districts based upon this prioritization.

Program and Schedule Projects: Places funded projects in a time schedule for work to begin.

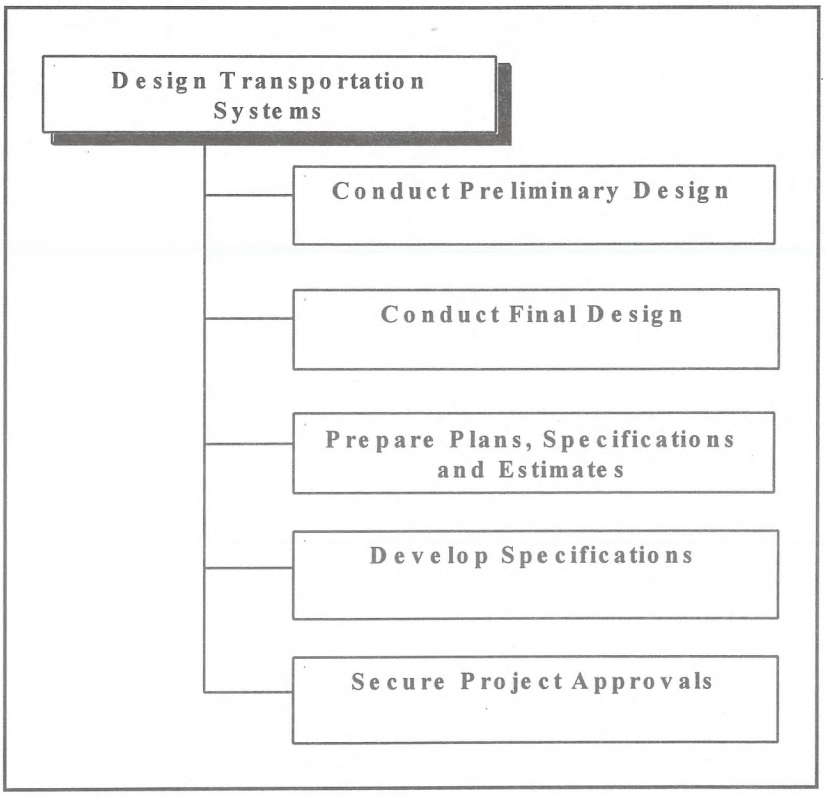


Figure 3.10 - Processes within the "Design Transportation Systems" Business Area

Design Transportation Systems: Transforms solutions from a conceptual framework to a fully designed project with detailed plans and specifications (see Figure 3.10).

The plans and specifications are developed for all transportation systems and facilities that serve TxDOT's external customers (roadways, right-of-way maintenance, transit facilities and services, aviation facilities, landscape, rest areas, travel information centers, etc.) Activities within the processes include providing oversight for external entities delivering design projects (e.g., transit authorities and consultants). The five processes are defined as follows:

> ***Conduct Preliminary Design:*** Refines the project scope and initiates the design of the project.
>
> ***Conduct Final Design:*** Performs primary design functions, including design and quantity calculations, developing details and selecting applicable specifications.
>
> ***Prepare Plans, Specifications and Estimates:*** Compiles the project details into a published form, ready for proposal preparation and contract development.

Develop Specifications: Develops project specifications and makes them available for project designers.

Secure Project Approvals: Provides appropriate coordination with external entities for effective communication and approvals.

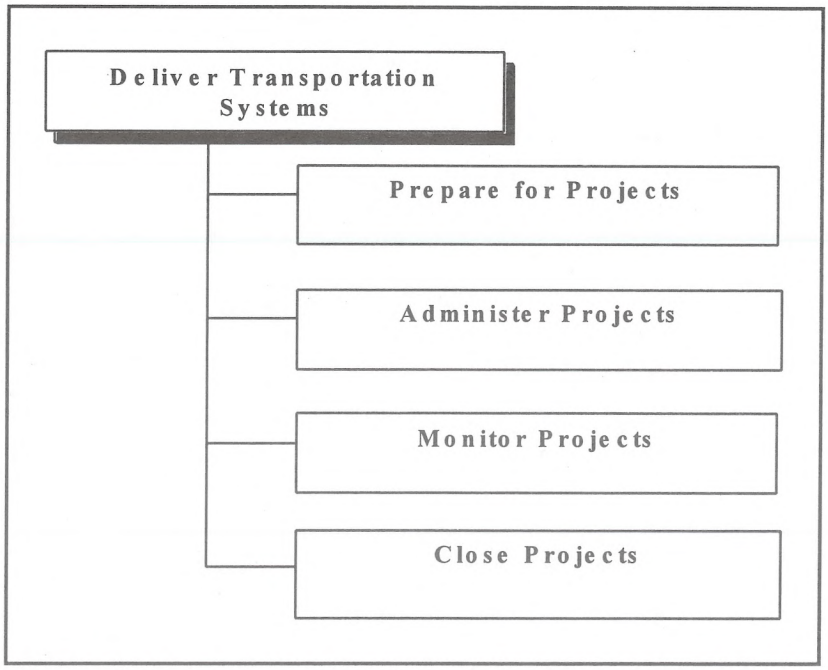


Figure 3.11 - Processes within the "Deliver Transportation Systems" Business Area

Deliver Transportation Systems: Transforms a fully designed project with detailed plans and specifications to a delivered product (construction projects, maintenance projects, transit facilities and services, landscape projects, traffic control systems projects, airport facilities, etc.). The "Deliver Transportation Systems" business area is depicted in Figure 3.11 above.

The activities in this business area are directed toward project management and includes quality assurance of delivered products. The business area also provides oversight for projects administered by external partners. Processes include:

Prepare for Projects: Prepares project personnel to manage and inspect a project.

Administer Projects: Performs project management, material testing and contract compliance functions to achieve quality assurance.

Monitor Projects: Performs project inspection and record keeping to provide quality control.

Close Projects: Performs the final acceptance of a completed project.

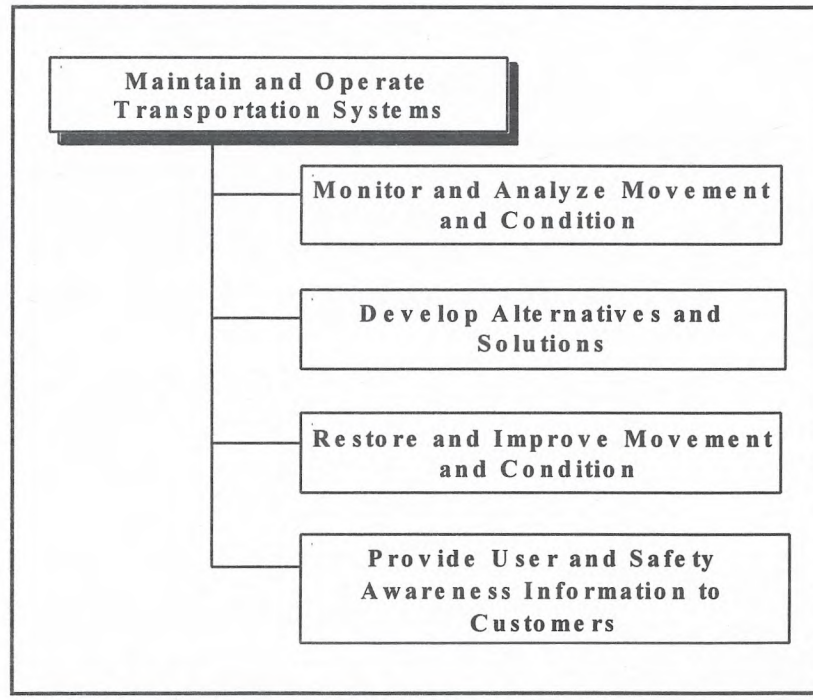


Figure 3.12 - Processes within the "Maintain and Operate Transportation Systems" Business Area

Maintain and Operate Transportation Systems: Keeps people and goods moving safely and efficiently on all modes of transportation networks (see Figure 3.12).

Some processes in this business area duplicate terms in the Plan Transportation Systems business area. The distinction lies within the continual and time responsive manner in which these activities are performed. The Plan Transportation Systems business area results in funded projects to address statewide transportation needs. The Maintain and Operate Transportation Systems business area results in the most effective continual operation and preservation of the transportation system. The activities performed within this business area are performed on a daily basis with a focus on responsiveness, safety and prevention of disruptions to movement and deterioration of the transportation systems. An effective transportation system operates best when users are properly informed. Having excellent facilities can be wasted if users do not know how to effectively and safely use the system. Processes include:

Monitor and Analyze Movement and Condition: Continually observes, detects and determines causes of disruptions to flow and deterioration of the system.

Develop Alternatives and Solutions: Identifies and develops solutions and courses of action to address disruption and deterioration.

Restore and Improve Movement and Condition: Preserves or restores system flow and condition to an acceptable level of service.

Provide User and Safety Awareness Information to Customers: Provides customers with educational and navigational information to effectively and safely utilize transportation systems.

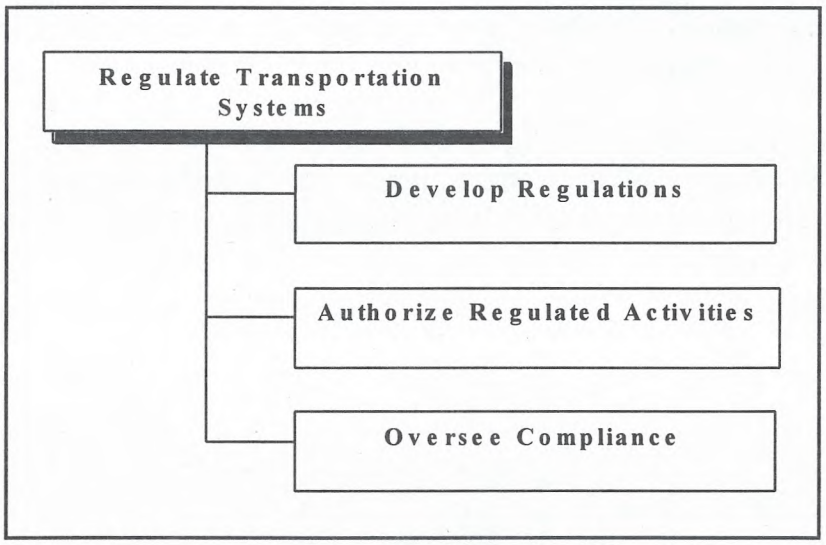


Figure 3.13 - Processes within the "Regulate Transportation Systems" Business Area

Regulate Transportation Systems: Enforces compliance with regulations relating to the use of the transportation systems and state owned right-of-way by issuing licenses or permits, or as specified by law (see Figure 3.13).

This business area concentrates on regulating the use of the transportation system only after the system is in place. It includes regulating the use of the right-of-way; registering and titling vehicles; licensing motor vehicle dealers, manufacturers, distributors and converters; issuing oversize/overweight permits, utility and driveway permits; regulating outdoor advertising signs and junkyards; and regulating the construction of tall towers near general aviation airports. TxDOT has limited enforcement powers in these areas except in licensing motor vehicle dealers, manufacturers and converters.

Where authorized, the department is responsible for developing the regulations for others to follow, authorizing the regulated activity and overseeing compliance. The department performs these regulatory activities for various reasons including the safety of the public; consumer protection; to protect and preserve the transportation system; to protect the environment; and to be in compliance with state and federal laws.

Processes include:

> ***Develop Regulations:*** Develops regulations for an area that the department is responsible or in response to federal or state laws and rules that give the department the authority to govern a particular activity.

Authorize Regulated Activities: Accepts applications and any related fees or bonds, reviews the application and either grants or denies the authorization (e.g., license or permit).

Oversee Compliance: Ensures that authorized individuals, companies or other entities comply with regulations established by the department. Includes subsequent renewal or cancellation of the authorization.

BUSINESS SERVICES FUNCTIONAL AREA:

Business services are those processes that are not directly associated with the product life cycle or the management processes described by the other two functional areas, but are necessary to support both. The six business areas do not directly deliver TxDOT products and services to external customers. The operations and management functional areas could not deliver products and services, however, without the support of processes and activities within the business services functional area. The activities and processes within these business areas may be performed in any and all department offices including maintenance and area offices, district offices, divisions and special offices. The business services functional area with six business areas is represented in Figure 3.14 below.

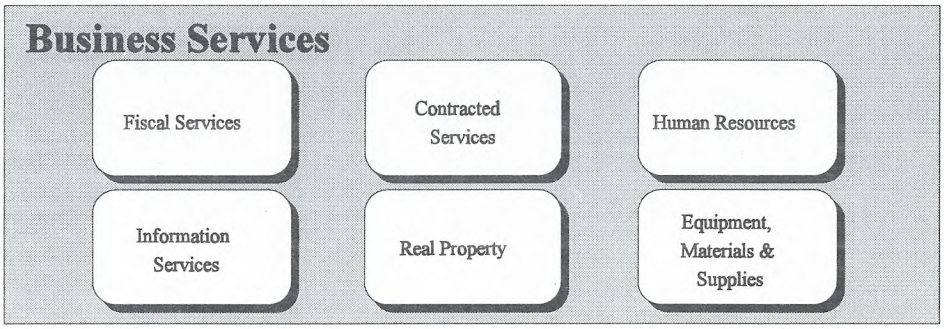


Figure 3.14 - Business Services Functional Area

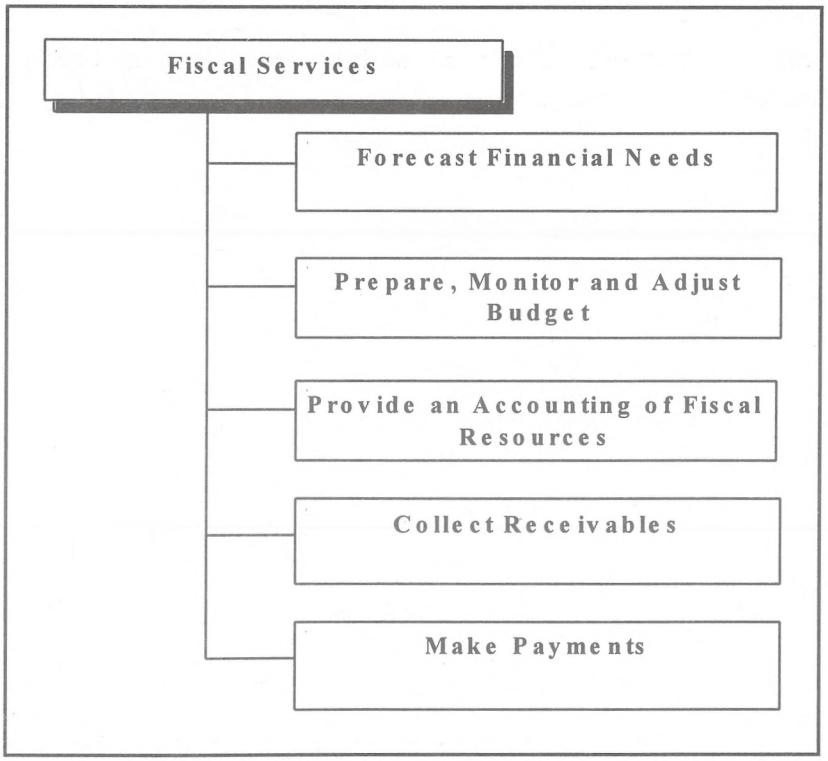


Figure 3.15 - Processes within the "Fiscal Services" Business Area

Fiscal Services: Determines financial needs and manages the department's financial resources (see Figure 3.15). Processes include:

Forecast Financial Needs: Identifies all trends, impacts, constraints and other factors that will affect the department's future financial needs and effectively quantifies those needs.

Prepare, Monitor and Adjust Budget: Provides for the allocation of money to be spent towards planned expenditures necessary for the department to perform according to plans. Also provides for monitoring and adjusting the allocation of money between budget cycles to ensure the department continues to perform according to plans.

Provide an Accounting of Fiscal Resources: Tracks and analyzes the department's use of taxpayers' dollars in order to facilitate decision-making and ensure fiscal accountability.

Collect Receivables: Collects all financial resources owed or entitled to the department.

Make Payments: Pays and records expenditures owed or obligated by the department to other entities and to employees.

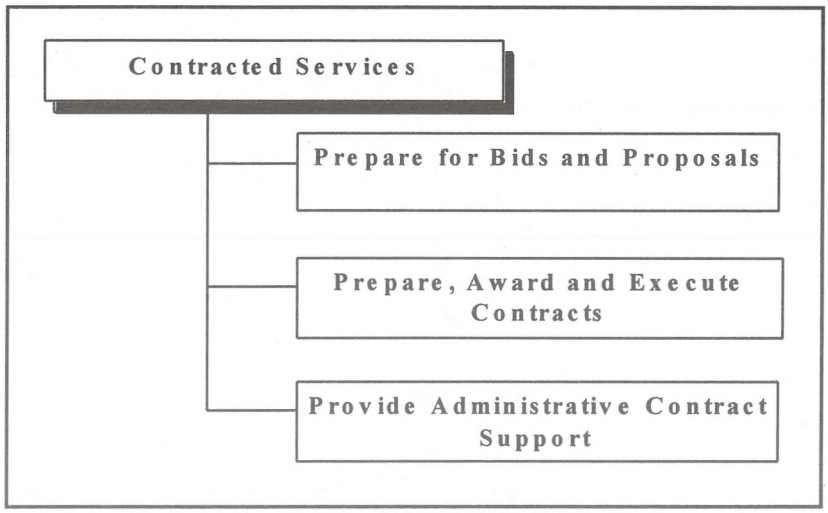


Figure 3.16 - Processes within the "Contracted Services" Business Area

Contracted Services: Guides and supports the various department functions responsible for project management and oversight of contracted services (see Figure 3.16). Processes include:

Prepare for Bids and Proposals: Prepares final bid proposals and requests for proposal, notifies potential candidates of project availability and ensures candidates are qualified to perform proposed projects.

Prepare, Award and Execute Contracts: Determines the most qualified candidate based on submitted bids and proposals, prepares and awards the contract and ensures that all contract requirements are met before work begins.

Provide Administrative Contract Support: Advises, recommends and assists project and contract managers with responsibilities related to contract administration (e.g., contract revisions, subcontractor approvals, claims resolution).

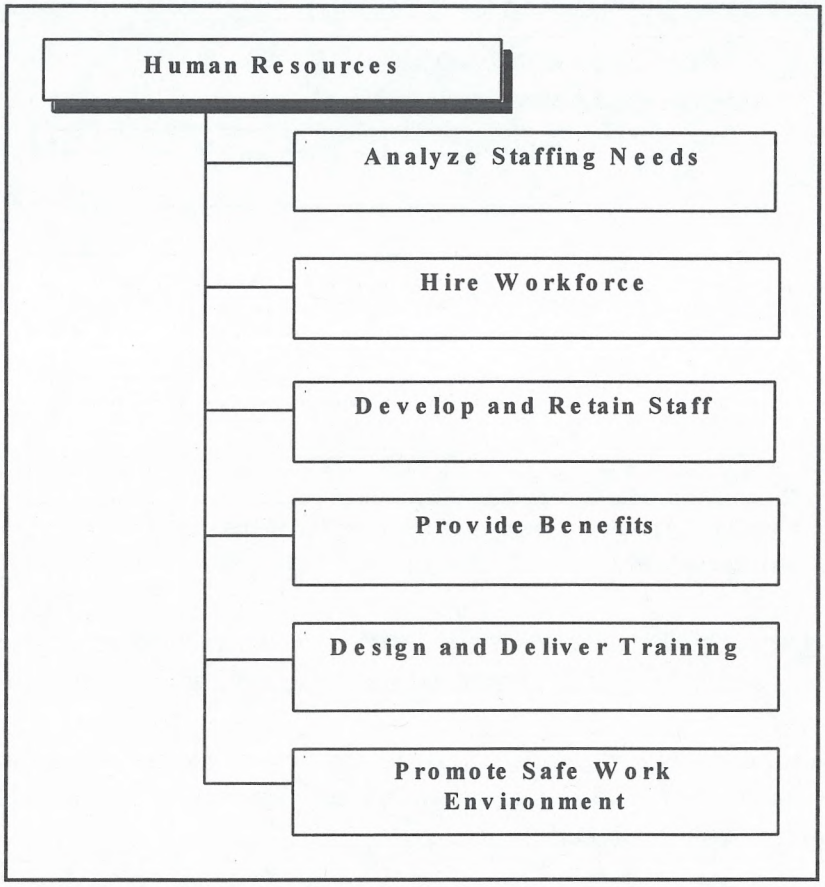


Figure 3.17 - Processes within the "Human Resources" Business Area

Human Resources: Addresses the department's needs by effectively hiring, managing and supporting human resources (see Figure 3.17). Processes include:

Analyze Staffing Needs: Forecasts, plans and allocates classified positions based on skill and workload needs identified by all business areas.

Hire Workforce (Staff/Personnel): Recruits and hires qualified individuals to meet the department's workforce needs. Includes the induction and orientation of new employees.

Develop and Retain Staff: Protects the department's investment in its employees by promoting individual career growth through systematic professional development and ensures the availability of career opportunities.

Provide Benefits: Ensures the availability of an array of benefits to all employees.

Design and Deliver Training: Develops, acquires or delivers training to the employees based on needed skills and individual career growth.

Promote Safe Work Environment: Provides for procedures and education that promote a safe work environment for all employees.

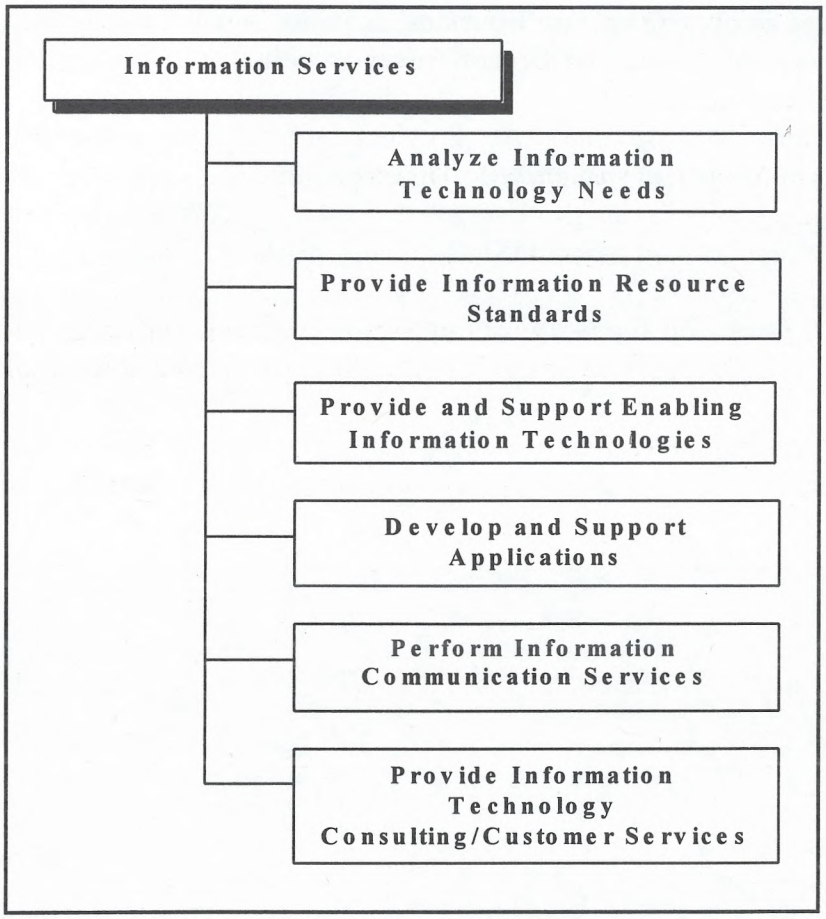


Figure 3.18 - Processes within the "Information Services" Business Area

Information Services: Enables and supports TxDOT's effective use of information as a business resource including services for communicating information (see Figure 3.18). Processes include:

Analyze Information Technology Needs: Analyzes and plans information resources based on the department's business requirements. Develops alternative applications and data strategies, technology solutions and resource requirements (e.g., skills, workload, services, equipment, materials and dollars).

Provide Information Resource Standards: Assesses, develops and implements information resource related standards. These standards facilitate the effective use of data, applications and technologies and consistent structured design practice.

Provide and Support Enabling Information Technologies: Researches, develops and implements technologies that support the department's use of information within established architectures.

Develop and Support Applications: Develops, enhances, preserves and provides production support, for application systems within established architectures to effectively support department business requirements.

Perform Information Communications Services: Enables effective information transfer within the department and between the department and external entities.

Provide Information Technology Consulting /Customer Service: Diagnoses and solves problems, assists and instructs technology users and facilitates vendor assistance.

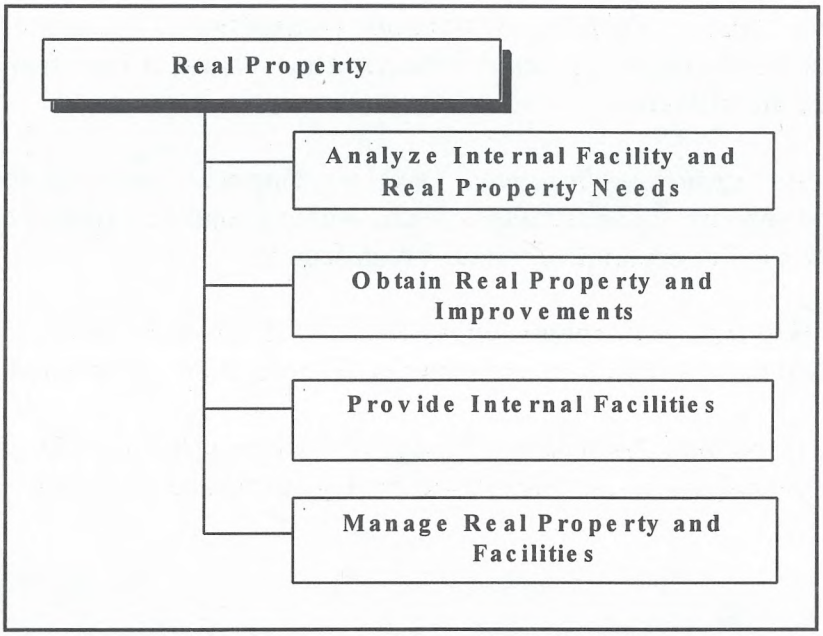


Figure 3.19 - Processes within the "Real Property" Business Area

Real Property: Acquires, manages and disposes of buildings and land for the transportation system and for the department's employees and assets (see Figure 3.19). Processes include:

Analyze Internal Facility and Real Property Needs: Identifies and analyzes land and building needs for effectively housing and supporting the employees and property of the department. (Note: Real property needs for the transportation system are identified in "Design Transportation Systems.")

Obtain Real Property and Improvements: Acquires land and improvements to serve the transportation system and to house TxDOT employees and property.

Provide Internal Facilities: Develops plans and specifications for construction or renovation of facilities for department employees and property. Includes overseeing the construction, remodeling or demolition of facilities.

Manage Real Property and Facilities (internal & transportation system): Maintains, protects and manages land and improvements that house department employees and property. Includes real estate activities and transactions related to transportation system parcels and managing land and facilities leased by the department to serve the public and the department's internal needs.

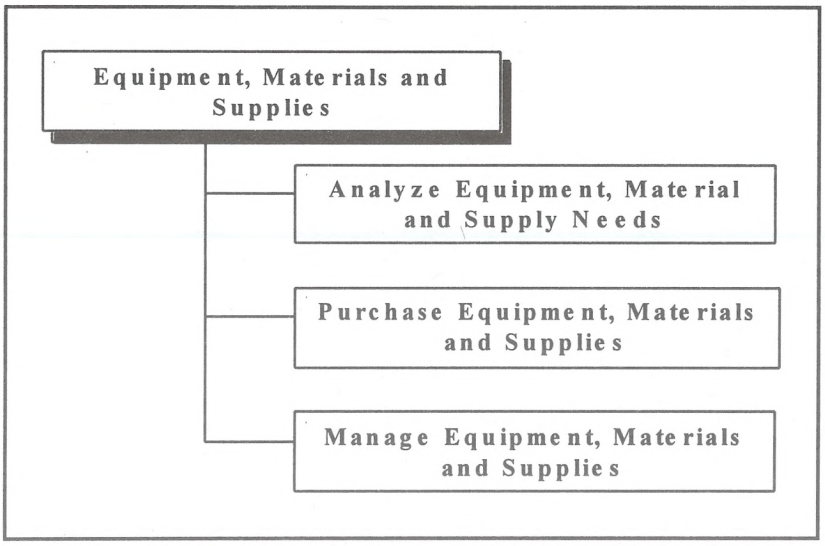


Figure 3.20 - Processes within the "Equipment, Materials and Supplies" Business Area

Equipment, Materials and Supplies: Analyzes needs, procures, manages and disposes of equipment, materials and supplies (see Figure 3.20). Processes include:

Analyze Equipment, Material and Supply Needs: Analyzes alternative acquisition methods, markets, vendors and products for department equipment, material and supply needs.

Purchase Equipment, Materials and Supplies: Procures equipment, materials and supplies for all areas of the department (includes leased equipment).

Manage Equipment, Materials and Supplies: Inventories, distributes, protects or maintains department equipment, materials and supplies.

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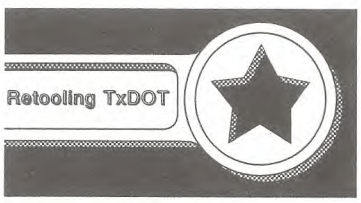
CHAPTER IV

INFORMATION ARCHITECTURES

BUSINESS INFORMATION AND SYSTEMS PLAN



Texas Department of Transportation

Chapter IV - Information Architectures

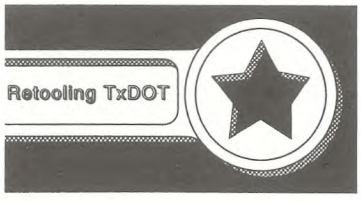
NOTES

CHAPTER IV

INFORMATION ARCHITECTURES

DATA

SECTION A



Texas Department of Transportation

Section A
Data

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OVERVIEW:

The strategic direction for the department's data resources is addressed in the Data Architecture and the Data Migration. The Data Architecture describes the data required to support the business needs of the department. The Data Migration defines the approach for changing from the current data environment to the data structure outlined in the Data Architecture.

DATA ARCHITECTURE:

The Data Architecture is the conceptual description of the data needed to support the business processes of the department. At a high level, this Data Architecture identifies the subjects that are of interest to the department and lists examples of the type of data included in each subject area. The Data Architecture is a forward-looking model that emphasizes the data needed, not the data that exists. The Data Architecture represents the framework that can be used for directing future data development.

The Data Architecture represents the top level of an enterprise data model. It will be used as input into each of the business process retooling efforts, so that the data for one business area can be viewed in relationship to the entire data model. Each business process retooling team will have responsibility for further defining the subject areas and identifying entity types and relationships between entity types.

There are two components to the Data Architecture:

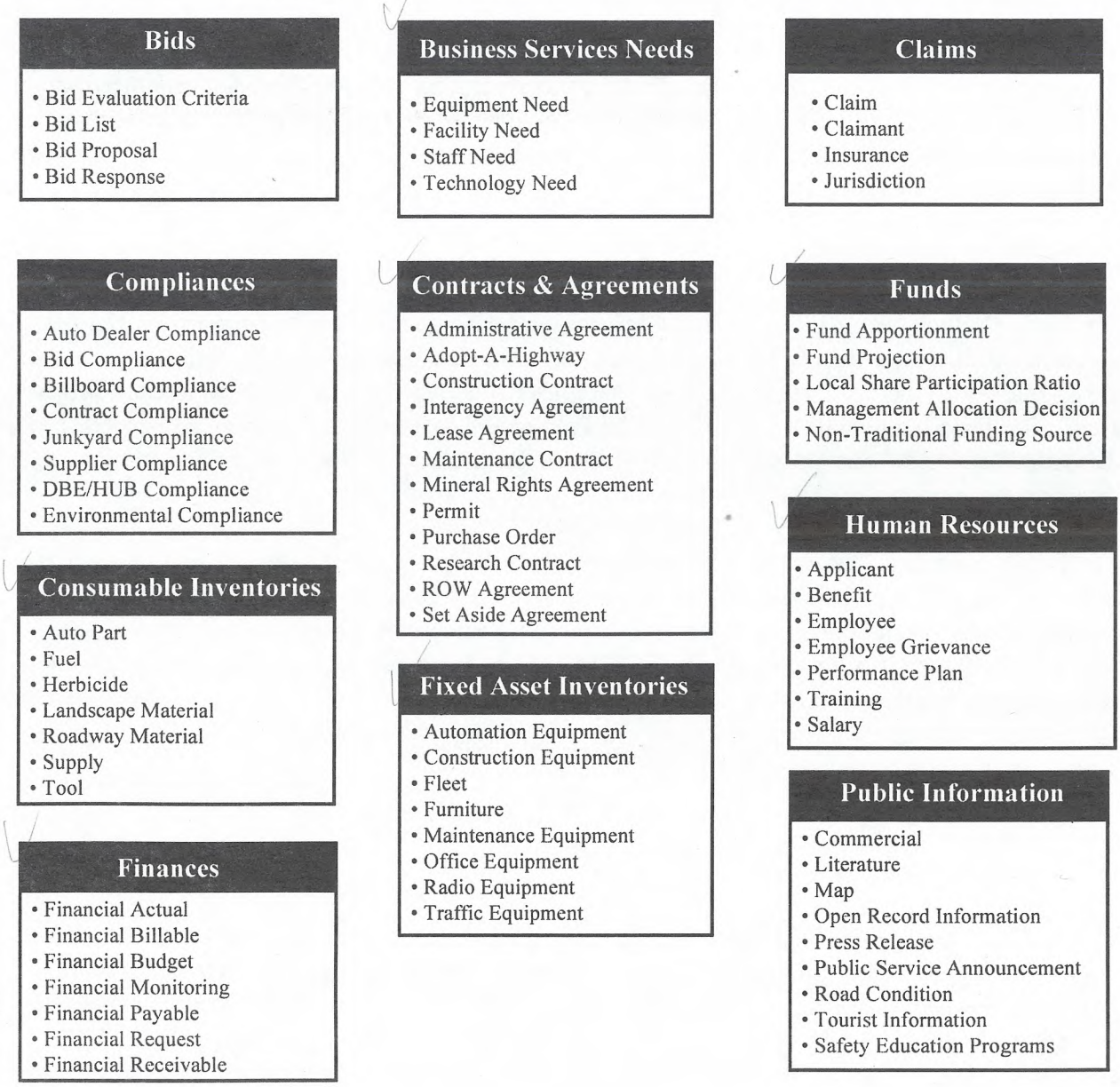
- Subject Level Data Model
- Subject Area Definitions

The ***Subject Level Data Model*** identifies the subject areas of interest to the department. This model is a logical representation of the data needed to support the business processes; it does not identify physical databases. Sample entity types are listed for each subject area, to define the intent and purpose of the subject area. The entity type list should not be considered complete; entity types will be further defined during business process retooling phases.

The ***Subject Area Definitions*** define each of the subject areas in the Subject Level Data Model.

Subject Level Data Model:

The following is a graphical representation of the TxDOT Subject Level Data Model.



Subject Level Data Model (continued):

Purchase Items
- Construction Item
- Consumable Item
- Fixed Asset Item
- Service Item

Suppliers
- Bidder
- Consultant
- Contractor
- DBE/HUB
- Producer
- Vendor
- ROW Payee

Customers
- Magazine Subscriber
- Permit Holder
- Vehicle Owner
- Tourist

Trans Sys Maintenance
- Maintenance Location
- Maintenance Resource
- Maintenance Schedule

Real Properties
- Building
- Land

Right Of Ways
- Abstract
- Acquisition
- Appraisal
- Owner

Projects
- Approval
- Resource
- Schedule
- Time Estimate

Restricted Sites
- Hazards
- Studies
- Site Locations

Information Resources
- Access Authorization
- Application Inventory
- Help Desk Log

Fixed Asset Usages
- Automation Equip. Usage
- Fleet Usage

Regulations
- Auto Dealer Regulation
- Billboard Regulation
- Environmental Regulation
- Junkyard Regulation
- Minute Order
- Permit Regulation
- Railroad Regulation
- Registration
- Title
- Tariff
- Hazardous Material

Subject Level Data Model (continued):

Transportation Systems
- Airport
- Hike and Bike
- Public Transit
- Rail System
- Roadway
- Waterway

Trans. Sys. Needs
- Demographics
- Forecast
- Minimum Acceptable Service Level
- Performance Goal
- Public Input

Trans. Sys. Structures
- Bridge
- Culvert
- Drainage
- Park and Ride
- Pier
- Ramp
- Site Development
- Traveling Surface

Trans. Sys. Standards
- Design Standard
- Environmental Standard
- Material Standard
- Regulatory Standard
- Safety Standard
- Service Standard

Trans. Sys. Constraints
- Access Restriction
- Design Limit
- Height/Width Limitation
- Passenger Count Constraint
- Road Ban Constraint
- Sound Limit
- Speed Limit
- Vehicle Type
- Weight Limit

Trans. Sys. Usages
- 18Kip Weight
- Accident
- Occupancy
- Pedestrian Count
- Road Ban
- Safety Device Usage
- Traffic Count
- Travel Speed
- Vehicle Usage

Trans. Sys. Routes
- Bicycle Route
- Business Route
- Evacuation Route
- Ferry Route
- Hazardous Material Route
- Over Sized Vehicle Route
- Scenic Route
- Travel Route
- Truck System Route

Trans. Sys. Features
- Barrier
- Guard Rail
- Landscape
- Lighting
- Monument
- Retaining Wall
- Sign
- Signal

Trans. Sys. Locations
- Area Office
- Control Section
- GPS
- Legislative District
- Maintenance Section
- Reference Marker
- Responsible District
- TxDOT District

Trans. Sys. Project Design Specs
- Archeological Survey
- Design Drawing
- Estimate
- Specification
- Terrain and Surface

Trans. Sys. Geometrics
- Off Surface Geometric
- Surface Geometric

Trans. Sys. Conditions
- Facility Condition
- Side-System Condition
- Structure Condition
- Surface Condition

Subject Area Definitions:

Bids:

Bids are specifications (in the form of proposals) for items or services for which an outside source/supplier submits information (price, quantity discounts, time/delivery estimates, etc.) in order to enter into a contract with TxDOT. This subject area includes bid evaluation criteria, bid list and bid responses.

Business Services Needs:

This subject area deals with forecasting, projections, planning, etc. to proactively fulfill equipment, facility, staff and technology commitments, opportunities and requirements for the organization. This subject area does not include transportation system needs.

Claims:

This subject area describes a demand for something believed to be due for a right or privilege that has been denied. The claim may involve outside parties and/or current or former employees. Types of claims include construction contracting companies asking for more money for work performed, TxDOT collecting on defaulted contracts, workers' compensation cases, discrimination cases, right-of-way judgments or condemnations, etc.

Compliances:

This subject area includes data about the inspection, monitoring and enforcement of official requirements. Types of compliances include bid specifications (contracts), use of HUBs, DBEs and WBEs on contracts, monitoring of billboards on rights-of-way, auto dealers, etc.

Consumable Inventories:

This subject area stores information about the stock or on-hand supply of various items which must be replenished periodically to maintain optimal levels. Consumable inventories include auto parts, fuel, tools, office supplies, etc.

- ***Contracts and Agreements:***

  A contract is an arrangement between two or more parties for the supply of certain goods or services. This subject area can include agreements, leases, permits, purchase orders, interagency agreements, set-aside agreements, etc.

- ***Customers:***

  This subject area contains information about outside parties who patronize or use the services of the department. Types of customers include magazine subscribers, permit holders, vehicle owners, tourists, public transit riders, etc. This subject area does not include providers of services to the department, such as suppliers, vendors, etc.

- ***Finances***:

  This subject area includes data about the financial transactions of the department, including budget requests, receivables, payables and payroll.

- ***Fixed Assets Inventories:***

  This subject area stores information (including description, location and maintenance history) about equipment resources which are not considered an expense item and are usually depleted or salvaged. Fixed assets include automation equipment, fleet, furniture, construction equipment, maintenance equipment, etc.

  Fixed Assets Usages:

  This subject area stores information about the utilization of equipment resources. This subject area may include information on automation equipment, construction equipment, fleet, furniture, etc.

- ***Funds:***

  This subject area contains data about the available sum of money or other resources set apart for a specific objective. This subject area includes allocations, apportionments and obligations of money and resources among federal, state, local and other governing entities involved in projects or other strategies.

Human Resources:

This subject area contains employee data and related information such as benefits (sick leave, vacation, pay, insurance), career planning, performance planning, training, grievances, counseling, etc. This subject area includes employee safety programs.

Information Resources:

This subject area contains data related to the inventory and management of the department's information resources, including an inventory of all applications, user-access profiles, and a help desk log. This subject area does not include computer equipment, which is included under Fixed Assets Inventory.

Projects:

This subject area stores data involved in the management (planning, organizing, leading and controlling) of any project. This subject area can include resources (human, money), schedules, estimates, etc.

Public Information:

This subject area includes information or promotional material disseminated from the department to the public. Public information includes commercials, literature, maps, open records, press releases, public service announcements, road conditions, tourist information, public safety education programs, etc.

Purchase Items:

This subject area is a grouping (catalog) of items approved for purchase. This subject area includes construction items, maintenance items, consumable items, fixed assets, services, etc.

Real Properties:

This subject area contains information about the department's inventory and maintenance of real property (i.e., buildings and land).

Regulations:

This subject area pertains to the laws, decrees, ordinances, rules or statutes of which the department must comply or enforce. Examples include billboard regulation,

environmental regulation, minute orders, oversize permits, vehicle registrations, etc.

Restricted Sites:

This subject area stores data about the location, hazard and study of restricted sites, including environmental, historical and archeological sites.

Right-of-Ways:

This subject area contains data about the strip of land over which a transportation system is built, as well as waterway rights, bike path rights, etc. This subject area can include information on abstracts, owners, appraisals and acquisition.

Suppliers:

This subject area is a broad grouping of all third parties, usually recipients of payment from the department, which provide goods or services. Performance and bonding are examples of the attributes kept about each supplier.

Transportation Systems:

This subject area contains general information about the department's transportation systems. Transportation systems are methods for getting goods and people from one place to another.

Transportation System Conditions:

This subject area contains data about the shape, order, or state of the transportation system components. The conditions must be measurable and objective. Includes condition information for facilities, side systems, structures, surfaces, assets, etc.

Transportation System Constraints:

This subject area stores data about the physical restrictions, checks or restraints placed on the transportation systems. Constraints may include access restriction, design limits, height/width limits, sound limits, air quality limits, speed limits, weight limits, mode of transportation, etc.

Transportation System Features:

This subject area encompasses the peripherals or additions to a transportation system

structure. Transportation System features include guardrails, landscaping, retaining walls, monuments and signals.

Transportation System Geometrics:

This subject area contains data about the measurements of the curve and slope of structures within a transportation system. This subject area defines physical geometric attributes such as length, width, degree, etc. for curves and baseline bearings which are maintained at centerline.

Transportation System Locations:

This subject area contains data used for the identification of a specific point, range or area on a transportation system. Locations include control-sections, global positioning, reference marker, responsible district, etc.

Transportation System Maintenance Activities:

This subject area stores data about the routine maintenance activities performed on the transportation system structures to provide and preserve system flow. This subject area includes the maintenance site, resources, schedule and maintenance activities.

Transportation System Needs:

This subject area defines the "pure" transportation needs identified from outside organizations (such as the public or MPOs) and within the department through the use of forecasting, projections and research studies without regard to resource constraints.

Transportation System Project Design Specifications:

This subject area contains data pertinent to the specification and cost and material estimates of transportation projects.

Transportation System Routes:

This subject area contains data about a predefined path with certain characteristics for a definite purpose such as a bike route, business route, evacuation route, hazardous material route, over-sized vehicle route, scenic route, etc.

Transportation System Standards:

A standard is a benchmark, gauge, measure, model, example, norm or pattern used for establishing and/or enforcing substantial uniformity. This subject area can include design standards, environmental standards, material standards, safety standards, etc.

Transportation System Structures:

This subject area contains information about components found in conjunction with or dependent on a transportation system but are not considered to be features. Structures can include bridges, piers, ramps, traveling surface, etc.

Transportation System Usages:

This subject area contains information about the utilization of the transportation systems. This subject area can include truck weights, accidents, vehicle occupancy, safety device usage, traffic counts, travel speeds, etc.

DATA MIGRATION:

The Data Migration identifies the strategy for changing from the current data environment to the data structure identified in the Subject Level Data Model. Using the inventory of current databases, each database was examined to determine the subject area(s) supported by the database. The results of this analysis are documented in the Subject Area/Current Data Store Matrix in Appendix 12. Each subject area was then analyzed to identify the gap between the optimal data requirements and current database support. The Data Migration Strategies describe the general approach for migrating to the new Subject Level Data Model.

The Data Migration consists of three sections:

- Subject Area Gap Analysis
- Future Data Environment
- Data Migration Strategies

The ***Subject Area Gap Analysis*** documents the degree to which the subject areas are supported by current centralized databases. This assessment will be used to help identify future data projects.

The ***Future Data Environment*** describes some characteristics and objectives of the future data environment.

The ***Data Migration Strategies*** section identifies the strategy for migrating from the current database environment to a database environment which will support the data groupings represented in the Subject Area Data Model.

Subject Area Gap Analysis:

To determine the degree to which the current database environment supports the Subject Level Data Model, each existing database was mapped to a subject area. Appendix 12, the Subject Area/Current Data Store Matrix, is an IEF-produced matrix that identifies the relationship between the subject areas and the current databases. The matrix merely identifies databases that contain some data about the subject area; the matrix does not indicate the level of support for the subject area.

The matrix results were used as input in determining the "gap" between subject area and current database support. This section indicates the "gap" between the data required in a subject area and the degree to which current databases contain data for each subject area. Each subject area is evaluated as follows:

- Small gap - The subject area is mostly or fully supported by the existing databases
- Medium gap - The databases contain some information for this subject area
- Large gap - The databases contain very little (if any) data about this subject area

Subject Area	Gap
Bids • Add data about service contracts	Medium gap
Business Service Needs • Some data available about automation equipment needs	Large gap
Claims • Data not stored in any centralized database	Large gap
Compliances • Data not stored in any centralized database	Large gap
Consumable Inventories • Inventory maintained on MSMS (Material and Supply Management System) files	Small gap

Contracts and Agreements — Medium gap

- Data available for construction contracts, purchase orders, and permits
- Maintenance contract data is being implemented
- Add data for other contract types, i.e., service contracts and right-of-way agreements

Customers — Small gap

- Existing databases for magazine subscribers, permit holders title registration holders and travel literature recipients

Environmental Sites — Large gap

- Data does not exist in any centralized database

Finances — Small gap

- FIMS (Financial Information Management System) files contain account balances and general ledger entries

Fixed Asset Inventories — Small gap

- Inventory data exists for fleet, office, construction and automation equipment

Fixed Asset Usages — Medium gap

- No utilization data for microcomputer equipment

Funds — Large gap

- Some federal fund information is stored

Human Resources — Small gap

- Personnel, salary and benefits data available
- Career planning information not maintained

Information Resources — Medium gap

- User profile data available
- ISD-developed application inventory is not adequate
- No database for user-developed applications

Projects — Medium gap

- Good data for safety projects

Public Information — Medium gap
- Data stored about highway conditions, bid announcements and travel literature

Purchase Items — Small gap
- Good "catalog" data, but does not include service items

Real Properties — Large gap
- Current right-of-way database is inadequate
- No existing database for 'building' inventory

Regulations — Large gap
- Data not stored in any centralized database

Suppliers — Small gap
- Data stored about bidders, contractors, subcontractors and vendors

Transportation Systems — Large gap
- Most data specific to "highway" mode; not multimodal

Transportation System Conditions — Medium gap
- Most data specific to "highway" mode; not multimodal

Transportation System Constraints — Large gap
- Data not available in existing databases

Transportation System Features — Medium gap
- Most data specific to "highway" mode; not multimodal

Transportation System Geometrics — Medium gap
- Most data specific to "highway" mode; not multimodal

Transportation System Maintenance Activities — Small gap
- Supported by Maintenance Management Information System

Transportation System Needs — Large gap
- Data not available in existing databases

Transportation System Project Design Specifications — Small gap
- Design specification data exists

Transportation System Routes Large gap
- Data not available in existing databases

Transportation System Standards Medium gap
- Design and material standards well documented

Transportation System Structures Medium gap
- Most data specific to "highway" mode; not multimodal

Transportation System Usages Medium gap
- Most data specific to "highway" mode; not multimodal

Future Data Environment:

The following assumptions have been made about the new data environment that will be necessary to support the Data Architecture.

Database Development: The current environment is distinguished by a "single application, single database" orientation. This means that there is minimal data sharing between applications. Problems inherent with this environment include duplication of data, data integrity, data timing problems and maintaining a large number of interfaces between applications. The future data environment assumes a "multiple applications, single database" orientation. Establishment of a shared database environment in which different applications use data located in one logical database eliminates many of the problems associated with the current data resources in addition to facilitating end-user reporting.

Rapid Application Development: The future application development environment will strive to reduce the development time necessary to create new applications. In order to reduce the development time, new tools will be utilized including 4GLs and CASE tools. The future data environment will need to support rapid application development by increasing the accessibility of data and reducing the number of application interfaces necessary, as well as clearly defining data definitions and business rules.

Data Management Tools: In order to support the Subject Level Data Model, it will be necessary to increase the use of data management tools (e.g., CASE tools) to organize and standardize the management of data across the organization. Currently, the use of tools is limited to business applications.

Distribution of Data: The distribution of future data resources will increase as technologies such as client/server are introduced and as the policies and procedures

concerning work group/business unit computing are implemented. As data becomes more decentralized the importance of procedures and tools to manage data increases in importance. The future data resources environment will need to address these data management challenges.

Data Administration Role: The role of data administration will expand in the future due to many of the assumptions stated above. Current data administration is limited to some centralized mainframe databases and none of the engineering data. Data administration will shift from an "after the fact" control standpoint to a consultative, support role to projects, as well as proactive data management. Data administration support should be available to non-ISD developers in order to support an enterprise data model.

Data Integration: The future data environment will require coordination and integration of all data resources, both business data and engineering data. Currently, the role of data administration does not extend to engineering data.

Data Migration Strategies:

Based on the assumptions outlined above, the following migration strategies have been developed to migrate the current data environment to the data environment represented in the data architecture.

Enterprise Data Modeling: An enterprise data model will be necessary to migrate to the future data architecture. An enterprise data model elevates data administration from a project orientation to viewing the organization's data from a global business perspective. Applications in the future will need to create and provide access to data across business functions and replace the concept of "local data." The ability to access data across organizational boundaries will require a newly defined enterprise data model. Without an enterprise data model, TxDOT will not be able to enhance user access to information and create integrated applications free of redundant data.

The benefits of building a structured enterprise model include:

- A model that is independent of physical limitations
- A means of logically locating data by business functions
- A means of capturing and documenting business knowledge
- Providing a framework for future project definition
- Providing a stable information structure less susceptible to changes in technology
- Allowing end users to satisfy their own needs for ad hoc reports, simple applications and data extracts

- Reducing or eliminating problems associated with non-shared data such as data inconsistency, redundant data and reduced data availability
- Creating and applying standards to business data which will facilitate the use of data for all users

There are two approaches TxDOT can take to create an enterprise data model. One would be to create the entire model as a single project. This approach would require more resources and may be less accurate than an incremental approach performed as individual business areas are "retooled".

The second option would be to create modeling standards and procedures initially, then as each business process retooling project is performed, that portion of the enterprise would be modeled. The second approach would result in an incremental approach to creating the enterprise model as well as developing a model which would be more accurate and timely.

Data Administration Tools and Skillsets: An increased use of sophisticated data management tools will be necessary to create and maintain an enterprise wide data model. The use of data modeling tools will need to extend to all database environments, not just the current mainframe database. In addition, business data and engineering data should be included in the enterprise model. This will likely require CASE tools which can support the modeling of data on many platforms and databases. Staff training in the use of these tools will be necessary to develop the data modeling skills necessary for the department to be successful in the creation of an enterprise data model. Skills which will be necessary include data structure development, distributed database management system design, relational database development and business analysis. In addition to in-depth training for data administrators and database analysts, application developers should receive training on the fundamentals of data modeling in order to fully utilize the enterprise model in application development. Application developers must also be educated on the importance and benefits of using the Enterprise Data Model to help eliminate the development of databases inconsistent with this architecture.

Organizational Education: For the department to fully benefit from an enterprise data model, it will be necessary to educate end users throughout the department regarding the necessity for a enterprise data model and the benefits the model can provide. This will require several "culture" changes such as a shift from viewing data as owned and controlled by a specific organizational unit to viewing all data as department data with responsibility assigned to specific units. Also, data administration will need to evolve from a control function to a support function that serves to improve the quality and timeliness of application development throughout the department. To achieve this shift

in thinking and to provide support for an enterprise modeling effort, all management and staff will need to be educated and informed of the benefits and cost of creating the future data environment outlined in the data architecture.

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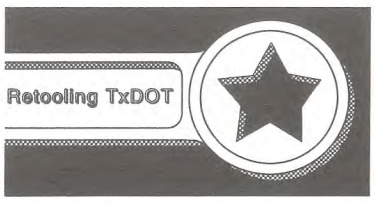
CHAPTER IV

INFORMATION ARCHITECTURES

APPLICATION

SECTION B



Texas Department of Transportation

Section B
Applications

●●●●●●●●●●●●●●

OVERVIEW:

The strategic direction for the department's application portfolio is outlined in the Application Architecture and the Application Migration. The Application Architecture describes the application systems needed to support the business of the department. The Application Migration defines the approach for transitioning from the current application inventory to the new Application Architecture.

APPLICATION ARCHITECTURE:

The Application Architecture describes the application systems needed to support the business needs and data requirements of the department. These application systems were identified by reviewing the processes within the TxDOT Business Model. The Application Architecture was further supplemented by reviewing the Subject Level Data Model and adding applications to capture data for the remaining subject areas.

The Application Architecture is based on the current TxDOT Business Model and will be continually updated as business areas undergo business process retooling. It is the blueprint from which future application development will be based. This blueprint, or strategic direction, communicates the integration of applications and supports the prioritization of application projects across business areas. This architecture will be valuable input into each business process retooling effort. It identifies current applications supporting each business process and also highlights processes with little or no application support.

The Application Architecture consists of two components:

- Application Architecture
- Logical Application System Definitions

The purpose of each component is described below.

The ***Application Architecture*** identifies the logical application systems necessary to support the business of the department. A logical application system is a logical grouping of applications which support the same business process. In most cases, a logical application system will consist of several user applications. The user applications are grouped into logical application

systems so that TxDOT can begin viewing future applications as pieces of an integrated whole, defined in terms of the business process(es) addressed, rather than viewing them as individual islands defined in terms of support to particular organizational units. The user applications within a logical application system will be defined during each business process retooling effort.

The Application Architecture is organized around the TxDOT Business Model. For each business area, there is a page in the Application Architecture. The processes within the business area are identified across the top of the page. The Future Logical Application Systems are listed underneath the business process(es) supported by the application system.

Each logical application system identifies the current applications considered to be within the scope of the logical application system. These applications can provide a building block for future development of the application system. A small sampling of locally-developed applications have been included in the Application Architecture to illustrate the business area support provided by the automation staffs and end users.

Occasionally, two or more logical application systems have been grouped into an Integrated Application System within the Application Architecture. These Integrated Application Systems are denoted by a rounded frame encompassing two or more logical application systems. These Integrated Application Systems have been identified to highlight the relationship between the logical application systems that must be considered during the business process retooling efforts.

Several appendices support the Application Architecture:

- Appendix 8, Application Acronyms, lists the full description of each application acronym listed in the Application Architecture.
- The current applications which support a business process are listed in Appendix 9. An application is considered to support a business process if it provides full or partial functional support to a process. Applications which only capture data used by a process are not mapped to a business process if no functionality is provided.
- Appendix 10 is a Logical Application System Cross-Reference. By logical application system, the cross reference lists the business processes supported. This will be useful in determining the impact of a logical application system across multiple business areas.

The ***Logical Application System Definitions*** define each of the Logical Applications Systems in the Application Architecture.

Determine & Analyze Transportation Needs

PROCESSES:

- **Establish Performance Goals**
- **Collect Inventory, Operational & User Data**
- **Project Travel Demands of People & Goods**
- **Evaluate Current & Future System Conditions**
- **Identify Transportation Needs**

FUTURE LOGICAL APPLICATION SYSTEMS:

PERFORMANCE GOAL MGMT SYSTEM

Transportation Data Collection System

TRANSPORTATION INVENTORY & CONDITION SYSTEM

~~MPE~~	RRX
~~PPE~~	BDG*
RIA	TRM
SKD	CSI
RIS	PMIS*

TRAFFIC OPERATION STATISTICS SYSTEM

ACR	WIM
ATR	MCC
SSS	TRA
TLG*	

TRAVEL DEMAND FORECASTING SYSTEM

LANSER	*HCS*
NETSIM	TAF*
TRANPLAN	TLG*
PMIS*	

ENVIRONMENTAL MGMT SYSTEM

EVM STAMINA

MAPPING SYSTEM

TRIMS GPS POSTADT PHOTOGRAMMETRY

ISTEA MGMT SYSTEM

PAVEMENT MGMT SYSTEM (ISTEA)

PMIS* HPMS

BRIDGE MGMT SYSTEM (ISTEA)

BDG* *PONTIS*

CONGESTION MGMT SYSTEM (ISTEA)

IVHS TAF* *ATMS* *HOV* *PASSERII*

INTERMODAL MGMT SYSTEM (ISTEA)

SAFETY MGMT SYSTEM (ISTEA)

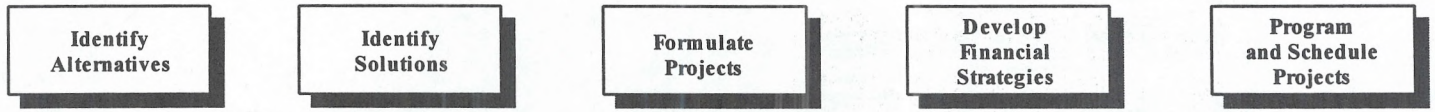
SWS

PUBLIC TRANSIT MGMT SYSTEM (ISTEA)

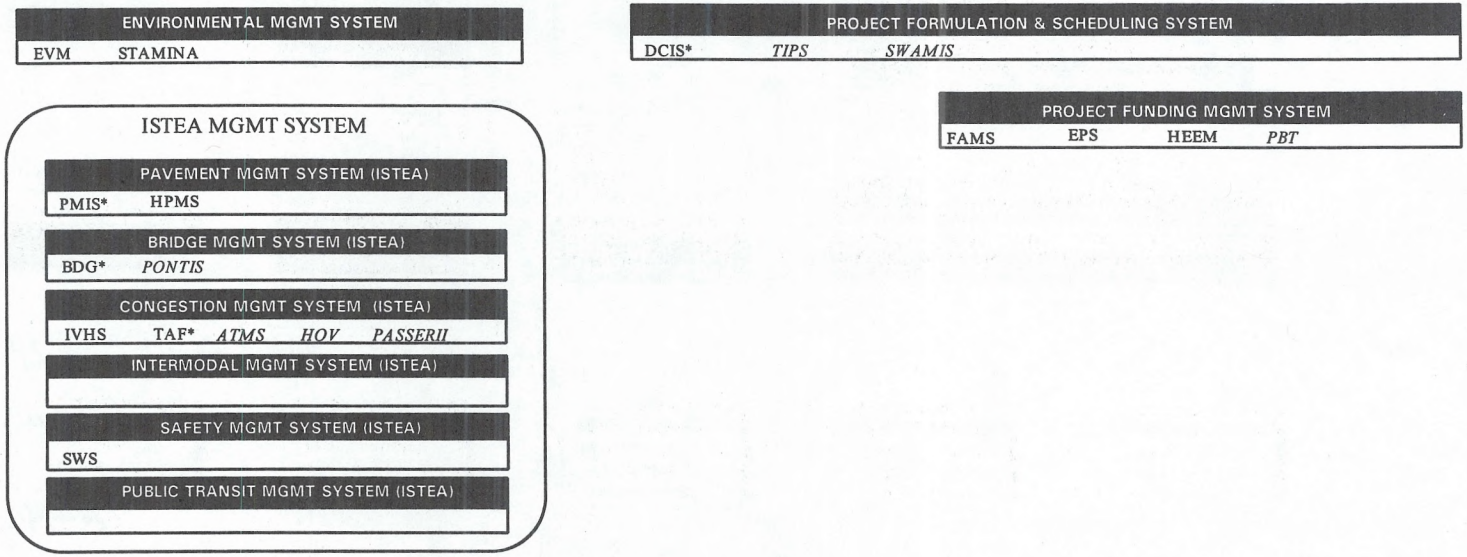
* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Plan Transportation Systems

PROCESSES:



FUTURE LOGICAL APPLICATION SYSTEMS:



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Design Transportation Systems

PROCESSES:

- **Conduct Preliminary Design**
- **Conduct Final Design**
- **Prepare Plans, Specifications & Estimates**
- **Develop Specifications**
- **Secure Project Approvals**

FUTURE LOGICAL APPLICATION SYSTEMS:

DESIGN DEVELOPMENT SYSTEM				
IGRDS	BFAST	OSB6	PSTRS14	SDMS
RDS	COSB1	SIGNAL	THYSYS	CAiCE
SIGNSZ	CAP18	B30	IGBENT	
TRFSGN	CULV5	TXTOM	STAAD	
PCACOL	DCIS*	APP*	PLANV*	

MAPPING SYSTEM			
TRIMS	GPS	POSTADT	PHOTOGRAMMETRY

PLAN & SPECIFICATION DEVELOPMENT SYSTEM			
ABUT	BLS	CULVERT	RWALL
APP*	IGSEG	PLANV*	SPAN
USF			

BID MGMT SYSTEM	
BPS	CBS (CMCS)
BAMS	LET (CMCS)

PROJECT APPROVAL MGMT SYSTEM

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Deliver Transportation Systems

PROCESSES:

- **Prepare for Projects**
- **Administer Projects**
- **Monitor Projects**
- **Close Projects**

FUTURE LOGICAL APPLICATION SYSTEMS:

PROJECT MGMT SYSTEM
CCF RL1 MMIS (SES)* MEARS* *MSS*

CONTRACT MGMT SYSTEM
CIS(CMCS) CTS SMS*

QUALITY MONITORING SYSTEM
MCS

HUB TRACKING MGMT SYSTEM
SMS*
SMBS

Financial System

FINANCIAL MGMT SYSTEM
FIMS VPS
SLD(SES) PAY

REVENUE COLLECTION SYSTEM
CPS* RTS* *MVAR*
IRP* ~~TXH*~~

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Maintain & Operate Trans. Systems

PROCESSES:

- **Monitor & Analyze Movement and Condition**
- **Develop Alternatives and Solutions**
- **Restore & Improve Movement and Condition**
- **Provide User Information & Safety Awareness to Customers**

FUTURE LOGICAL APPLICATION SYSTEMS:

ISTEA MGMT SYSTEM

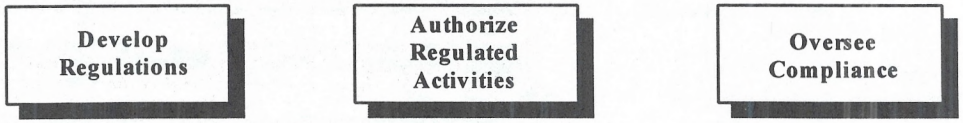
- **PAVEMENT MGMT SYSTEM (ISTEA)**
  - PMIS* HPMS
- **BRIDGE MGMT SYSTEM (ISTEA)**
  - BDG* PONTIS
- **CONGESTION MGMT SYSTEM (ISTEA)**
  - *IVHS* TAF* *ATMS* *HOV* *PASSERII*
- **INTERMODAL MGMT SYSTEM (ISTEA)**
- **SAFETY MGMT SYSTEM (ISTEA)**
  - SWS
- **PUBLIC TRANSIT MGMT SYSTEM (ISTEA)**

- **MAINTENANCE MGMT SYSTEM**
  - MMIS(SES)* MEARS*
- **TRANSPORTATION INFORMATION SYSTEM**
  - HCR
- **SAFETY MGMT SYSTEM (ISTEA)**
  - SWS

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Regulate Transportation Systems

PROCESSES:



FUTURE LOGICAL APPLICATION SYSTEMS:

REGULATION, AUTHORIZATION & COMPLIANCE SYSTEM						
CPS*	IRP*	RTS*	~~SPC~~	~~RRA~~	*HBA*	*CDC*

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Fiscal Services

PROCESSES:

- **Forecast Financial Needs**
- **Prepare, Monitor, and Adjust Budget**
- **Provide an Accounting of Fiscal Resources**
- **Collect Receivables**
- **Make Payments**

FUTURE LOGICAL APPLICATION SYSTEMS:

FINANCIAL FORECASTING & BUDGETING SYSTEM		
BUD	*BOP*	*CFS*

Financial System

FINANCIAL MGMT SYSTEM			
FIMS	SLD(SES)	VPS	PAY

REVENUE COLLECTION SYSTEM	
CPS*	RTS*
IRP*	~~TXII~~
MVAR	

PROJECT FUNDING MGMT SYSTEM			
FAMS	EPS	HEEM	*PBT*

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Information Services

PROCESSES:

- **Analyze Info. Resource Needs**
- **Provide Info. Resource Standards**
- **Provide & Support Enabling Technologies**
- **Develop and Support Applications**
- **Perform Information Communications Services**
- **Provide Info. Tech. Consulting/ Customer Service**

FUTURE LOGICAL APPLICATION SYSTEMS:

TECHNOLOGY NEEDS MGMT SYSTEM	
OPA	PJS

INFORMATION TECHNOLOGY MGMT SYSTEM		
MICS	*ACID*	NCS

APPLICATION MGMT SYSTEM	
DOTS	MDC
PDL	TACS

IR HELP DESK

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Human Resources

PROCESSES:

- Analyze Staffing Needs
- Hire Workforce
- Develop and Retain Staff
- Provide Benefits
- Design and Deliver Training
- Promote Safe Work Environment

FUTURE LOGICAL APPLICATION SYSTEMS:

Staff Needs Management System

STAFF FORECASTING SYSTEM	RECRUITING & APPLICANT MGMT SYSTEM
	JAT

Human Resource Management System

EMPLOYEE MGMT SYSTEM	BENEFITS MGMT SYSTEM	TRAINING MGMT SYSTEM	WORKPLACE SAFETY MGMT SYSTEM
HRIS CPP	VSL ~~BEN~~	RGN *PHOENIX*	SDA
~~PER~~ DRC	INA ~~INS~~		
ECT	~~PIF~~		

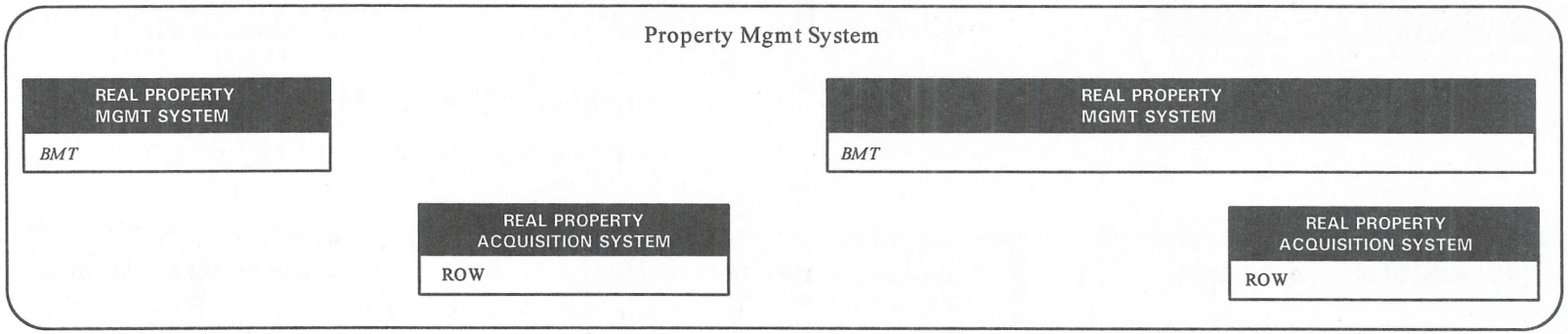
* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Real Property

PROCESSES:

- **Analyze Internal Facility and Real Property Needs**
- **Obtain Real Property and Improvements**
- **Provide Internal Facilities**
- **Manage Real Property and Facilities**

FUTURE LOGICAL APPLICATION SYSTEMS:



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Equipment, Materials & Supplies

PROCESSES:

Analyze Equipment, Material, and Supply Needs

Purchase Equipment, Materials, and Supplies

Manage Equipment, Materials, and Supplies

FUTURE LOGICAL APPLICATION SYSTEMS:

Materials & Equip Mgmt System

MATERIAL MGMT SYSTEM
MSMS(SES)

EQUIPMENT MGMT SYSTEM	
ARMS	PJS*
EOS(SES)	
MES	

PROCUREMENT SYSTEM		
APS*	~~ARRS~~	*PRT*

VENDOR MGMT SYSTEM		
CBS(CMCS)	UVD	APS*

Materials & Equip Mgmt System

MATERIAL MGMT SYSTEM
MSMS(SES)

EQUIPMENT MGMT SYSTEM	
ARMS	PJS*
EOS(SES)	
MES	

* - Application Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Contracted Services

PROCESSES:

- **Prepare for Bids & Proposals**
- **Prepare, Award and Execute Contracts**
- **Provide Administrative Contract Support**

FUTURE LOGICAL APPLICATION SYSTEMS:

BID MGMT SYSTEM
BPS CBS(CMCS)
BAMS LET(CMCS)

VENDOR MGMT SYSTEM
CBS(CMCS) UVD
APS*

CONTRACT MGMT SYSTEM
CIS(CMCS) CTS SMS*

BID MGMT SYSTEM
BPS CBS(CMCS)
BAMS LET(CMCS)

Financial System

FINANCIAL MGMT SYSTEM
FIMS SLD(SES)
VPS PAY

REVENUE COLLECTION SYSTEM
CPS* RTS* IRP*
~~TXII*~~ *MVAR*

HUB TRACKiNG MGMT SYSTEM
SMS* SMBS

* ation Appears In More Than One Logical Application System *Italicized* Applications Are Not Supported By ISD ~~ABC~~ Application will be eliminated

Logical Applications System Definitions:

Application Management System:

An application system which captures inventory data regarding applications throughout the department, upgrade and new release information and version control functions.

Benefits Management System:

An application system which captures and tracks data related to employee benefit plans including insurance, worker's compensation, employee assistance, retirement plans, etc.

Bid Management System:

A system which encompasses all activities related to bid development including production and distribution of bid proposals, bid analysis and contract awarding.

Bridge Management System (ISTEA):

An application system that supplies analysis and summaries of data, uses mathematical models to make predictions and recommendations, and provides the means by which alternative policies and programs may be efficiently considered.

Congestion Management System (ISTEA):

A system that provides information on transportation system performance and alternative strategies to alleviate congestion and enhance the mobility of people and goods (e.g., ITS).

Contract Management System:

A system which supports the management of all contract activities including writing the contract, monitoring contract compliance, and supporting department functions responsible for project management and oversight of contracted services.

Design Development System:

An application system which supports transportation system project design from initiation through final design, including schematics, cost estimates and design details.

Employee Management System:

A system which captures employee data and manages employee development through career planning, performance evaluations and compensation determination, etc.

Environmental Management Information System:

A system which will inventory environmental locations (e.g., hazardous, wetlands, etc.), collect data regarding the impact of transportation systems on the environment (e.g., noise levels, air pollutants) and forecast and analyze the impact of transportation systems on the environment.

Equipment Management System:

An application which supports the evaluation of fixed asset needs, tracks inventory utilization, preventative maintenance schedules and equipment distribution.

Financial Forecasting & Budgeting System:

A system which quantifies the departments future financial needs and allocates money to planned expenditures. The system also monitors and adjusts the allocation of money between budget cycles.

Financial Management System:

A system which tracks and monitors actual financial transactions including receivables, payables and payroll. In addition, the system maintains accounts, balances and historical transaction data.

HUB Tracking Management System:

A system which monitors the participation of HUBs in the department's contracting activities and monitors compliance with legislative and department goals.

Information Technology Management System:

An application which supports the effective utilization of the department's technology resources through security, network management, etc.

Intermodal Management System (ISTEA):

A system to identify linkages between one or more modes of transportation, where the performance or use of one mode will affect another, defining strategies for improving the effectiveness of these interactions, and the evaluation and implementation of these strategies. This system does not collect the underlying data to perform these analyses.

IR Help Desk System:

An application system which diagnoses and tracks hardware, software and telecommunication problems, and facilitates providing user assistance.

Maintenance Management System:

An application system which records and monitors those activities which are performed to preserve and/or restore system flow including resource assignments, scheduling and monitoring maintenance effectiveness.

Mapping System:

An application system that translates inventory and traffic statistics into graphical representations assisting in the evaluation of transportation system conditions in order to identify transportation needs. The Mapping System also supports transportation system design by graphically presenting topographical detail.

Material Management System:

An application which inventories materials, and monitors inventory levels to insure adequate supplies.

Pavement Management System (ISTEA):

An application system that collects and analyzes pavement information to select cost-effective strategies for providing and maintaining pavements in a serviceable condition.

Performance Goal Management System:

A system to identify multimodal transportation performance goals, including monitoring actual performance against the established goals.

Plan & Specification Development System:

A system which supports the creation or drafting of plan/profile sheets and maintenance and publication of specifications.

Procurement System:

An application system which supports the selection and acquisition of equipment and materials. Functions include approving purchase requests, maintaining item catalogs, vendor selection and purchase orders.

Project Approval Management System:

A system which assists in the management and coordination of securing necessary project approvals from internal and external entities.

Project Formulation & Scheduling System:

An application system that identifies transportation system projects. The application also supports prioritizing and scheduling projects for letting.

Project Funding Management System:

A system which defines funding apportionments to districts and matches available funding to prioritized projects.

Project Management System:

An application system that supports all transportation system project management activities including resource assignment, estimating, scheduling, status reporting and project acceptance.

Public Transit Management System (ISTEA):

An application system which analyzes existing transit asset conditions to identify strategies necessary to improve transit performance.

Quality Monitoring System:

A system which collects quality control data for all aspects of project development including project inspection and material testing. Results are compared to

specifications to determine acceptance.

Real Property Acquisition System:

An application system which supports acquiring real property for internal use by the department as well as transportation system property and facilities. The application functions would include tracking appraisals, insurance, surveys, etc.

Real Property Management System:

An application system which tracks internal property and facility needs, and maintains, protects and manages land and improvements acquired or leased by the department. This application assists in managing the construction, remodeling or demolition of facilities.

Recruiting & Applicant Management:

An application which provides for recruiting and hiring qualified individuals to meet staff forecasts.

Regulation, Authorization & Compliance System:

An application system which supports authorizing regulated activities via licenses, permits, registrations, etc. in compliance with legislated mandates. Compliance is monitored for subsequent renewal or canceling of the authorization.

Revenue Collection System:

An application system which collects financial resources owed or entitled to the department.

Safety Management System (ISTEA):

A system to assist in the creation of highway safety goals, including the collection and analysis of data necessary to develop and implement safety programs and educational activities.

Staff Forecasting System:

A system which provides the functionality necessary to forecast, plan and allocate staff positions based on skill requirements and workload assessments.

Technology Needs System:

An application system which identifies technology resource requirements such as skills, services, equipment and materials.

Traffic Operation Statistics System:

A system to capture and warehouse statistics about the movement of goods and people across transportation system structures (e.g., traffic volume, accident statistics).

Training Management System:

An application system which schedules and registers employees for internal and external training needs. The system also inventories existing training courses and matches courses with staff training needs.

Transportation Information System:

An application system which supports the dissemination of transportation information to the public.

Transportation Inventory & Condition System:

A system to capture data related to physical transportation system structure inventories and the condition of those structures.

Travel Demand Forecasting System:

A modeling application to simulate travel and project/forecast travel demand on all transportation modes.

Vendor Management System:

An application system which identifies vendors qualified to conduct business with the department and captures data relevant to the administration of these vendors.

Workplace Safety Management System:

An application system which monitors compliance with legislated guidelines (OSHA, ADA) and assists in developing and maintaining safety standards and educational programs.

APPLICATION MIGRATION:

The Application Migration identifies the strategy for transitioning from the current application portfolio to the application environment described in the Application Architecture. The existing applications are compared to the logical application systems identified by the Application Architecture, to identify application "gaps". Finally, the general approach for migrating to the new Application Architecture is outlined.

There are two components to the Application Migration:

- Application Gap Analysis
- Application Migration Approach

The ***Application Gap Analysis*** identifies the 'gap' between processes identified in a logical application system and the current applications.

The ***Application Migration Approach*** identifies the strategy for migrating from the current application environment to the new Application Architecture.

Additionally, Appendix 11, an IEF matrix, identifies the current applications that support each business area and each business process.

Application Gap Analysis:

This section defines the degree to which the current application portfolio matches the new Application Architecture. Each new logical application system was examined in relationship to the existing applications considered to be within the scope of the logical application system.

The 'gap' between the current application support and the future application system requirements was evaluated as follows:

Small gap The logical application system is mostly or fully supported by the current applications.

Medium gap Some applications exist to support the new logical application system, but some functionality is not supported.

Large gap The logical application system is not supported by the existing applications.

For clarity, each logical application system is followed by its definition. The definition is followed by general comments explaining the 'gap' evaluation.

Application Management System **Large gap**

An application system which captures inventory data regarding applications throughout the department, upgrade and new release information and version control functions.

Gap Comments:

- Application(s) do not exist
- Some inventory data can be found in Program Documentation Log (PDL)

Benefits Management System **Small gap**

An application system which captures and tracks data related to employee benefit plans including insurance, worker's compensation, employee assistance, retirement plans, etc.

Gap Comments:

- Employee benefits are adequately tracked
- Provide decision making tool for employee to select benefits package

Bid Management System **Small gap**

A system which encompasses all activities related to bid development including production and distribution of bid proposals, bid analysis and contract awarding.

Gap Comments:

- Service contracts not fully supported
- Applications currently being modified for maintenance contracts

Bridge Management System (ISTEA) **Medium gap**

An application system that supplies analysis and summaries of data, uses mathematical models to make predictions and recommendations, and provides the means by which alternative policies and programs may be efficiently considered.

Gap Comments:

- Lack of effective models to evaluate bridge conditions, predict needs and suggest alternative solutions

Congestion Management System (ISTEA) **Large gap**

A system that provides information on transportation system performance and alternative strategies to alleviate congestion and enhance the mobility of people and goods (e.g., ITS).

Gap Comments:

- Most application support is provided by non-ISD applications

Contract Management System **Medium gap**

A system which supports the management of all contract activities including writing the contract, monitoring contract compliance, and supporting department functions responsible for project management and oversight of contracted services.

Gap Comments:

- No ISD application support for writing contracts and change orders
- Applications currently being modified for maintenance contracts
- Add management of service contracts

Design Development System **Small gap**

An application system which supports transportation system project design from initiation through final design, including schematics, cost estimates and design details.

Gap Comments:

- Many automated tools available
- Link plan sheets with DCIS components to prepare cost estimations

Employee Management System **Small gap**

A system which captures employee data and manages employee development through career planning, performance evaluations and compensation determination, etc.

Gap Comments:

- Good employee tracking application support
- Automate employee performance planning processes

Environmental Management Information System **Large gap**

A system which will inventory environmental locations (e.g., hazardous, wetlands, etc.), collect data regarding the impact of transportation systems on the environment (e.g., noise levels, air pollutants) and forecast and analyze the impact of transportation systems on the environment.

Gap Comments:

- Environmental location inventory does not exist
- Improve models to forecast environmental impact and suggest alternative methods

Equipment Management System **Medium gap**

An application which supports the evaluation of fixed asset needs, tracks inventory utilization, preventative maintenance schedules and equipment distribution.

Gap Comments:

- Add 'expert system' capability to match user needs with equipment (user should not have to know what equipment he needs)
- Add preventive maintenance capabilities
- Add maintenance tracking for automation and minor equipment
- Capture and monitor automation equipment utilization

Financial Forecasting & Budgeting System **Medium gap**

A system which quantifies the department's future financial needs and allocates money to planned expenditures. The system also monitors and adjusts the allocation of money between budget cycles.

Gap Comments:

- Improve modeling to forecast financial needs
- Improve useability of budget preparation application

Financial Management System **Small gap**

A system which tracks and monitors actual financial transactions including receivables, payables and payroll. In addition, the system maintains accounts, balances and historical transaction data.

Gap Comments:

- Application and reports are difficult to use
- Add functionality to distribute overhead costs

HUB Tracking Management System **Medium gap**

A system which monitors the participation of HUBs in the department's contracting activities and monitors compliance with legislative and department goals.

Gap Comments:

- Add analysis of actual compliance against performance goals

Information Technology Management System **Small gap**

An application which supports the effective utilization of the department's technology resources through security, network management, etc.

Gap Comments:

- Technology management tools available
- Gaps may be defined dependent on new technology architectures

Intermodal Management System (ISTEA) **Large gap**

A system to identify linkages between one or more modes of transportation, where the performance or use of one mode will affect another, defining strategies for improving the effectiveness of these interactions, and the evaluation and implementation of these strategies. This system does not collect the underlying data to perform these analyses.

- Application(s) do not exist

Information Resource (IR) Help Desk System **Large gap**

An application system which diagnoses hardware, software and telecommunication problems, and facilitates providing user assistance.

Gap Comments:

- Application(s) do not exist

Maintenance Management System **Medium gap**

An application system which records and monitors those activities which are performed to preserve and/or restore system flow including resource assignments, scheduling and monitoring maintenance effectiveness.

Gap Comments:

- Existing Maintenance Management Information System (MMIS) requires data at inappropriate level of detail
- Add 'project management' functionality (resource assignments, scheduling, etc.)
- Add capability to record effectiveness and use results in future decision making

Mapping System **Medium gap**

An application system that translates inventory and traffic statistics into graphical representations assisting in the evaluation of transportation system conditions in order to identify transportation needs. The Mapping System also supports transportation system design by graphically presenting topographical detail.

Gap Comments:

- Preparation of property maps needs to be more fully automated
- Use GIS technology

Material Management System **Small gap**

An application which inventories materials, and monitors inventory levels to insure adequate supplies.

Gap Comments:

- Good application support

Pavement Management System (ISTEA) **Small gap**

An application system that collects and analyzes pavement information to select cost-effective strategies for providing and maintaining pavements in a serviceable condition.

Gap Comments:

- Pavement Management Information System (PMIS), currently being developed, should satisfy the modeling and planning requirements of this ISTEA application

Performance Goal Management System **Large gap**

A system to identify multimodal transportation performance goals, including monitoring actual performance against the established goals.

Gap Comments:

- Application(s) do not exist

Plan & Specification Development System **Small gap**

A system which supports the creation or drafting of plan/profile sheets and maintenance and publication of specifications.

Gap Comments:

- Potentially link business and engineering platforms

Procurement System **Small gap**

An application system which supports the selection and acquisition of equipment and materials. Functions include approving purchase requests, maintaining item catalogs, vendor selection and purchase orders.

Gap Comments:

- Request number, requisition number and purchase order numbers must be linked

Project Approval Management System **Large gap**

A system which assists in the management and coordination of securing necessary project approvals from internal and external entities.

Gap Comments:

- Application(s) do not exist

Project Formulation & Scheduling System **Large gap**

An application system that identifies transportation system projects. The application also supports prioritizing and scheduling projects for letting.

Gap Comments:

- Current applications are specific to highway construction projects
- Add functionality to evaluate needs, formulate and prioritize projects among all modes

Project Funding Management System **Large gap**

A system which defines funding apportionments to districts and matches available funding to prioritized projects.

Gap Comments:

- Improve functionality to allocate funds equitably and document allocation
- Current ISD application does not support fund management for all project types

Project Management System **Large gap**

An application system that supports all transportation system project management activities including resource assignment, estimating, scheduling, status reporting and project acceptance.

Gap Comments:

- Improve project management tools (resource allocation, Critical Path analysis)
- Excessive documentation required by MMIS; inappropriate level of detail

Public Transit Management System (ISTEA) **Large gap**

An application system which analyzes existing transit asset conditions to identify strategies necessary to improve transit performance.

Gap Comments:

- Application(s) do not exist

Quality Monitoring System **Large gap**

A system which collects quality control data for all aspects of project development including project inspection and material testing. Results are compared to specifications to determine acceptance.

Gap Comments:

- Application support only for material testing
- Incorporate other inspections
- Add monitoring capabilities

Real Property Acquisition System **Large gap**

An application system which supports acquiring real property for internal use by the department as well as transportation system property and facilities. The application functions would include tracking appraisals, insurance, surveys, etc.

Gap Comments:

- Application(s) do not exist

Real Property Management System **Large gap**

An application system which tracks internal property and facility needs, and maintains, protects and manages land and improvements acquired or leased by the department. This application assists in managing the construction, remodeling or demolition of

facilities.

Gap Comments:

- Application(s) do not exist

Recruiting & Applicant Management **Medium gap**

An application which provides for recruiting and hiring qualified individuals to meet staff forecasts.

Gap Comments:

- 'Prepare and Post job openings' is the only activity supported by current applications
- Add decision-support capability for screening applicants

Regulation, Authorization & Compliance System **Medium gap**

An application system which supports authorizing regulated activities via licenses, permits, registrations, etc. in compliance with legislated mandates. Compliance is monitored for subsequent renewal or canceling of the authorization.

Gap Comments:

- No support for authorization of environmental permits and outdoor advertising sign licenses
- Support needed for compliance monitoring activities

Revenue Collection System **Small gap**

An application system which collects financial resources owed or entitled to the department.

Gap Comments:

- Current revenue collection is dispersed in several applications
- No automated interface to Financial Information Management System (FIMS)

Safety Management System (ISTEA) **Medium gap**

A system to assist in the creation of highway safety goals, including the collection and analysis of data necessary to develop and implement safety programs and educational activities.

Gap Comments:

- Lack of effective models to predict needs and suggest alternative programs
- No application support for safety educational programs

Staff Forecasting System **Large gap**

A system which provides the functionality necessary to forecast, plan and allocate staff positions based on skill requirements and workload assessments.

Gap Comments:

- Application(s) do not exist

Technology Needs System **Large gap**

An application system which identifies technology resource requirements such as skills, services, equipment and materials.

Gap Comments:

- Add 'expert system' capability to match user needs with required equipment
- Add estimating functionality (estimate workload, dollars, time)

Traffic Operation Statistics System **Large gap**

A system to capture and warehouse statistics about the movement of goods and people across transportation system structures (e.g., traffic volume, accident statistics).

Gap Comments:

- This application system is intended to be a primary data collector for the ISTEA systems; must add functionality for Environmental, Intermodal, and Public Transit segments
- Socio-economic data is not collected
- Current data collection techniques antiquated
- Applications focus on highway usage; not multimodal
- Current applications difficult to use

Training Management System **Small gap**

An application system which schedules and registers employees for internal and external training needs. The system also inventories existing training courses and matches courses with staff training needs.

Gap Comments:

- Scheduling/registration application is adequate
- Add application to match employee training needs with available training

Transportation Information System **Medium gap**

An application system which supports the dissemination of transportation information to the public.

Gap Comments:

- Existing application support specific to highway conditions

Transportation Inventory & Condition System **Large gap**

A system to capture data related to physical transportation system structure inventories and the condition of those structures.

Gap Comments:

- This application system is intended to be a primary data collector for the ISTEA systems; must add functionality for Environmental, Intermodal and Public

Transit segments
- Current applications specific to highway and pavement; not multimodal
- Existing applications old and difficult to use
- Potential for GIS technology

Travel Demand Forecasting System **Large gap**

A modeling application to simulate travel and project/forecast travel demand on all transportation modes.

Gap Comments:
- Almost all application support comes from non-ISD applications
- Lack of models for rural areas and alternative routes

Vendor Management System **Small gap**

An application system which identifies vendors qualified to conduct business with the department and captures data relevant to the administration of these vendors.

Gap Comments:
- Some redundancy in vendor applications
- Needs to capture information about past performance

Workplace Safety Management System **Large gap**

An application system which monitors compliance with legislated guidelines (OSHA, ADA) and assists in developing and maintaining safety standards and educational programs.

Gap Comments:
- Application(s) do not exist

Application Migration:

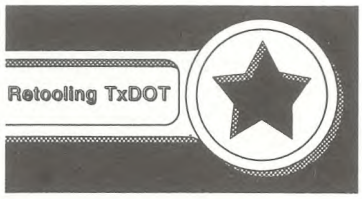
The migration to the new Application Architecture will be defined in each of the business process retooling (BPR) efforts. After a detailed analysis of the improved business processes, the retooling team will evaluate how well the current applications support the business processes. These evaluations will be used to refine the Application Gap Analysis. Each BPR will then define the new applications and enhancements to current applications that are required to implement the Application Architecture. The application migration strategy from each BPR will also include the sequencing, dependencies and scheduling of the application projects. Incorporating the migration strategy into each business process retooling project facilitates a migration based on the business needs and priorities of each business area.

CHAPTER IV

INFORMATION ARCHITECTURES

TECHNOLOGY

SECTION C



Texas Department of Transportation

Section C
Technology

●●●●●●●●●●●●●●

OVERVIEW:

The rapidly changing nature of today's technology environment combined with TxDOT's changing business needs requires that TxDOT clearly define the department's technology direction. The technology direction will provide guidance in creating and implementing the infrastructure necessary to support the shift from application methodologies, architectures and tools that foster a legacy system environment to one that supports a customer-driven, rapid application and service delivery environment. This shift will better enable TxDOT to carry out its goals and objectives in the future by providing an information systems environment that can be easily and quickly changed to meet TxDOT's changing business needs. The Technology Architecture outlines the strategic direction regarding twelve technologies that will be vital to providing a technology infrastructure for the department in the future. These technologies include:

- Application Development Tools
  - Integrated Computer-Aided Software Engineering (I-CASE)
  - Fourth Generation Languages (4GL)
  - Personal Application Development Tools
  - End-user Reporting Tools
- User Interfaces
- Relational Database Management Systems (RDBMS)
- Client/Server
- Desktop Operating Systems
- Bar Coding
- Document Management/Imaging
- Telecommunications
- Mobile Computing/Remote Data Collection
- Videologging
- Global Positioning Systems (GPS)
- Geographic Information Systems (GIS)

The technology architecture has been created to support the following objectives:

- Provide direction on the establishment of "infrastructure" technologies necessary to support the Business Process Retooling effort
- Support the data and application migration strategies

- Provide input to project definition, approval and prioritization to insure that projects are consistent with the department's technology direction
- Support the department's Information Resource mission, vision, goals and objectives

In addition to the objectives stated above, the technology architecture should support the information resources technology objectives which include:

- Moving TxDOT towards a position of technology leadership
- Creating an environment in which TxDOT is willing to replace its investment in technology when appropriate
- Increasing the ability of end users to access information
- Increasing the degree of computerization within the department
- Significantly increasing the level of customer service provided
- Promoting the use of software packages when appropriate
- Positioning TxDOT to provide vendors with TxDOT's stated technology objectives to assist vendors in meeting TxDOT's future technology needs, rather than the marketplace driving technology at TxDOT

TECHNOLOGY IDENTIFICATION:

Statements of direction have been created for the group of technologies that are necessary infrastructure technologies for the department. The process for updating the BISP will provide the mechanism for reviewing new technologies and refining the direction statements each year. The technologies were identified and evaluated in a series of workshops that included district, division and special office representatives. In order to identify technologies that would qualify as infrastructure technologies, a long list of technologies were evaluated against criteria which indicated the technology's support for Business Process Retooling, the data and application architectures, and the department's technology objectives. A risk and impact factor was assigned to each technology. Risk was determined by reviewing the technology with regard to:

- How complex is the environment?
- What is TxDOT's level of experience with the technology?
- Will external resources be necessary?
- Is the technology mature?
- How easily can the technology be implemented?
- Is the technology proprietary?
- Are there available resources to support the technology?

The impact of the technology on TxDOT was assessed by analyzing the following criteria:

- How many users are effected (statewide and local)?
- What level of resources may be necessary (people, money, equipment)?
- Are current applications or technologies impacted?
- What level of maintenance and support is necessary?
- Does the technology impact multiple organization units?

Figure 4.1 summarizes the business case for the technologies for which a statement of direction has been developed. The check marks indicate which architecture or technology objective the technology supports strongly.

BUSINESS CASE FOR TECHNOLOGY DIRECTION

	I-CASE	4GLs	Individual Development Tools	End-User Reporting Tools	User Interface	Relational Databases	Client/Server	Desktop Operating Systems	Bar-Coding	Document Management	Telecommunications	Remote Data Collection	Videologging	GPS	GIS
Business Area Analysis:															
Methodology Support	☑														
RAD Support	☑	☑				☑				☑					☑
Data Architecture:															
Enterprise Model	☑					☑									
Distributed Data	☑					☑	☑				☑				☑
Data Integration	☑					☑									☑
Application Architecture:															
User Interfaces	☑	☑			☑		☑	☑	☑	☑		☑	☑		☑
Technology Objectives:															
Technology Leadership	☑	☑			☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
IS Investment Replacement	☑	☑			☑	☑	☑	☑		☑	☑	☑	☑		☑
Ad Hoc End-User Access			☑	☑		☑	☑			☑		☑	☑		☑
Increase Degree of Computerization			☑	☑	☑		☑		☑	☑	☑	☑	☑	☑	
Increase Customer Service Level	☑	☑	☑	☑	☑		☑		☑	☑	☑	☑	☑	☑	☑
Increase Package Use					☑	☑		☑							
Decrease Vendor Dependence						☑									
Risk (1=Low, 5=High)	4	2	3	1	2	3	4	4	1	5	5	2	3	3	5
Impact (1=Low, 5=High)	2	2	3	1	3	4	5	5	2	5	5	4	2	3	4

Figure 4.1 - Business Case For Technology Direction

TECHNOLOGY IMPLEMENTATION:

The department should not expect an immediate roll-out of these technologies. The intent of the direction statements is to identify the technologies that the department must consider to create a sound infrastructure for the future. As such, these direction statements must not be perceived as policy or procedure for implementing a specific technology. The inclusion of any particular technology in this strategic plan does not authorize the implementation of this technology by any district, division, or special office. A series of projects has been defined in the Technology Projects section of the BISP to evaluate products, set standards and develop policies and procedures for implementing these infrastructure technologies. The active involvement of districts, divisions and special offices will be required for the implementation of these technology projects. Refer to chapter five for more information about the technology projects.

TECHNOLOGY RESOURCES:

In order to adequately implement the technologies set forth in the technology architecture, considerable resources will be required. Most of the technologies require the expenditure of resources for hardware, software, training and ongoing support to various degrees. The successful implementation of any of the technologies will require not only the investment in hardware and software, but an equal or greater investment in information technology professionals and end users trained in the appropriate use of the technology. This will be necessary to gain the full potential of updating TxDOT's infrastructure to support the future information technology needs of the department. Besides training, an investment in providing an effective level of ongoing support for each technology will be necessary to maintain and maximize the benefits of the technology architecture and meet the service level requirements of users throughout the department.

The dedication of personnel resources to research new technologies and the commitment to providing quality training for these professionals are critical success factors for information resources at TxDOT. The rapidly decreasing life cycle of new technologies combined with the department's desire to identify and implement emerging technologies will require improvement in the delivery of IS staff and user technology training. It will be critical for management, Information Services staff and employees to be willing to accept and learn new technologies as they become available.

DIRECTION STATEMENTS:

The key to the successful development of the future technology infrastructure will be the integration of all technologies. Although each technology is addressed separately, each must be considered in relationship to the impact and support it provides to other technologies.

Application Development Tools:

Application development is widely dispersed throughout the department, as indicated by the large number of applications developed by district/division automation staffs and end users. This trend will continue as the availability of powerful and easy-to-use application development tools increases. Additionally, new tools are needed to support the business process retooling efforts and rapid application development approach. In order for the department to take advantage of these tools in an integrated development environment, specific technical direction statements have been created for the following development tools:

- Integrated Computer-Aided Software Engineering (I-CASE) Tools
- Fourth Generation Languages (4GL)
- Employee Application Development Tools
- End-User Reporting Tools

Application Types: The effective use of these tools hinges on applying the proper tool set to each type of application development project. For example, the development of a mission-critical statewide application requires a much more rigorous approach and tool set than the development of an employee application. Therefore, selection of the proper tool set should be based on the type of application to be developed. Applications are divided into three categories:

- Employee
- Business Unit/Work Group
- Enterprise

Generally, employee applications are built and used by a limited set of users. Although the application may be copied and shared with others, the users do not share a common database (e.g., signboard tracking). Business unit and work group applications provide data access and update for one business unit, despite geographic location (e.g., occupational safety system). These applications should be driven by the application and data architectures and be consistent with the business model. Because a larger group of users rely on applications of this type, good development tools and practices must be used to ease ongoing maintenance and enhancements. Enterprise applications support a large number of diverse users from more than one business unit (e.g., equipment inventory).

These applications usually reflect mission critical applications that contain complex business logic, requiring more analytical modeling tools. Enterprise applications are more often developed by a team of developers, requiring tools with project repository capabilities.

The organizational roles and responsibilities for these application types are discussed in the Information Resources Organization strategy. Additionally, policies and procedures will be developed to further define the appropriate usage of these application categories.

Integrated Computer-Aided Software Engineering (I-CASE):

Statement of Direction: I-CASE tools should be implemented for the development of enterprise applications. I-CASE must also be considered for development of business unit/work group applications with mission-critical business logic and rules.

I-CASE tools automate the complete application development cycle, including planning, analysis and requirements definition (via modeling tools) and design and construction (via screen designers, generators and testing aids). The I-CASE modeling features facilitate the integration of applications, since applications share a common set of business rules. The diagraming and prototyping capabilities of I-CASE tools encourage end-user involvement and improve communication between the user and development team, resulting in higher quality applications. Code generators will speed the development of program logic. The model-driven approach to application development that will be deployed with these tools also facilitates the use of packaged and borrowed model-driven solutions.

Fourth-Generation Languages (4GL):

Statement of Direction: Although I-CASE is the chosen development approach for enterprise application development, 4GL tools can be used for application development when warranted by a strong business case. For example, the department will need to continue to support the ongoing use of Software AG's Natural language at least until legacy applications dependent on Natural are replaced. From a business perspective, Natural is required to efficiently maintain many existing applications.

4GL is a class of programming languages that are easier to use than traditional programming languages like COBOL and Assembler, allowing applications to be developed more quickly. 4GL are also compatible with the other components of the infrastructure by supporting newer data technology and graphical user interface (GUI) development. 4GL are often embedded in I-CASE tools.

Employee Application Development Tools:

Statement of Direction: A core set of employee application development tools will be selected and available on a statewide basis. Candidate applications for these tools are those that have the following characteristics:

- Are developed by only one or two developers
- Are not expected to generate reusable code
- Contain simple business logic
- Do not create or use shared data
- Require limited maintenance or ongoing enhancements

Employee application development tools provide some of the same functionality as fourth-generation languages such as screen design aids, English-like programming commands and code generators. However, since these employee application development tools are not as robust as the I-CASE and 4GL tools, they are less complicated and easier to use. These tools are ideal for small applications with simple business logic. By deploying these tools, users can develop unique applications for specific business needs.

There are risks associated with employee application development, including possible redundancy of effort, duplication of data, and no enforcement of standards. However, if these tools are used in the appropriate situation, the benefits should outweigh the risks.

End-User Reporting Tools:

Statement of Direction: Easy-to-use reporting tools should be available to end users to improve data access and reporting capabilities. A core set of these tools must be identified, including the requirement that the tools must be adaptable to multiple, concurrent database environments.

These tools assist the user in accessing the information they need in the format they prefer. The reporting tools can also be used to analyze, manipulate and visualize data, thereby supporting the decision-making process. With these tools at their fingertips, users will receive information in a more timely manner, increasing customer satisfaction.

Tool set Selection:

Statement of Direction: The statement of direction for the preceding tools does not preclude the use of other development tools. I-CASE, 4GL, employee application development tools, and end-user reporting tools have been given special consideration because these tools are the core tool set that should be available to developers and end users within the department. Other tools will continue to be used in specific situations.

Figure 4.2 documents the development tool set and model direction that is appropriate for each application type. This represents the strategic direction for deploying development tools and will be reviewed periodically in light of project results and policy and procedure development.

Application Type	**Development Tools**	**Model Driving Development**
Employee	Spreadsheets Databases End-user reporting tools Employee application tools	Unique needs
Business Unit/ Work Group	Employee application tools CASE 4GL 3GL GUI Builders Screen Scrapers	Application Architecture Enterprise Data Model Business Model
Enterprise	I-CASE 4GL 3GL GUI Builders Screen Scrapers	Application Architecture Enterprise Data Model Business Model

Figure 4.2 - Development Tools and Model Direction

Although a technical direction has not specifically been made about the use of third-generation languages (3GL), these languages will continue to be an important part of the application development strategy. The risks associated with developing new enterprise

and business unit applications can be limited by building the core components with a 3GL (such as COBOL or C) and using a 4GL for building the graphical user interface. I-CASE tools can complement both approaches.

The CASE tools recommended for the business unit/work group applications should not be confused with the I-CASE tools recommended for enterprise applications. CASE tools address program, screen design and program development. These tools are less cumbersome than the model-driven I-CASE tools and are easier-to-use. These CASE tools must be compatible with the I-CASE tools to enable architecture-based development.

The key to the success of this strategy is the selection of a core set of development tools. Developers should not be allowed to randomly select a tool from the growing tool market. Although developers should be presented with alternatives, TxDOT should support a limited set of development tools for which it can provide assistance in selection, installation assistance, release management coordination, training classes, help-desk services and other technical support.

Viable methodologies must also be adopted for each type of application development. Without the appropriate methodology, merely selecting the right tool will result in minimal and isolated success.

There are obvious software costs associated with procuring these tools. The cost will vary depending on the tool type and number of users. The cost of I-CASE is relatively high but will be distributed to developers, which represent a small unit count. On the other hand, end-user reporting tools are inexpensive, but will be distributed to a large number of users. The department must also be prepared to provide adequate support to the users who receive these tools.

There are also significant training costs for these tools, especially the I-CASE tools. These tools are quite different from the current development approach. I-CASE tools will force a more structured approach that will result in higher-quality applications. Ultimately, applications will be developed more quickly than they are today, but management and users should not expect immediate improvements in development time while the I-CASE learning curve is addressed unless staff are acquired which already have this skill set.

By using this approach, the department will more effectively implement application development tools. While this approach provides tools to all levels of application developers, the set of tools is standardized, thus improving development support and ongoing maintenance.

User Interfaces:

Statement of Direction: The department should move from character-based presentation to graphical user interfaces. When possible, new applications should be developed with graphical user interfaces. Graphical user interfaces can also be developed for existing legacy systems that are adequately addressing business needs, have an adequate technical foundation, and are not scheduled for replacement in the next two to three years. The "refurbishment" of these legacy systems will provide support for the migration to a client/server environment and a consistent user interface. A set of tools, including screen scrapers and GUI builders, must be identified for the development of these user interfaces.

Graphical user interfaces (GUI's) provide the end user with an improved way to interact with the system versus the character-based systems currently in place. GUI's tend to be more intuitive, a better match to the user's work flow, and can reduce errors. In general, the use of a consistent user interface among applications can reduce overall training, documentation and support costs because basic application functions are performed consistently in all applications. A move towards GUI's by the department supports many of the department's technology and business objectives while representing a minimal risk to the department.

There are a variety of costs associated with implementing GUI technology at the department. These include:

- GUI development tools
- Training for application developers
- Training for users
- Possible hardware upgrades
- Modifications to legacy systems to take advantage of a new user interface
- Impact on network resources will require additional network hardware

Relational Database Management System:

Statement of Direction: Implement a relational database management system (RDBMS) which is diverse in the set of platforms supported, rich in functionality and which supports a distributed data environment. New applications development should consider the business case for adopting a relational strategy. The need to continue to support the current RDBMS, ADABAS, will exist for the foreseeable future until current applications are rewritten or phased out.

The last several years have seen the relational RDBMS become the dominant RDBMS

technology, partially due to its support for client/server based development. However, it is important to note that relational database technology is not the "end-all" to data integration. Poor application and data design and the lack of an architecture to ensure application integration are the root of much of the department's application problems.

There are many advantages of a relational database management system:

- Relational databases have a high degree of support for client/server technology tools and distributed data environments
- Relational database structures facilitate end-user reporting (many end-user tools are available)
- Improved third-party support is available for a relational database environment
- Data can be independent of applications, meaning that data rules, triggers and links are not imbedded in application programming
- More packages utilize RDBMS technology
- The industry trend continues toward RDBMS's, therefore the resources and development tools being developed for non-relational RDBMS's may be on the decline

Primary disadvantages of a relational database environment include:

- In order to take advantage of the relational database flexibility, the development of a relational database requires extensive planning and design since small design errors can quickly evolve into significant problems
- Increased training cost for data administrators, application developers and end users
- A major conversion effort would be required to convert existing data, applications and ad-hoc reports
- RDBMS's will require additional system resources
- The high volume of transactions at TxDOT could create performance problems with an RDBMS

A major influence in the statement of direction towards a relational database environment is the availability today, and in the foreseeable future, for vendor-supported software and development and reporting tools. A shift towards relational database technology will reduce the department's dependence on proprietary vendor support.

In addition to a dominant presence in the general RDBMS field, RDBMS's are used by or support I-CASE and geographic information system technologies. RDBMS technology supports many of the department's technology and business objectives, including Rapid Application Development, the Data Architecture and Ad Hoc End-User Access. The risk

of implementing relational database technology is considered moderate and the impact to TxDOT would be moderate to high.

Client/Server:

Statement of Direction: The replacement of legacy systems with systems that move computing power and data processing out of the centralized information services center and onto the user's desktop will become a more viable option for TxDOT in the future. TxDOT should build an infrastructure which will accommodate client/server computing as an option for application development and information services delivery. However, TxDOT should continue to evaluate all platform options (including mainframe) for each application development project.

In general terms, the concept of client/server computing centers on placing some portion of an applications processing and data on a "client" computer, such as a PC, and the remaining application processing logic and data on a "server" (another PC, mainframe, etc.). As indicated in Figure 4.3, what portion of the data and application processing logic belongs on the server or client can vary greatly depending on the individual business case for each development project.

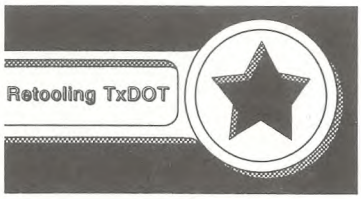
The migration to client/server computing will provide a technology infrastructure which supports the placement of business rule editing with the business data or off-loading the editing process to the client. This technology supports the design of applications which can be less batch oriented and reduce the need for batch updating processes.

CHAPTER IV

INFORMATION ARCHITECTURES

INFORMATION RESOURCES ORGANIZATION

SECTION D

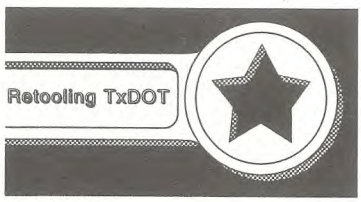


Texas Department of Transportation

CHAPTER V

PROJECT/RESOURCES

BUSINESS INFORMATION AND SYSTEMS PLAN



Texas Department of Transportation

Chapter V - Projects/Resources

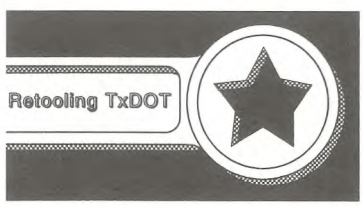
NOTES

CHAPTER V

PROJECT/RESOURCES

BUSINESS PROJECTS

SECTION A



Texas Department of Transportation

Section A
Business Projects

●●●●●●●●●●●●●●

OVERVIEW:

This section describes the business process retooling (BPR) approach. Business process retooling is designed to provide a multidisciplinary method for implementing fundamental changes in the way work is performed across the organization. During the BPR, the department evaluates "how" the processes are performed and identifies ways to improve the business processes. This evaluation results in the identification of business improvement projects.

The prioritization of business areas for business process retooling is described. The BPR approach is discussed as well as strategies important to the success of BPR. The BPR approach includes a description of the BPR methodology and how business improvement projects are identified.

ANALYSIS OF BUSINESS AREAS:

The business areas from the business model were analyzed to determine their scope and impact on key business criteria. The scope and degree of impact on these business criteria were key components in determining the priority of business areas for business process retooling. The scope was determined by considering attributes, improvement projects, and potential issues and risks related to each business area. Business criteria included strategic business objectives, department critical success factors, significant management issues and considerations for successful business process retooling. Each of these criteria is discussed in the following pages. Strategic business objectives, department critical success factors, and significant management issues are also discussed in Chapter II, Section B: Business Direction and Needs.

Key Business Criteria:

The following figure summarizes the impact of each business area on a series of criteria considered to be key to the success of TxDOT and to any business process retooling efforts. Scores range from one to three, with a one indicating low impact or support of the business and a three indicating high impact or support of the business. The scales provided on the next page provide more clarification on the methodology used to score each criterion.

Weight	3	3	2	2	1	2	1	3	3	2	66
Business Areas	Supports Organization Objectives	Supports Organization Critical Success Factors	Addresses Significant Mgmt Issues	Improvement Opportunities Available	Affected Employees are Supportive of BPR	Has Limited External Influence	Requires Limited Resources	Maximizes Customer Satisfaction	Total Budget Affected	Provides Broad Organizational Impact	Total Weighted Score
Determine and Analyze Transportation Needs	2	3	2	2	2	1	1	3	3	2	50
Plan Transportation Systems	3	3	3	3	2	2	2	3	3	2	60
Design Transportation Systems	3	2	2	2	2	3	2	2	3	2	52
Deliver Transportation Systems	2	1	2	3	2	2	2	3	3	2	49
Maintain and Operate Transportation Systems	3	3	2	3	3	2	2	3	3	2	59
Regulate Transportation Systems	3	2	1	2	2	1	2	3	2	1	44
Fiscal Services	1	2	2	3	2	2	2	3	1	3	45
Human Resources	1	2	3	3	2	3	2	3	1	3	49
Information Services	1	1	2	1	2	3	3	3	3	3	47
Real Property	2	1	1	3	2	2	2	3	2	2	44
Contracted Services	2	1	1	3	3	1	2	2	2	3	42
Equipment, Materials and Supplies	2	1	2	3	3	3	2	3	2	3	51
Business Management	2	2	2	2	2	3	3	3	1	3	49
Direction & Leadership	1	2	2	3	2	3	1	3	1	3	46

Figure 5.1 - Key Business Criteria Scores

The figure above summarizes the impact of each business area on key business criteria. The most that could be scored was a 66. The weighted scores show that the Plan Transportation Systems business area has the largest impact of all business areas on the key business criteria with a score of 60. The Maintain and Operate Transportation Systems scored a 59 which also shows a high impact on the criteria.

Key Business Criteria Scale:

Supports Organizational Objectives	1 = 0% - 20% 2 = 21% - 40% 3 = 41% - 100%
Supports Organizational Critical Success Factors	1 = 0% - 40% 2 = 41% - 60% 3 = 61% - 100%
Addresses Significant Management Issues	1 = 0% - 20% 2 = 21% - 40% 3 = 41% - 100%
Improvement Opportunities Available	1 = Limited improvement opportunities 2 = Minor improvement opportunities 3 = Major improvement opportunities
Affected Employees Are Supportive of Business Process Retooling	1 = Employees will not accept change 2 = Employees will accept change 3 = Employees will initiate change
Has Limited External Influence	1 = High complexity/heavy external control 2 = Moderate complexity/limited external control 3 = Low complexity/Complete internal control
Requires Limited Resources	1 = High complexity/major resource involvement 2 = Moderate complexity/moderate resource involvement 3 = Low complexity/low resource involvement
Maximizes Customer Satisfaction	1 = Low customer interaction/limited feedback mechanism 2 = Moderate customer interaction/moderate feedback mechanism 3 = High customer interaction/high feedback mechanism
Total Budget Affected	1 = Low effect on total budget 2 = Moderate effect on total budget 3 = Significant effect on total budget

Provides Broad Organizational Impact

1 = Limited (0-1 business areas affected)
2 = Moderate (2-7 business areas affected)
3 = Broad (8+ business areas affected)

Strategic Business Objectives:

The following figure summarizes the strategic business objectives supported by each business area. The objectives were not ranked in any order and thus carry the same amount of weight. The totals in the "Percent Addressed" column were applied against the scales presented earlier to determine their scores. These scores were entered into the Key Business Criteria table for final tabulation. The business objectives are listed in the table by strategic business goal and are referenced on the next page.

Business Areas	Goal 1						Goal 2					Goal 3				Percent Addressed
	1	2	3	4	5	6	1	2	3	4	5	1	2	3	4	
Determine and Analyze Transportation Needs	●		●				●	●								27%
Plan Transportation Systems	●	●	●	●	●	●		●								47%
Design Transportation Systems	●	●	●	●			●	●			●					47%
Deliver Transportation Systems		●	●	●	●			●								33%
Maintain and Operate Transportation Systems	●	●	●	●	●	●	●	●			●					60%
Regulate Transportation Systems	●	●	●	●		●	●	●			●					53%
Fiscal Services						●	●									13%
Human Resources							●	●								13%
Information Services							●	●								13%
Real Property	●			●			●	●								27%
Contracted Services								●				●	●		●	27%
Equipment, Materials and Supplies							●	●				●	●		●	33%
Business Management						●	●	●	●	●	●					40%
Direction & Leadership								●			●			●		20%

Figure 5.2 - Strategic Business Objectives Scores

In this figure, the Maintain and Operate Transportation Systems business area supported 60 percent of the strategic business objectives. The Regulate Transportation Systems business area supported 53 percent of the business objectives. The Fiscal Services, Human Resources, and Information Services business areas provide minimal support of the objectives.

Strategic Business Goal & Objective Definitions:

Goal 1: To provide the State of Texas with transportation services and systems that:

- work together
- are safe, comfortable, durable, affordable
- are environmentally sensitive
- support economic and social prosperity

Objectives:

1. To develop, operate and maintain efficient and effective transportation systems and services
2. To improve public safety and security on transportation systems
3. To facilitate economic and social prosperity through the efficient movement of people and goods
4. To protect and enhance the environment in transportation activities
5. To improve and promote the connectivity of transportation services and systems
6. To optimize transportation funding to meet the mobility needs of the state

Goal 2: To achieve the highest level of external and internal customer satisfaction

Objectives:

1. Improve methods of identifying customer needs
2. Maximize the quality and improve the delivery of products and services used or provided by TxDOT
3. Continuously improve the way we do business
4. Promote an environment of mutual respect, trust, and fairness in which all employees' contributions are recognized as important
5. Enhance the public's perception of TxDOT

Goal 3: To establish a comprehensive program that increases the opportunities for historically underutilized businesses (HUBs) to provide goods and services to the department

Objectives:

1. To increase the number of HUBs participating in TxDOT contracting and purchasing activities
2. To increase the number of contracting and purchasing opportunities in TxDOT for HUBs
3. To develop a comprehensive HUB education program

4. To expand communication efforts with the business community, other agencies and organizations regarding HUB opportunities and services in TxDOT

Critical Success Factors:

The following figure summarizes the critical success factors (CSFs) supported by each business area. The CSFs were prioritized by the Senior Management Team and are weighted in the first row of the table below. The totals in the "Percent Addressed" column were applied against the scales presented earlier to determine their scores. These scores were entered into the Key Business Criteria table for final tabulation. Complete definitions for each critical success factor are included below.

Weight	9	8	7	6	5	5	4	3	2	1	1	
Business Areas	Plan and Design Transportation Systems	Understand and Partner with External and Internal Stakeholders	Maintain and Operate Safe Highway Systems	Maximize Funding and Resources	Develop New Programs to Foster Alternative Modes of Transportation and their Connectivity	Diversify the TxDOT Workforce	Measure and Monitor the Department's Collective Performance	Streamline Business Processes and Eliminate Bureaucracy	Provide a Good Public Information Program	Educate Business Community about HUB Business Opportunities	Define Responsibilities and Authority of Each Employee and Hold Them Accountable	Percent Addressed (Weighted)
Determine and Analyze Transportation Needs	1	1	1	1				1				65%
Plan Transportation Systems	1	1	1	1	1			1				75%
Design Transportation Systems	1	1		1				1				5B%
Deliver Transportation Systems		1		1				1				33%
Maintain and Operate Transportation Systems	1	1	1	1				1	1			69%
Regulate Transportation Systems		1	1	1				1				47%
Fiscal Services		1		1			1	1				4B%
Human Resources		1		1		1		1				43%
Information Services		1		1				1				33%
Real Property		1	1					1				35%
Contracted Services		1		1				1				33%
Equipment, Materials and Supplies		1		1				1				33%
Business Management		1		1	1		1	1			1	53%
Direction &Leadership		1			1	1		1	1	1		47%

Figure 5.3 - Critical Success Factor Scores

The Plan Transportation Systems business area scored 75 percent to rank the highest in supporting critical success factors. The Maintain and Operate Transportation Systems business area ranked second with a score of 69 percent.

Critical Success Factor Definitions:

1. Plan, design and construct transportation systems

- Collect, analyze, forecast data about transportation needs

2. **Understand and partner with the external and internal stakeholders**
   - Plan drives budget
   - Be innovative in utilizing private sector
   - Transportation research
   - Must have good political relations

3. **Construct, maintain and operate safe highway systems**

4. **Maximize funding and resources**
   - Cost/benefit analysis (programs, organization, projects, needs)
   - Retain eligibility of receiving funding
   - Maximize alternative sources of funds

5. **Develop new programs to foster alternative modes of transportation and their connectivity**
   - Recognize worth/value of other modes of transportation
   - Must become a DOT

6. **Diversify the TxDOT workforce**
   - Diversify the professionals
   - Train the workforce

7. **Measure and monitor the department's collective performance**

8. **Streamline the business processes and reduce bureaucracy**
   - Utilize advanced technologies
   - Encourage creativity and innovation of people
   - Transportation research
   - Implement Registration and Title System (RTS)
   - Staff must learn how to say yes to the internal and external customers

9. **Provide a good public information program**
   - Must have good political relations
   - Consistently/persistently support and communicate goals and mission
   - Communicate who our customers are

10. Educate business community about historically underutilized business opportunities

- Partner with other government HUB programs
- Encourage mentor/protege relationships
- Need HUB incentive programs
- Educate TxDOT staff
- Educate HUBs - skills, opportunities
- Simplify/restructure HUB requirements
- Utilize private sector resources

11. Define the responsibilities and authority of each employee and hold them accountable

Management Issues:

The following table summarizes the management issues addressed by each business area. These issues were identified at the Bandera Management Team Meeting in October, 1993 and are considered to be key issue areas important to the department's future. The totals in the "Percent Addressed" column were applied against the scales presented earlier to determine their scores. These scores were entered into the Key Business Criteria table for final tabulation. Complete definitions of each management issue can be found following the table.

Business Areas	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Percent Addressed
Determine and Analyze Transportation Needs		●					●				●	●	●				31%
Plan Transportation Systems		●					●		●		●	●	●		●	●	50%
Design Transportation Systems		●					●				●	●			●		31%
Deliver Transportation Systems		●					●				●	●			●		31%
Maintain and Operate Transportation Systems							●				●	●			●		25%
Regulate Transportation Systems							●				●	●					19%
Fiscal Services		●							●	●	●	●	●				38%
Human Resources		●	●		●		●				●	●	●				44%
Information Services				●			●				●	●	●	●			38%
Real Property							●				●				●		19%
Contracted Services							●				●	●					19%
Equipment, Materials and Supplies							●				●	●			●		25%
Business Management	●					●			●	●	●	●					38%
Direction & Leadership		●		●				●			●		●				31%

Figure 5.4 - Management Issues Scores

Figure 5.4, Management Issue Scores, depicts that the Plan Transportation Systems business area supports 50 percent of the management issues. The Human Resources business area is second highest with a 44 percent score.

Management Issue Definitions:

1. **Accountability, Risk-Taking and Innovation for a Changing TxDOT Culture**
   The department will promote a culture which supports risk-taking, provides innovation for change and instills accountability at all levels.

2. **Becoming a Department of Transportation**
Emphasis is being placed, both externally and internally, on creating and supporting a balance in the development and implementation of all modes of transportation.

3. **Changing the Workforce Culture: Diversity and Teamwork**
Through recruiting, hiring and training, TxDOT is striving to achieve and maintain cultural diversity within the workforce and use that diversity effectively in a team environment.

4. **Communication, Openness and Trust in the Changing TxDOT Culture**
TxDOT is striving to make communications open, accurate, timely, relevant, and done in the spirit of cooperation.

5. **Internal Staff Development and Education for a Changing TxDOT Culture**
Emphasis is being placed on comprehensive internal staff development and education to allow for a successful transformation of TxDOT's culture.

6. **Continuous Improvement**
Efforts are being made to fully utilize continuous improvement to ensure an increasingly effective work environment.

7. **External Partnerships**
TxDOT is seeking to utilize external partnerships to provide the highest quality of service to its customers.

8. **Public Involvement, Marketing and External Education to Promote a Service Orientation**
Through increased communication and involvement, the department can educate the public on the many services and activities that it provides.

9. **Alternative Financing for Transportation**
The department continues to identify and use alternative financing to provide transportation services to the state of Texas.

10. **Evaluating the Way We Do Business**
The department is evaluating the way it conducts business to increase the effectiveness of its operations through improved productivity and customer service.

11. **Increasing Opportunities for New Partners**
The department is identifying and increasing opportunities for new partners, including historically underutilized and disadvantaged businesses.

12. Optimizing Resources
The department is evaluating ways in which resources can be shared across traditional organizational lines and to effectively optimize the resources available to TxDOT, including contract labor.

13. Plan Driving the Budget
The department has begun to lay the groundwork to ensure that it is driven by the needs of its customers versus the monetary resources of the government.

14. Application of New Technology in the Transportation Network
The Business Information and Systems Plan will identify opportunities for the department to implement emerging technologies in a timely manner.

15. Environmental Sensitivity in the Transportation Network
Each employee plays a critical role in establishing and maintaining environmental sensitivity in the transportation network and department operations.

16. Evaluating Corridor Alternatives
Effective development of transportation systems in the future will include corridors for all modes of transportation.

Note: The following two issues were not scored in Figure 5.4, Management Issue Scores, since these issues were not originally addressed by the Management Team.

17. Dealing With Aging Population
TxDOT is providing services to the aging population to respond to their needs.

18. Consistent Message
Communications will be made in a clear, understandable, consistent manner to ensure customer satisfaction.

Attributes:

Attributes were identified for each business area to assist in the determination of the scope and duration of each business process retooling effort. These attributes include operating budget, number of full time equivalents (FTEs), and related outcome, output, and efficiency measures. These attributes helped determine how much of the organization and budget is impacted by the business area, and current performance of the business area. This information was used as input into scoring key business criteria and establishing the business process retooling schedule. Attributes are provided for each business area in Appendix 13, Business Area Attributes.

Improvement Opportunities:

Improvement opportunities were identified in the workshops conducted to develop the business model. These improvement opportunities were identified by workshop participants and were determined to be important to the success of each business area. These improvement opportunities will be used as input into each business process retooling (BPR) effort. These opportunities are very preliminary and have not been studied or analyzed for benefits, costs, feasibility, risks, etc. Each BPR will analyze these opportunities as possible business improvement projects.

PRIORITIZATION OF BUSINESS AREAS:

Prioritization Order:

Based upon the analysis of each business area's scope and impact on key business criteria, a weighted score was determined for each business area (refer to Figure 5.1, Key Business Criteria Scores). This weighted score served as a basis for preliminary prioritization of the business areas for business process retooling. This prioritization order was then adjusted to reflect dependencies that exist between certain business areas and any other significant factors. The figure below illustrates the business process retooling scheduling order after the weighted scores and other factors were considered. The factors are explained after the table.

Scheduling Order	Business Area
1	(a) Information Services
2	(b) Human Resources
3	(c) Plan Transportation Systems
4	(d) Determine and Analyze Transportation Needs
5	(e) Deliver Transportation Systems
6	(f) Contracted Services
7	Maintain and Operate Transportation Systems
8	Design Transportation Systems
9	Equipment, Materials and Supplies
10	Fiscal Services
11	Regulate Transportation Systems
12	Real Property
13	(g) Business Management
14	(g) Direction and Leadership

Figure 5.5 - Business Process Retooling Scheduling Order

Scheduling Factors:

(a) Information Services was selected as the first business area for retooling since it serves as an enabler for any technology changes identified in future business process retooling efforts. Any change in technology in other business areas will be dependent upon this business area. Moving ahead with these changes will expedite business improvement projects in the other business areas since technology can be a part of the potential solution or it can serve as a limitation to the department's ability to change. More discussion can be found under the description of Information Services (IS) Business Process Retooling in Appendix 14.

(b) Human Resources was selected as the second business area for retooling since it serves as an enabler for people issues. Business change cannot succeed without human resources effectively considered as part of the solution. Retooling the human resource processes will enable the department to address these issues in a timely manner in order to effectively support change management.

(c) The Plan Transportation Systems business area had the highest weighted score. This business area was scheduled to coincide with the Texas Transportation Plan. Having these two efforts coincide will provide benefits to both endeavors.

(d) Determine and Analyze Transportation Needs was scheduled for retooling with the Plan Transportation Systems business area because the Plan business area improvement opportunities are dependent upon results from the Needs business area.

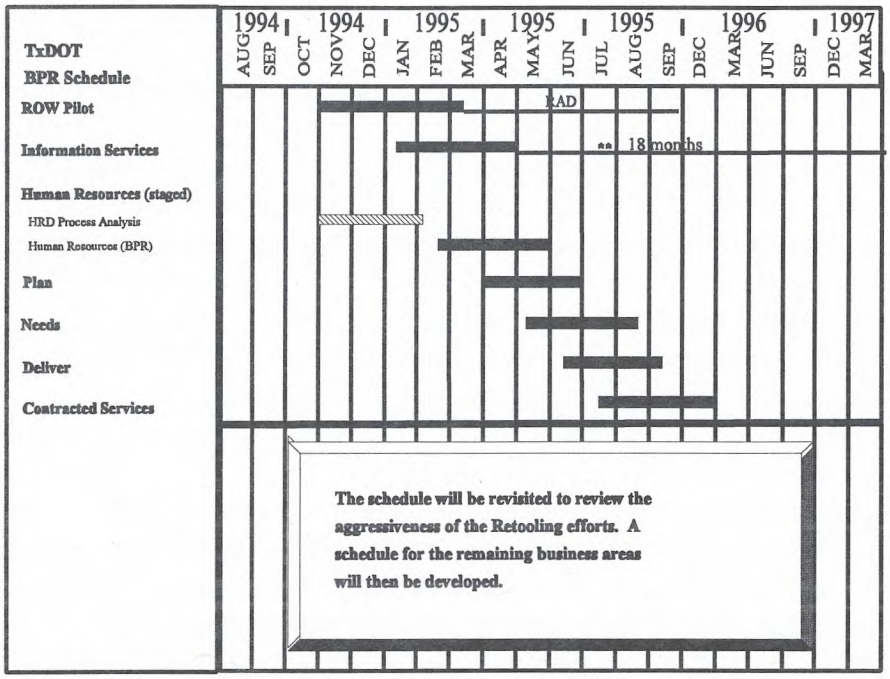
(e) Deliver Transportation Systems was scheduled to coincide with a national American Association of State Highway and Transportation Officials (AASHTO) effort relating to a Construction Management System and the associated business processes.

(f) Contracted Services was moved to coincide with the Deliver Transportation Systems business area because the Deliver improvement opportunities are highly integrated with those from the Contracted Services business area. To achieve the greatest benefit, these two business areas should be reviewed simultaneously.

(g) It is anticipated that the analysis of the other business areas will identify issues to be addressed during the business process retooling efforts for the Business Management and Direction and Leadership business areas. Thus these business areas were scheduled to take place at the end.

Business Process Retooling Schedule:

Using the scheduling order for the business areas, a time schedule was developed to determine when the business process retooling effort for each business area should begin. Refer to Figure 5.6, Desired Business Process Retooling Schedule where efforts are initially scheduled through fiscal year 1995. The schedule will be revisited to review the aggressiveness of the Retooling efforts, the business process retooling approach, availability of resources to staff each Retooling effort and the impact of BPR on department resources and operations.



** 10-20 Business Improvement Projects
RAD = Rapid Application Development

Figure 5.6 - Desired Business Process Retooling Schedule

The right of way pilot will begin in November, 1994. The right of way pilot will test the business process retooling methodology and rapid application development methods. The pilot will begin before the other business areas to allow for a transfer of knowledge to subsequent business areas and an opportunity to become familiar with the business process retooling methodology. More discussion on the right of way pilot is included in the General Approach to Business Process Retooling, Strategies.

As previously described, the Information Services and Human Resources business areas were identified as key enablers for carrying out change in all other business areas. Therefore, these efforts have been scheduled to start prior to other business process retooling efforts. For the Human Resources business area, a staged approach will be used to focus initially on quick success opportunities associated with key enabler activities such as classification, training, etc. A comprehensive business process retooling effort will begin in late February, 1995 to address all processes associated with the Human Resources business area.

Key factors which will affect the business process retooling schedule include:

- beginning with an aggressive schedule to determine timing of future business process retooling efforts;

- allowing time for knowledge transfer from business area to business area; and
- availability of resources to carry out business process retooling efforts.

GENERAL APPROACH TO BUSINESS PROCESS RETOOLING:

Business Process Retooling Approach:

The business process retooling approach is designed to provide a multidisciplinary method for implementing fundamental changes in the way work is performed across the organization. The approach also equips the department for dramatically improved performance. Business process retooling focuses on people, technology, risk management and change management to ensure successful implementation. The business process retooling approach is comprised of the following phases:

Phase I of the approach is "Establish Change Imperative". In this phase a strategic assessment is conducted, customer and stakeholder requirements are assessed, change readiness is measured and a change imperative is documented. The current way the department is doing business is documented. Methodology and change management training is conducted. The key result of this phase is a commitment to change.

Phase II of the approach is "Create Vision and Targets". In this phase process boundaries are defined, strategic issues are identified, a vision for the future and performance targets are established, and change requirements are evaluated. Benchmarking activities are performed to define the vision. The result of this phase is a shared vision and performance expectations by which success of the business process retooling effort can be measured.

Phase III of the approach is "Redesign". In this phase business processes are redesigned (retooled), prototypes are conducted, impacts are assessed, and change programs are refined. A gap analysis is conducted between the current operations and the vision. Business improvement projects are defined to accomplish the vision. Results of this phase are identified business improvement projects.

Phase IV of the approach is "Build". In this phase new relationships are initiated (business improvement project teams), systems are constructed, transitional arrangements are established, performance measurement criteria are designed, and implementation strategies for the business improvement projects are prepared. Results of this phase are new and/or enhanced information applications that support the business and an implementation plan for business improvement projects is developed.

Phase V of the approach is "Implement". In this phase pilots are conducted, performance measures are tested, and a learning organization is established. If information technology is a

factor in the business improvement project, system pilots are conducted, user documentation is created, hardware and software is installed, user training is performed, procedures are developed, and a support infrastructure is established. Results of this phase are operational retooled processes, improved performance, and user applications which are integrated with business processes.

Business Improvement Projects:

Each business area will be analyzed by a core team. Once the analysis is completed (Phase I, II, and part of Phase III), several business improvement projects will be identified as improvement opportunities for the department. These projects will be designed in a manner that internal resources can complete the project or external resources can be requested to complete the project. It is anticipated that 10 - 20 business improvement projects will result from each business process retooling effort.

These business improvement projects will fall into one of three categories: projects which will require business changes only, projects which will require information systems changes only, and projects which will require a business change and result in a change to information systems. Each of these projects will be built and implemented differently depending on which category they fall. The business process retooling methodology supports directions for each of these categories.

Scoping of these business improvement projects will occur during Phase III, Redesign. The scoping of the projects will help determine what team skill sets are necessary to implement the business improvement project. These projects will then be prioritized by management for implementation.

Strategies:

The successful completion of the business process retooling effort will require significant coordination between all of the parties involved. The following strategies have been developed to help ensure this success as well as identify any issues which may impede progress at a later date.

> *Management:* The TxDOT Information Resource Management Office (IRM) will facilitate and provide a structured approach that enables employees to improve business operations and services through the Retooling TxDOT efforts. In this role, the IRM will function as the project administrator for all business process retooling efforts. The IRM reports Retooling progress to the Deputy Executive Director for Administrative Services. A Retooling project manager will report to the IRM and will facilitate overall project planning and integration. The Retooling project manager will work

with external lead consultants concerning contract issues, overall project planning and integration for any Retooling efforts requiring consultant services. A TxDOT team leader will be assigned to each business area and will be responsible for day to day project planning, scheduling, team assignments and status for BPR activities and will work with any consultant team leaders assigned to business process retooling efforts. It is anticipated that the team leaders from the various business areas will meet, as appropriate, with the project administrator and project manager to discuss status and integration issues between business areas.

Quality Assurance: The Retooling project manager will facilitate quality assurance concerning BPR activities, implementation issues and integration between the various teams working on Retooling efforts. The team status meetings are the project quality checkpoints identified so far. Team status meetings will provide an avenue for team leaders to share their success stories, challenges to overcome, partnering ideas, shared lessons, and other information valuable to the core teams. It is anticipated that these meetings will assist the various core teams as they perform their business process retooling analyses.

Organizational quality management issues identified so far are the importance of change initiatives, collaborative team building, managing the impact of change on the organization, integration between the various business process retooling efforts, and the definition of an on-going Retooling process for TxDOT. Change management training will be provided to appropriate core team members to enable them to prepare for and handle situations that occur in the organization due to change.

Other partnerships, as necessary, will be optimized to assure quality and success for business process retooling.

Team Transition from the BISP effort: There were seven full time, temporary members of the business analyst team (BAT) that were assigned to the Business Information and Systems Plan (BISP) project. These team members came from various areas of the department. One of these team members served as the project manager for the BISP effort. Another team member was responsible for the marketing aspect of the Retooling TxDOT project. The remaining five team members had various responsibilities relating to the project.

The BISP project manager will remain involved in overseeing Retooling TxDOT efforts and will facilitate quality assurance for the effort. Five team members were given the opportunity to serve on core business process retooling teams. The marketing role has been returned to the Public Information Office who will help facilitate the communication of Retooling status and direction to the employees of TxDOT and to

external entities where appropriate.

Core Teams: A core team for each business process retooling effort will be assigned. The core team will require a mix of skills and talents to match the needs of the business area. Initially, the core team will consist of both consultant team members and TxDOT team members. Refer to Figure 5.7, Core Team Structure.

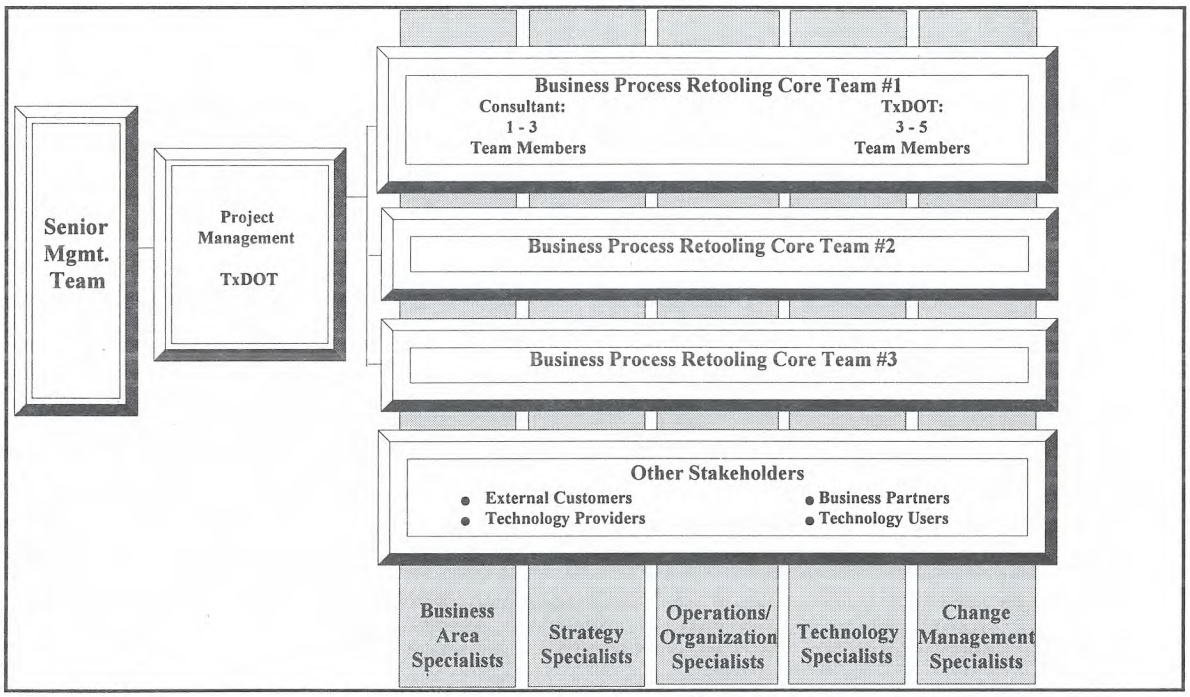


Figure 5.7 - Core Team Structure

TxDOT team members will be assigned full time for each business process retooling analysis effort. These team members will be subject matter experts from within the department. They will be project employees and will return to their respective offices when deemed appropriate. The size of each team will vary depending on the size of the business area, the amount of decentralization in the department, and the amount of risk involved. Each team will consist of two business analyst team members, of which one will serve as team leader. Each team will also have at least one district representative and an information systems specialist. Once the analysis phases (Phase I, II, and part of III) are complete, it is anticipated that the two business analyst team members will move on to other BPR analysis efforts. One of these team members will also be assigned to serve a quality assurance role for the multiple business improvement projects activated as a result of the BPR analysis. The remaining core team members will either be assigned to business improvement project teams or return

to their respective offices.

The number of *consultant* core team members will vary depending on the size of the business area. The amount of time consultants contribute to the core team is anticipated to decrease as the department becomes more familiar with business process retooling and core team members gain knowledge about the business process retooling methodology.

Business Improvement Project Teams: A business improvement project team will be appointed for each business improvement project. This team will consist of business partners (TxDOT employees knowledgeable about that part of the business) and information system experts (if applicable). A business project could be assigned to its respective organizational unit for implementation. If the project is information systems only, the assumption has been made that the project team will be 20 percent information systems experts, 20 percent system application users, and 60 percent external sources. This combination of team members may vary depending on the type of information system project (e.g., purchasing available software or developing with own resources) or the type of resources, and corresponding skill sets, available for project implementation. A data analyst will be assigned to each business improvement project that involves application development.

Enterprise-Wide Data Model: The Enterprise-Wide Data Model project discussed in Chapter V, Section B: Infrastructure Projects, will be activated in conjunction with the business process retooling efforts. The purpose of the Enterprise-Wide Data Model project is to develop a detailed data model that describes the data needed to support the business requirements of the department. As necessary, a data analyst will work with each core team on a part-time, limited basis to analyze the information needs of the business area. During the business improvement project(s), the enterprise data model will be defined to its lowest level.

Continuous Improvement: The Retooling TxDOT project and TxDOT's Continuous Improvement Office (CIO) share a common goal of initiating quality techniques in conducting department business. To maximize resources, Retooling TxDOT and the CIO will continually share results of group work sessions, facilitator resources and training efforts.

Training: As appropriate, core team members will be trained in the methodology used in business process retooling, including change management. This training is considered a part of the business process retooling approach and will be conducted as each BPR analysis is begun. This training will initially be provided by the consultants. It is anticipated that the training can eventually be conducted by TxDOT employees

who have already received the training similar to TxDOT's train-the-trainer approach.

Facilitation training for team members needed to facilitate workshops will be required as well as training in the use of office automation tools for team members who need it.

Equipment: The amount of and type of office equipment (workstations) to be procured for the core teams is dependent on what office equipment is available for team members to bring on board from their respective offices. It is anticipated that only one to two team members will need workstations with all the necessary tools loaded (e.g., project management and Information Engineering Facility (IEF) software). There are currently seven fully equipped workstations available from the business analyst team assigned to the Business Information and Systems Plan. Workstations from business process retooling efforts that are begun early in the time schedule will be used by business areas scheduled later in the time schedule as work is completed.

Office Support: Office support for the BPR core teams will be provided by the Information Resource Management Office. A full-time administrative technician and technical writer are dedicated to this effort. It is anticipated that there will be periods of excessive work load that these two individuals may not be able to support. Temporary services or part-time assistance will be used as necessary for these periods.

Technical Support: Technical support in the use of office automation tools, project management tools and IEF tools will be needed throughout the Retooling TxDOT effort.

Methodology integration and implementation assistance will also be required. Initially, technical support for the IEF encyclopedia will be provided by a TxDOT application developer participating on the ROW pilot. During the ROW pilot, knowledge will be gained about the IEF environment that will assist in successfully implementing and supporting IEF tools at TxDOT as well as applications generated using IEF tools. The Retooling TxDOT effort will turn to the Information Systems Division to provide these enabling services and to assist in ensuring the successful implementation and support of Retooling methodologies and tools.

Office Space: Office space will be needed for the Information Resource Management Office to accommodate multiple business process retooling core teams. The core teams should be housed in one location to assure appropriate technical and office support. Distributed teams will require that office space and technical solutions be addressed at the beginning of every business process Retooling effort.

Right of Way Pilot: A pilot project will be carried out which will test the entire

business process retooling methodology and partnering principles and will provide business improvements to TxDOT. A scaled down business area which focuses on right-of-way activities only (which fall primarily in the Real Property business area) will begin in November, 1994. Two Retooling business analysts and an Information Systems Division application developer will be assigned to the business process retooling analysis phases of the pilot project. Two right of way subject matter experts have also been identified as part of the core team. One business analyst will serve as team leader during the business process retooling analysis.

It is anticipated that during the ROW business process retooling phases, multiple business improvement projects will be identified. It is also anticipated that at least one of these will entail the development of a business application which supports ROW activities. This effort will be carried out with at least three developers from the Information Systems Division (ISD) and several ROW subject matter experts assigned to the team. The ISD developer assigned to the business process retooling analysis phases will serve as team leader for this business improvement project. The business improvement project team will develop a business application using Rapid Application Development (RAD) methods and Information Engineering Facility (IEF) software based on needs identified during the business process retooling analysis.

As a result of this pilot project, it is anticipated that the department will gain knowledge that will assist us in successfully implementing full life cycle business process retooling at TxDOT. Once the business process retooling phases are complete, methodology and business model implementation issues for carrying out business process retooling analyses for the remaining business areas will be addressed. Once the business improvement project stage of the ROW pilot is carried out, business improvement methodology, application development methodology and IEF tool implementation issues will be addressed.

Information Services (IS) Business Process Retooling - The BPR analysis for the Information Services business area will be the first BPR started after the ROW pilot is underway. It is necessary that IS process and organizational issues be addressed to ensure that future business improvement projects involving the development of business applications are successful. This analysis will also enable the department to carry out information resource and information systems directions set forth in the BISP. For a more detailed description of the IS BPR refer to Appendix 14, IS BPR Project Description.

The IS core team will obtain as much knowledge transfer as possible from the ROW core team during the BPR analysis phases of the effort. During the IS BPR analysis, findings concerning new methods and tools for developing applications based on the

ROW application development effort will be carefully considered. To ensure tight integration between the ROW pilot and the IS business process retooling efforts, the ROW application development team leader will report directly to the Information Services business process retooling team leader.

Time and Cost Assumptions:

Time and cost estimates were calculated for each business process retooling analysis effort. Assumptions used in this calculation are listed below.

Resources: The following figures are guidelines only. Resources were determined by considering these established guidelines, amount of risk determined, and degree of decentralization in the organization.

Resources	Small BPR	Medium BPR	Large BPR
Time - Phases I & II & part of Phase III	3 months	4 months	5 months
TxDOT Team (includes leader)	3	4	5
Consultants (includes project manager)	*	*	*

* Consultant use will vary for each business process retooling effort. It is anticipated that the use of consultants will be heavier at the beginning of the business process retooling schedule and decrease as more business process retooling efforts are conducted. We expect that the training, skills and knowledge gained from the earlier BPR efforts will provide TxDOT with the abilities to independently conduct these efforts later in the schedule with less dependence on consultant expertise.

Training: Methodology and facilitation training for certain TxDOT core team members will be necessary to conduct each business process retooling effort. Office automation tools training is also expected as we bring team members in from various areas of the department.

Equipment: It is anticipated that only one to two team members will need workstations with all the necessary tools installed (e.g., project management and IEF software). These workstations were procured for each business analyst team member at a cost of approximately $15,000 each (includes software, printers, etc.). There are currently seven fully equipped workstations available from the business analyst team assigned to the Business Information and Systems Plan.

Other Time and Cost Assumptions:

- Approximate figures were used to determine the time and costs for each business process retooling effort
- Team leader from TxDOT is considered in the team size
- Training courses will be developed to accommodate team members
- Training costs include a one week course for methodology training, which includes training in change management, at a cost of $2,000 per individual (8-10 participants per course); one week of facilitation training for appropriate team members at $2,500 per person; $100 each for training classes in office automation tools for appropriate team members (anticipating two classes); and a one time charge of $5,000 for customizing training
- Training and equipment costs relate to TxDOT personnel only
- The use of consultants will be heavier at the beginning of the business process retooling schedule and decrease as more business process retooling efforts are conducted
- Other expenses (travel costs) for consultants needed from outside the Austin area can be estimated at approximately 10-15 percent of consultant salaries
- Current consultant service rates are being used to estimate costs
- A five year time line was used to complete the business process retooling efforts
- Travel costs for TxDOT team members were not estimated

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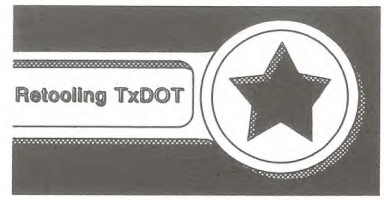
CHAPTER V

PROJECT/RESOURCES

INFRASTRUCTURE PROJECTS

SECTION B



Texas Department of Transportation

Section B
Infrastructure Projects

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OVERVIEW:

Over the course of the next several years, many data, application and technology projects will be required to carry out the technology directions and to implement the architectures outlined in the BISP. Specific data and technology projects have been defined to build an infrastructure that can support the application, data and technology architectures in the BISP. This infrastructure will be critical to enabling TxDOT to achieve information resource goals and objectives, and to proceed with the business process retooling efforts.

Application projects will be defined during the retooling of the department's business processes to ensure that the modified business practices are well supported by automation. The identification of application projects as well as the migration of existing legacy systems will be dependent on needs generated from the business process retooling.

DATA PROJECTS:

Enterprise-Wide Data Modeling:

TxDOT generates and utilizes a large amount of data in its daily operations. This data is located in many different physical and logical locations throughout the department. In order to improve the management of the department's data and implement an infrastructure to address current data issues, TxDOT should create an enterprise data model to assist in the migration to the future data architecture.

The Enterprise-wide Data Modeling project will be initiated in conjunction with each of the business process retooling efforts to define the data requirements of the department. A data analyst is to be assigned to each BPR core team on a part-time basis. As the core team performs the business analysis and redesigns the business processes, the data analyst will define the entity types and relationships for that business area.

Project Objectives:

1. Establish comprehensive standards to guide the modeling effort.
2. Assign permanent responsibility for the creation and maintenance of the enterprise-wide data model.

3. Refine the subject level data model by taking the data model to a lower level of detail and assigning the subject areas in the model to the appropriate business process retooling effort.
4. Develop a complete inventory of current data, and identify data which is no longer necessary.
5. Train the permanent resources in data modeling skills.
6. Educate users and developers about the necessity of an enterprise-wide data model an the benefits the model can provide.

Considerations:

1. As each business process retooling project is conducted, incrementally build the detailed enterprise data model. This will allow the model to be built gradually without the use of excessive resources, while still providing support to the business process retooling projects.
2. Outside resources should be considered in assisting with the definition of standards and conducting the first business project, as well as assisting with the chosen CASE tool.
3. A part-time data analyst should be assigned to the core team of each business process retooling project in order to properly address the data issues and requirements in each business area.

TECHNOLOGY PROJECTS:

Application Development Tools:

The purpose of this project is to evaluate and select application development tools appropriate for the development of enterprise, business unit/work group, and employee applications. Recommendations should be made about specific products in each of the following categories:

- Integrated Computer-Aided Software Engineering (I-CASE)
- Fourth-generation Languages (4GL)
- Employee Application Development Tools
- End-User Reporting Tools
- Graphical User Interface (GUI) Tools

Project Objectives:

1. Evaluate the effectiveness of Texas Instrument's Integrated Engineering Facility (IEF) on the ROW pilot. If the IEF tool is not selected, identify an alternate

toolset for the relational environment.
2. Evaluate and recommend a core set of 4GL, employee application development tools, end-user reporting tools, and GUI development tools (i.e., GUI design and screen scraper tools).
3. Evaluate and recommend a core set of third-generation languages (3GL) for continued use.
4. Initiate a mechanism to advertise and deploy these tools.
5. Develop a detailed strategy for training and on-going support.
6. Determine the impact the deployment of these toolsets will create.

Considerations:

1. Project team must include representation from the districts/divisions, as well as ISD business, engineering and support sections.
2. External assistance should be considered.
3. Tools must be compatible across many platforms.
4. Tools must support the RDBMS development environment. Therefore, this project may be dependent on results of the RDBMS project.
5. Tools must be adaptable to multiple, concurrent databases.
6. The evaluation of tools must include the review of the current toolset and the disposition of the current toolset should be determined.
7. The development tools should be re-evaluated on a recurring basis.
8. GUI tools must support the redesign of existing legacy application interfaces.

Relational Database Management System:

The purpose of this project is to select and implement a relational database management system in order to support the migration to a shared data environment. The database selected should consider the needs of business, engineering, support, district, division and special office staff.

Project Objectives:

1. Define the requirements and criteria for selecting an RDBMS.
2. Evaluate, select and implement an RDBMS.
3. Identify and pilot an application development project utilizing the new RDBMS.
4. Establish a migration strategy to move from ADABAS to the new RDBMS.
5. Identify the training requirements for support personnel and application developers.

Considerations:

1. The selected RDBMS should run on multiple computer platforms.
2. The RDBMS should support distributed data processing in a client/server environment.
3. The use of outside services familiar with the features and design requirements of RDBMS's should be utilized in order to expedite the selection of this technology infrastructure due to the reliance of other technologies on the chosen RDBMS platform.
4. The selection process should consider the availability of query tools to be an important selection criteria.
5. The selected RDBMS should be supported by multiple third party vendors.
6. The selection of the RDBMS should address the needs of new development tools and should be coordinated with the selection of the application development tools.

User Interfaces:

The purpose of this project is to define department standards for GUI development of enterprise, business unit/work group and employee applications.

Project Objectives:

1. Establish department standards for GUI development.
2. Develop a strategy for distributing the GUI standards and educating application developers about the importance of adhering to these standards.

Considerations:

1. Consider the acquisition of externally developed GUI design standards for use within the department to expedite the process.
2. This team must include representation from the ISD business and engineering development branches and district/division developers.

Desktop Operating Systems:

In order to fully support many aspects of client/server computing, the use of a 32-bit operating system on the "client" side will be necessary. TxDOT should initiate a project to identify a 32-bit operating system or systems for the department which will minimize cost and support requirements as well as minimize the impact on the user community while still providing the applications developer with a robust development environment. The project should strive to

identify a single operating system for the future if possible.

Project Objectives:

1. Establish criteria for the evaluation of desktop operating systems.
2. Evaluate and recommend a standard operating system or systems.
3. If more than operating system is recommended, define the appropriate usage of each operating system.
4. Identify statewide applications that do not conform to the chosen platform and recommend a migration strategy for these applications.

Considerations:

1. This project should be initiated when the Microsoft "Chicago" product is available (approximately mid-1995).
2. The project should strive to identify a single operating system if possible.
3. The project team must include representation from the districts/divisions, as well as ISD business, engineering and support sections.
4. The project should consider performing an impact analysis including the impact on resources, end users and support issues.

Document Management/Imaging:

The purpose of this project is to introduce document management/imaging technology as an infrastructure technology for the department. This technology will provide the ability to store and retrieve documents electronically and will support modifications in process workflow. The department should proceed with the existing effort to identify a package(s) solution, which considers the wide array of potential document management/ imaging needs of the department (i.e., large transaction volumes, work flow management, etc.).

Project Objectives:

1. Evaluate and recommend a document management package(s).
2. Identify an area of the department in which to conduct a pilot document management/imaging project.

Considerations:

1. The initial project scope should be kept small (approximately 10 users).
2. The use of outside services should be considered due to the lack of experience internally.

3. The existing Document Management Advisory Team should be considered for the project core team.

Bar Coding:

The purpose of this project is to establish department standards regarding the use and procurement of bar coding technology.

Project Objective:

1. Develop standards for the procurement of bar coding technology.

Considerations:

1. Review the results of the study conducted by the bar coding task force.
2. Include bar coding task force in the project core team.

Videologging:

Although incremental value can be added by implementing videologging for a district, the greatest value remains in a statewide implementation which integrates GIS and GPS technologies. Since these technologies are generally provided by a combination of vendors, and due to the sophisticated nature of these technologies, the videologging, GIS and GPS technology deployment should be well planned and highly coordinated.

Project Objectives:

1. Identify a segment of the business in which to conduct a pilot videologging project.
2. Identify the appropriate hardware, software and training requirements necessary to implement videologging technology.

Considerations:

1. This project should be closely coordinated with the GIS and RDBMS projects.
2. This project should include district representation.

Geographic Information System:

Geographic Information Systems are well suited to the DOT business because it is designed to deal with spatially-oriented data such as roadway networks, railroad lines, waterways, political

boundaries, etc. In order to take full advantage of GIS technology, the department should evaluate, select and implement a package GIS solution. The project should be coordinated and directed by a GIS specialist, and should begin by developing a department-wide GIS tactical plan, which considers the specific applications for which the initial implementations of GIS will be used.

Project Objectives:

1. Identification of an appropriate technical environment (hardware and software) which will support future development of GIS applications.
2. The development of internal technical expertise which can remain focused on GIS issues.
3. Implementation of an initial mapping application (on a small scale).
4. Planning for the continued implementation of strategic GIS applications.

Considerations:

1. An appropriate map base must exist before GIS application development can begin.
2. The selection of the hardware and software platform should consider the possibility of significant growth in the use of GIS systems in the future.
3. The use of outside services familiar with GIS planning and implementation to assist in the determination of the necessary level of map accuracy and user requirements will be necessary.
4. The department GIS initiatives should be well coordinated with other state agency GIS efforts.

Telecommunications:

The purpose of this project is to develop a telecommunications plan which identifies the necessary telecommunications infrastructure for TxDOT. This comprehensive study should evaluate the long-term implications of client/server application design, ISDN, frame relay, ATM, multi-protocol routers, in addition to the business requirements associated with mobile computing, video conferencing, GIS, etc.

Project Objectives:

1. Develop a telecommunications plan which identifies the necessary telecommunications infrastructure for TxDOT.
2. Develop a migration plan for upgrading/replacing TxDOT's telecommunication infrastructure.

Considerations:

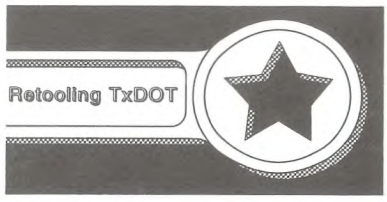
1. The use of outside resources will be necessary in order to provide the required technical expertise in the evaluation of the many telecommunication technologies available now and in the future.

CHAPTER V

PROJECT/RESOURCES

MASTER PLAN

SECTION C



Texas Department of Transportation

Section C
Master Plan

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OVERVIEW:

The resource plan provides an order of magnitude estimate of the resources required to implement the Business Information and Systems Plan . This is a *high-level* financial planning assessment. The estimates should not be considered or represented as "budget projections" or other such projections for funding purposes. They are solely for *planning* purposes to estimate whether or not the *potential* resources required for plan implementation according to a schedule is reasonable and affordable to the department.

The estimates indicate that significant resources will be required to implement the BISP. No attempt has been made to quantify the specific financial benefits for the technology and infrastructure projects, as this is typically difficult, if not impossible to quantify. These projects will be key to providing the underlying technology components needed to enable the development of improved, integrated, and flexible information systems throughout TxDOT in the future. Each information system will in turn provide quantifiable business value.

A number of funding and implementation scenarios are possible considering numerous project dependencies (which are provided later in this section). Overall, the department will require a much greater technology investment rate than the department's historical rate. This increased investment rate is required to implement the vision and strategies that have been stated in this BISP while maintaining the current level of support and meeting mandated project deadlines.

PROJECTS AND TRAINING:

The projects and training plan identifies the business and technology projects needed to carry out the business information and systems plan. It also identifies training efforts which will be key to effectively carrying out the plan (see Figure 5.8). Note that business process retooling efforts are completed in two phases. The initial phase includes the business process retooling analysis which will result in the identification of multiple business improvement projects.

Project / Training Needed	4FRONT Methodology	4FRONT RAD	BPR	Customer Service	Workshop Facilitation	Office Automation Tools	Data Modeling	Relational Database Design	RDBMS Product Training	GUI Design	Project Management	IEF CASE Tool	Application Development Tools	GIS
Business Process Retooling:														
ROW Pilot		●	●								●	●		
Information Services	●		●	●	●						●	●	●	
Human Resources			●	●	●						●		●	
Plan Transportation Systems			●	●	●						●		●	
Determine & Analyze Trans. Needs			●	●	●						●		●	
Deliver Transportation Systems			●	●	●						●		●	
Contracted Services			●	●	●						●		●	
Maintain and Operate Transportation Sys			●	●	●						●		●	
BISP Updates														
Data:														
Enterprise Data Modeling	●	●					●				●	●	●	
Technology Infrastructure:											●			
Relational Database Mgmt								●	●		●			
User Interfaces						●				●	●			
Bar Coding											●			
Development Tools	●	●							●	●	●	●	●	
Telecommunications						●					●			
GIS											●			●
Desktop Operating Systems						●					●			
Document Management/Imaging											●			
Videologging											●			●

Figure 5.8 - Projects and Training Plan

Scheduling Assumptions & Dependencies:

Projected start dates for business process retooling efforts have only been set through fiscal year 1995. The schedule, projected costs, and resource requirements for the remaining business areas as well as for business improvement projects resulting from the business process retooling efforts will be identified in May, 1995. This will better enable the department to determine an appropriate level of aggressiveness for business process retooling schedules with regard to resource impact, risks, benefits and costs.

There are a number of considerations and project dependency issues that apply to the projects generated by the BISP. Dependencies among projects were determined by reviewing project priorities, project definitions, and determining the relationship or need to support the business process retooling effort. The dependencies of the technology projects are depicted in Figure 5.9. The dependencies for each of the BISP generated projects are described in the following paragraphs.

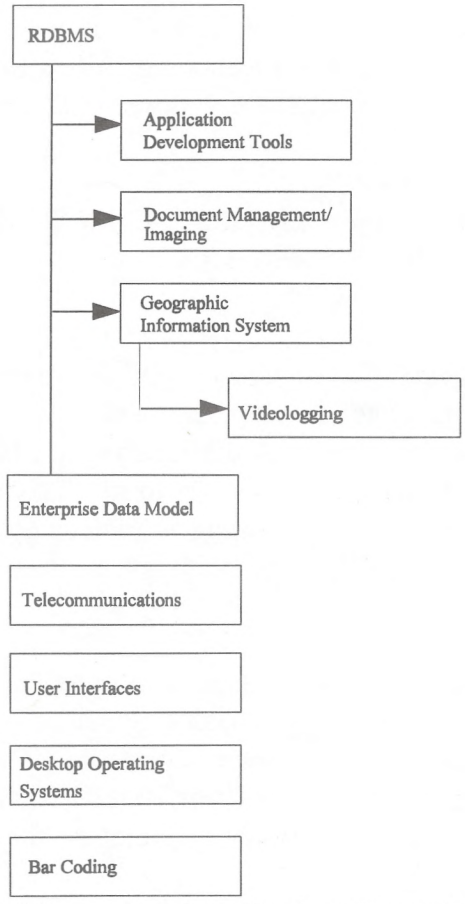

Figure 5.9 - Technology Project Dependencies

ROW Pilot: In order for the developers to be properly prepared for the ROW pilot project which includes the use of the 4FRONT development methodology and the Texas Instruments IEF CASE tool, several training courses will be necessary. These include IEF CASE tool training and the Rapid Application Development methodology. These courses should be scheduled immediately to coincide with the start of the ROW pilot project.

Initial Business Process Retooling Projects: As described in Section A of this chapter (page V-16), the following BPR efforts are scheduled to begin in early 1995:

- Information Services
- Human Resources
- Plan Transportation Systems
- Determine and Analyze Transportation Needs

As these projects conclude their initial phases, many business improvement projects requiring information services development could be initiated. These projects will require that many of the BISP-generated technology infrastructure projects be completed or be in process to support the new development. These include:

- Enterprise-wide data model
- Relational database management system (RDBMS) selection
- Application development tool selection
- User interface tool selection

Enterprise-Wide Data Model: The enterprise-wide data modeling project has been structured to allow the incremental development of the data model as each business process retooling project is conducted. A data analyst will be included as a part-time member of each business process retooling core team. This will require that analysts receive enterprise-wide data modeling training as soon as possible. The data analysts will also require training in the IEF CASE tool in order to begin the creation of the data model.

RDBMS Selection: Several projects are dependent upon the selection of the RDBMS as indicated in Figure 5.9, Technology Project Dependencies. Therefore, the RDBMS project should be staffed and started as soon as possible. The purpose of the project is to select a RDBMS product. At the completion of this project, training in the specific package selected should begin for application developers throughout the department.

Application Development Tools: The application development tool selection project should not begin before the RDBMS project determines the selected RDBMS for the

department. A major criteria in selecting the development tools should be compatibility with the RDBMS selected. Training in the selected tools should begin for application developers and users throughout the department as soon as the tools have been identified and purchased.

User Interfaces: There are no direct dependencies for this project, since GUI design standards should be independent of the chosen GUI tool set. However, this project should be scheduled so that completion coincides with tool set implementation.

Bar Coding: No dependencies exist for the bar coding project.

Telecommunications: There are no direct dependencies that exist for the telecommunications project. However, the project should begin soon in order to analyze the impact of the future application, data and technology architectures on the telecommunications needs of the department.

Geographic Information Systems: The GIS project should not begin before the RDBMS project determines the selected RDBMS for the department. GIS technology utilizes a relational database as the primary method of storing data. The selected GIS product should be compatible with the selected RDBMS.

Desktop Operating Systems: The desktop operating systems project should begin after the release of Microsoft's "Chicago" product in order for the project to be able to evaluate as many available 32-bit operating systems as possible.

Document Management/Imaging: The document management/imaging project should begin after the RDBMS project has selected a specific RDBMS product for the department. Most document management/imaging technology products utilize a relational database to store data. The selected document management/imaging product should be compatible with the selected RDBMS.

Videologging: The videologging project should begin after the RDBMS and the GIS project. Videologging technology utilizes a relational database to store data and can be dependent on the GIS technology implemented. The selected videologging product should be compatible with the selected RDBMS and the GIS technology implemented.

Training Efforts Defined:

In order to ensure that BISP projects are carried out effectively, training will be necessary as previously reflected in Figure 5.8. On-going training will also be needed in many areas to ensure successful implementation of methods, technologies, and services. An overview for

each training need is provided here:

Methodology Training: Training for the overall methodology will apply to the Information Systems Division and district, division and special office automation staffs. This training should cover the application design, builder and implementation modules as well as the package selection module. This training should be ongoing and provided regularly in order to educate new employees.

4FRONT Strategy Training: The purpose of this training is to familiarize new business and technical analysts involved in the update of the BISP with specifics on how to develop a business and information system plan. This training should occur prior to beginning the BISP update cycle each year as necessary.

4FRONT Rapid Application Development Training: This training is for developers who will be involved in the right of way pilot project. This training course will familiarize the developers with the 4FRONT application development methodology for RAD. RAD training should occur at the beginning of the ROW pilot. If the RAD methodology is successful in the pilot project, additional application developers must be trained as the methodology is implemented for other development projects.

Business Process Retooling Training: The purpose of this training is to familiarize the team members involved in the BPR efforts with the methodology used to complete the BPR activities. This training will include information on establishing the change imperative, creating visions and targets, and redesigning, building and implementing the retooled/reengineered business processes. In addition, information on how to implement change management should be discussed. This training should occur for each team prior to the beginning of each respective BPR effort.

Customer Service Training: The purpose of this training is to provide the personnel who will be responsible for interacting with the end-user community and providing support with the skills necessary to provide exceptional customer service. This training is non-technical in nature and covers topics such as how to handle customer complaints and how to manage conflicting customer priorities. This training should occur prior to the implementation of an Enabling Center concept. This training should be ongoing and provided regularly in order to educate new employees.

Workshop Facilitation Training: The purpose of this training is to provide BPR analysts, BISP analysts and data analysts with the ability to effectively conduct facilitated meetings with business personnel to determine business requirements. This training should occur in conjunction with either the 4FRONT Strategy or the Business Process Retooling training.

Office Automation Tools Training: The purpose of this training is to provide BPR and BISP team members with the skills necessary to effectively use the office automation tools provided (e.g., Word Perfect, Lotus 1-2-3, etc.). These tools are used throughout each project and it is imperative that team members have the knowledge to use them effectively. This training should occur in conjunction with either the 4FRONT Strategy or the Business Process Retooling training.

Enterprise-Wide Data Modeling Training: This training should be provided to the data analysts. It should include all aspects of logical database design, including the concepts of normalization, database integrity, cardinality, etc. This training will provide the skills necessary in order to migrate to a relational database environment.

Relational Database Design Training: The purpose of this training is to familiarize the database analysts (DBA) with relational database design concepts. This training focuses on the physical versus logical design of relational databases. Training should be conducted at the beginning of the RDBMS project for personnel participating on the selection team as background information for selecting a RDBMS product.

Relational Database Management System (Vendor/Package) Training: This training is intended to provide specific training related to the RDBMS package selected during the RDBMS project. This training should be provided for data analysts, DBAs and application developers as appropriate.

Graphical User Interface (GUI) Design Training: This training should be provided for application developers throughout the department. This course is not intended to be product specific, but rather to convey the concepts of GUI design. This type of training will be crucial as the department moves away from a character based design environment to a graphical environment.

Project Management Training: This training should be provided as appropriate for the project leaders of the BPR and business improvement projects. Consideration should be given to product specific training.

IEF CASE Tool Training: This training is necessary for the analysts and developers assigned to the ROW rapid application development portion of the ROW pilot. This training should be conducted as soon as possible in order to properly prepare developers to begin the ROW project.

Application Development Tools Training: Training for the suite of tools selected by the application development tool selection project should be provided for all staff who will utilize the tools. This would include district, division, and special office

automation staffs and end users. This training should be ongoing and provided regularly in order to educate new employees. If the suite of tools selected includes IEF CASE tools, then IEF training should proceed based on experiences with the ROW pilot.

Geographic Information System Training: Training should be provided for the developers who will be responsible for developing GIS applications. The training should coincide with the end of the GIS project. In addition, the training should be specific to the GIS products selected.

ESTIMATED RESOURCE REQUIREMENTS:

Projected Dollar Costs:

Figure 5.10 shows projected dollar costs for the business process retooling projects identified in the projects and training plan schedule. These projected costs include training and equipment for the project team; and consultant costs are included only for the ROW Pilot and IS BPR.

	BISP PROJECTS	PROJECT COST			
		FY 1995	FY 1996	FY 1997	FY 1998
I R M	**Business Process Retooling**				
	ROW Pilot	$699,000			
	Information Services	$233,000			
	Human Resources	$44,000			
	Plan Transportation Systems	$45,000			
	Determine and Analyze Transp. Needs	$44,000			
	Deliver Transportation Systems	$44,000			
	Contracted Services	$46,000			
	BISP Annual Update	$70,000			

Figure 5.10 - Projected Costs for BPR Projects

The estimated costs for the data and technology infrastructure projects are listed in Figure 5.11.

	BISP PROJECTS	PROJECT COST			
		FY 1995	FY 1996	FY 1997	FY 1998
	Data				
	Enterprise-Wide Data Model	$345,000	$265,000	$65,000	
	Technology Infrastructure				
I S D	RDBMS	$660,000			
	User Interfaces	$0			
	Bar Coding	$0			
	Application Development Tools	$100,000			
	Telecommunications	$365,000			
	GIS	$735,000			
	Desktop O/S	$5,000			
	Document Management/Imaging	$355,000	$25,000		
	Videologging	$500,000	$170,000		

Figure 5.11 - Projected Costs for Data and Technology Projects

The estimated costs of the technology infrastructure projects are based on the following assumptions:

- Costs are estimated for project execution only and do not include the cost of full implementation and roll-out.
- Training has been included for team members of every project. Although some projects may not require specific product training, a minimum training cost has been included for other education.
- Costs do not include any upgrades to the current computing platform that may be required to support project implementation (i.e., increased disk space has not been estimated).
- Product/software costs have been included for the RDBMS and User Interface projects. The costs of application development tools and desktop operating systems were not estimated due to the uncertainty of the roll-out of these tools.
- Hardware and software costs have been included for the pilot projects identified for RDBMS, document management and videologging.
- Salaries for TxDOT personnel have not been included.

Projected FTE Requirements:

The FTE requirements for the BISP projects are listed in Figure 5.12. Anticipated internal resource requirements are identified in each column labeled 'INT' and contract resources are identified in columns labeled 'CON'.

	BISP PROJECTS	FY 1995		FY 1996		FY 1997		FY 1998	
		INT	CON	INT	CON	INT	CON	INT	CON
IRM	**Business Process Retooling**								
	ROW Pilot	3	4						
	Information Services	5	1.5						
	Human Resources	4							
	Plan Transportation Systems	4							
	Determine and Analyze Transp. Needs	4							
	Deliver Transportation Systems	4							
	Contracted Services	5							
	BISP Annual Update	3		3		3		3	

	BISP PROJECTS	FY 1995		FY 1996		FY 1997		FY 1998	
		INT	CON	INT	CON	INT	CON	INT	CON
ISD	**Data**								
	Enterprise-Wide Data Model	5	2	5	2	1.25	0.5		
	Technology Infrastructure								
	RDBMS	4	1.5						
	User Interfaces	1	0						
	Bar Coding	0	0						
	Application Development Tools	8	1						
	Telecommunications	4	3						
	GIS	3	1.5						
	Desktop O/S	4	0						
	Document Management/Imaging	2	2	0.2	0.2				
	Videologging	2	1	2	1				

Figure 5.12 - Projected FTE Requirements

Note from the previous figure that resource estimates for business improvement projects identified during each business process retooling effort have not been included in this plan. As described in Section A, approximately 10 - 20 business improvement projects will be identified during each business process retooling effort. Many of these improvement projects will result in the development of applications. Resource requirements for each will vary depending on the scope of the business change, but it is estimated that approximately 3-9 information services resources per business area will need to be dedicated to the business improvement projects. Other personnel with various business subject matter expertise will also need to be heavily involved in these efforts.

The technology infrastructure projects are the responsibility of the Information Systems Division. TxDOT resources for these projects will include Information Systems Division personnel and district/division/special office automation administrator personnel.

RESOURCE PLANNING:

An integrated resource planning process does not currently exist for projecting information resource personnel needs. An integrated process which meets BISP, Biennial Operating Plan, Information Resource Council and other information resource requirements is needed to effectively identify the impact of retooling efforts on existing workloads.

The information services business process retooling effort will consider the development of an integrated resource planning process for information resources. The resulting resource plan would be used for effectively projecting and assigning information resources statewide for each quarter over five fiscal years. This process should include information resources needed for business process retooling and strategic technology infrastructure projects, as well as for enterprise-wide and work group computing efforts. A status reporting mechanism for keeping existing resource allocations current is also needed so that resource projections can be made in a timely manner.