Business Process Analysis/Modeling for Defining GIS Applications and Uses

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Business process analysis and modeling is an effective tool for defining the business activities associated with the use of GIS. The GIS investment is leveraged and the benefits are greatly enhanced when a wide range of business processes throughout the organization use GIS information. Business process modeling was employed by the City of Austin to identify current and future uses of GIS, as well as the process changes needed after the migration to ArcGIS 8. Business process modeling was used to define the processes needed to manage ArcSDE versions within the QA/QC processes.

Introduction

The City of Austin Water and Wastewater Utility (Utility) has an extensive Geographic Information System (GIS) that is used to support a wide variety of different business functions throughout the Utility and other City departments. The Utility is upgrading their GIS system from ESRI's ArcInfo 7.2 and ArcView 3.x to ArcSDE and the ArcGIS 8 suite of products. The upgrade to ArcSDE and ArcGIS 8 represented a significant enhancement in the GIS technology, which offered the Utility the opportunity to develop a true enterprise GIS and to significantly improve their GIS management processes and procedures.

The realization of benefits from the new GIS technology required the alignment of their GIS business processes with the capabilities of the new GIS technology. The existing GIS data development and management processes had to be modified to work with the new GIS software and to effectively use the new capabilities offered by ArcSDE and ArcGIS 8. It was the marriage of the new GIS business processes and the new ESRI GIS technology that will result in achieving the cost savings, improved GIS data quality, and enhanced GIS services. Simply implementing the new software without modifying the GIS business processes would not have produced the desired benefits.

A business process analysis was conducted to identify the business process adjustments and modifications that were needed to effectively use the new GIS technology. The first step in the business process analysis was to define the existing GIS business processes. A business process model was used to capture the existing business process and workflows. The model of the existing GIS processes was then used to identify the recommended modifications to the GIS management and use procedures to allow effective use of the new GIS technology. A second business process model was developed to document the "recommended" or "To be" processes. The implementation of these recommended process modification, in combination with the implementation of the new GIS technology, should significantly enhance the chances to achieve the desired benefits.

The Role of Business Process Analysis

Business process analysis and modeling is an effective tool to help utilities modify their business processes to improve efficiency and to effectively use their information technology. The coordination and alignment of the business processes with the supporting information management technology offers the greatest opportunity for improving the business operations.

The Need to Integrate Business Process with Information Management Technology

Utilities, like other business organizations, are under increased pressure to improve efficiency, while at the same time, offering new services within the current limited and often declining resources. They are looking to new information management technology for help in achieving increased efficiency in the following activities:

- Reducing cost and extending the life expectancy of their facilities,
- Limiting staff growth while improving staff skills, and
- Effectively using their current technology investments.

Businesses are increasingly becoming aware that simply investing in new technology often does not produce the desired increases in efficiency. There is a growing awareness that the desired increases in efficiency can only be achieved by aligning the business processes with the technology. The business processes and activities must be designed to effectively use the new technology. In addition, the new technology must provide the information in a usable and understandable manner to allow the users to make the needed decisions and to complete the tasks. To achieve the desired increases in efficiency, the business processes must be aligned with the capabilities of the new technology and the skills of the staff.

The Use of COTS Solutions Requires the Adjustment of Business Processes

In today's world, businesses are acquiring the new information management technology through the purchase of commercial off-the-shelf (COTS) solutions. Most businesses cannot afford to develop and maintain custom software that closely matches their existing business processes. As a result, businesses select a COTS solution that closely matches their business processes and requirements. The COTS solution is then configured or tailored to match, as closely as possible, the existing business processes. However a perfect match is not possible and adjustments must be made.

Adjustments to the business processes are also needed to accommodate the COTS software upgrades. COTS software are constantly being upgraded and enhanced. The effective use of the COTS software upgrades requires businesses to implement new changes on a regular basis. Most major software systems provide one major upgrade every year or two. Minor upgrades are often provided several times a year. Failure to implement upgrades increases the risk that the COTS solution will drift out of date and could eventually fail due to lack of technical support.

The alignment of the COTS solutions functions and capabilities with the business processes may be made in one of three ways:

- Developing custom software modules or applications,
- Adjusting business processes and practices, or
- Providing a combination of custom software and business process modifications.

Developing custom software models or applications to be used with a COTS solution to accommodate the existing business processes is a dangerous approach that often leads to additional cost when the COTS software is upgraded. And there is no guarantee that custom software modules or applications will work with the COTS software upgrade.

Adjusting business processes and practices to match the capabilities and functions of the new technology is a much more reasonable approach. Developing more efficient business processes that reduce labor is often the best way to reduce costs and improve efficiency. Developing workflows to provide information and data to the users when they need it can avoid time spent looking for the information or waiting for the

information to arrive. Most of the major COTS solutions incorporate industry accepted best practices and implementing these practices as part of the COTS software implementation could provide additional efficiencies.

In actual practice most businesses use a combination of custom software applications and business process modification to implement a new COTS solution. Business process modeling and analysis provide the tools to identify the optimum mix of business process modification with the development of custom applications.

Business Process Modifications Options

A Historical Perspective of Business Process Modification Methods

A number of different procedures for improving business processes have be developed and tried by businesses with varying degrees of success. Some of the most notable earlier procedures include Porter's Value Chains and Total Quality Management which were used during the 1980s. Business Process Reengineering was popular during the 1990 decade. The 1990s also saw the emergence of the ERP package software systems.

Most of these procedures are actively evolving. For example, Total Quality Management is being replaced with the Six Sigma methodology, which is currently receiving a lot of attention. Business Process Reengineering is evolving into Business Process Redesign. [Harmon, 2003]. Other processes such as Continuous Quality Improvements, Management by Objective, Management by Walking Around, Customer Focus Management have also emerged [Sharp and McDermott, 2001].

The growth and acceptance of information management technology has had a major impact on the procedures for improving business processes. Sharp and McDermott in their book Workflow Modeling: Tools for Process Improvement and Application Development [Sharp and McDermott, 2001] identified some of the major ways that business processes have been integrated into information technology.

> "Many of the major commercial applications include facilities for automating and managing process workflow.
>
> Workflow systems, especially in the document management and imaging areas, have been a staple of the IT scene for years.
>
> The study of workflow –'who does what, when'—has emerged as a critical component of systems analysis and design methodologies and the tools that support them."

The emergence of the Internet and email have had a major impact on business processes and this impact is expected to increase in the future. [Harmon, 2003]. The use of information technology and Business Process Management is becoming a core competency that every business must have in order to function in today's global and highly competitive business environment.

As result, there is a bewildering array of tools and procedures for reviewing business processes and developing improvements. The different tools and procedures have a large number of conflicting claims and counter claims. However, all of the various business process improvement procedures are merging into the single discipline of Business Process Management.

Effective Business Process Management requires the use of a range of interrelated tools and procedures that are designed to address a variety of types of business problems. Different tools and procedures have different capabilities and are appropriate for addressing different types of problems and achieving different goals. No one single tool or procedure can be use to review all of the different types of business problems.

Giancarlo Succi, Paolo Predonzani and Tullio Vernazza present a useful list of four major business process change processes [Bustard *et al.*, 2000], which include:

- Business process improvements,
- Business process reengineering,
- Technology transfer, and
- Process Standardization

Paul Harmon [Harmon, 2003] completed a similar list, which include the following three processes:

- Improvement process,
- Process redesign, and
- Process reengineering

Harmon also indicated that these three processes are found in most of the various business process evaluation procedures and tools that have been developed to date.

The definition of the "Improvement process" and "Process reengineering" are similar to the processes identified by Succi, Predonzani, and Vernazza. However, Paul Harmon suggests that most of the business process modifications will fall between the extremes of "Improvement process" and "Process reengineering."

Potential Processes for Changing Business Procedures

The list of potential processes for changing business procedures are a combination of the two lists and include the following five business process evaluation procedures:

Business process reengineering. Radical changes are defined and implemented to achieve major improvements in business processes or to implement a major redirection of the business processes. New business goals and missions maybe developed. Alternative business processes are usually identified and evaluated to identify the recommended new business processes. Business process modeling is often used to identify and evaluate the strategic choices and to define the new business processes.

Business process redesign. A major effort redefinition of the business process and workflow is completed to significantly improve the existing business process performance. The changes to the business processes often change the sequence of how work is completed and the resources that are required. However, the goal and mission of the business are not modified. A business process redesign may include the identification, evaluation, selection, acquisition, and implementation of new business information management systems. Business process modeling is used to evaluate the existing system and to identify opportunities for improving business processes. The business model could also be used to define the requirement for acquiring new information management technology.

Business process improvements. Incremental and continuous changes to business processes based on the measurement and monitoring of process performance. Business processes are tuned or modified to increase performance. The business process modifications are usually small and incremental. However, the monitoring is continuous and the business process modification should also occur frequently. Business process modeling may be used in conjunction with process measurements to identify potential process improvements and to define the impacts of proposed modifications.

Technology transfer. Existing business processes and data are translated and transferred from the existing business processes environment to a new technology or system. The business processes are modified to effectively use the capabilities and features of the new technology. The new technology must be clearly identified and its capabilities and functions known. This procedure would be used to modify business processes to use a new information management system that resulted from a "Business process reengineering" or a "Business process redesign."

Process standardization. Business processes are defined and standardized to provide consistent, predictable and repeatable performance. Business processes may be standardized to satisfy legal requirements and to provide documentation for ISO 9000 certification or other certification standards. Business process modeling can be used to identify standardized processes and to document the standardized business processes.

Business Process Modeling

Business process modeling is used to identify and evaluate the opportunities for modifying the business processes. All of the previous procedures for identifying and defining the business processes envision the use of business process modeling. Business process modeling is the description of how work is accomplished in a business. Business process models use a combination of graphic diagrams and supporting text to describe how work is accomplished. A number of different diagrams are used to describe the various aspects of the business processes. No single diagram can effectively describe the business processes. Most business process models will use a number of different integrated diagrams to describe the business processes. Figure 1 presents a simplified summary of the major diagrams used in the City of Austin's business process model.
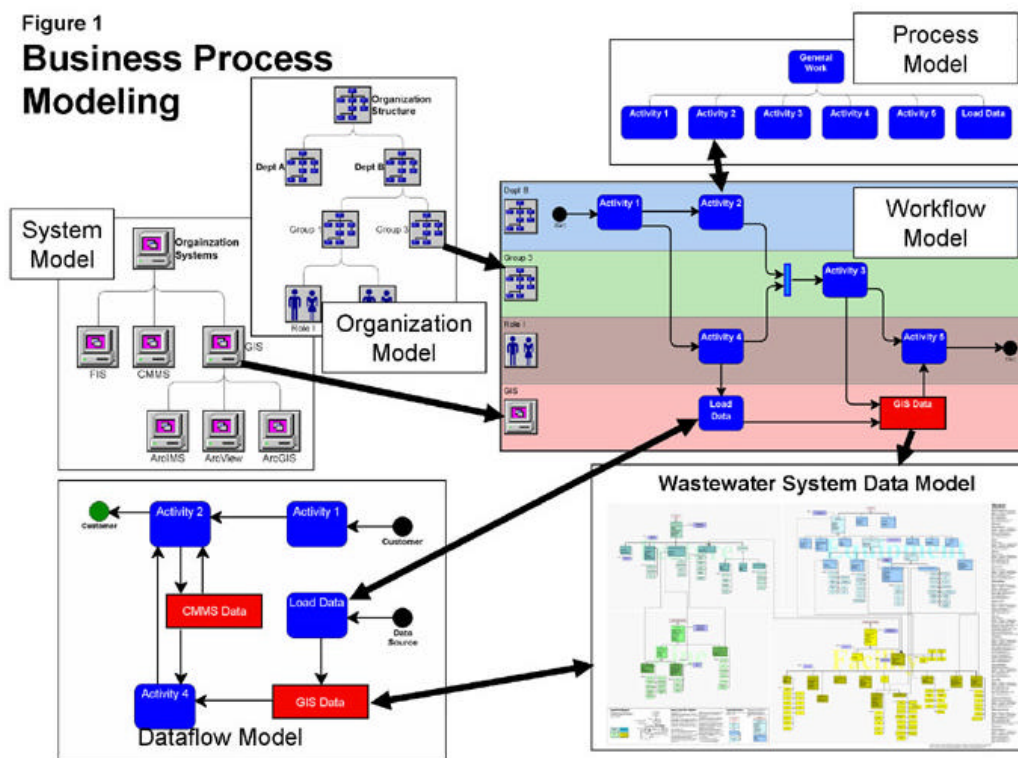
The first diagram is an organization chart. The organization chart is used to define who will be doing the various activities or business processes.

The second diagram is a process diagram that presents the initial definition of the various business processes or activities. This diagram defines what activities will be completed. The business process

models are commonly presented as a hierarchal diagram similar to the organization chart. Business processes are broken down into sub-processes and tasks.

The third diagram is a workflow diagram that describes how and when the work is accomplished. The most common form of workflow diagram is a "swimlane" or channelized workflow diagram. A swimlane, channel, or workflow lane is assigned for each department or role in the organization chart. Business processes are assigned to the various departments or roles by placing the process symbol in their swimlane. Arrows between the processes describe the outputs from the previous process and the order in which the processes are completed.

A swimlane or workflow lane is also added for each of the major information management systems that are used to complete the workflow. The databases or data stores, shown as red rectangles, are placed in the system's swimlane and are used to define the databases that are used or generated by the workflow activities. It should also be noted that the data stores included in the workflow diagram may also include file cabinets and map storage files.

The fourth diagram is a dataflow diagram of the processes. The dataflow diagram shows a relationship between the processes, the dataflow and the data stores. The data flow diagram is often used to present a generalization of the more detailed workflow and process diagrams.

The fifth diagram is database design diagram. This diagram is usually a class diagram used to define the various class objects that are included in the database design. One class diagram, or entity relationship diagram, is developed for each database included in the model. The class diagram is also used to identify the attributes and methods that are included in each object class.

The different diagrams are developed during different phases of the project. The definition of the organization chart and a listing of all of the existing systems are usually accomplished at the start of the project before any workshops or interviews are initiated. The initial process diagrammed is often developed prior to the initiation of the workshops and used to schedule the workshops.

The workflows are initially defined and diagrammed in a series of interactive workshops. The workshop facilitator completes an initial workflow diagram in the workshop based on input received from Utility staff. The workflow diagrams completed in the workshop are rough draft diagrams and require editing and reformatting before the Utility staff can review them.

The dataflow diagrams and revised workflow diagrams are developed by the modelers based on input developed during the initial workshops. Additional workshops are scheduled as needed with selective groups to review the diagrams, to provide clarifications, and to answer questions.

The database design or class diagram is the next diagram to be completed and requires a clear definition of the data needs and data stores identified during the workflow definition. The detailed description of the activities is used in the development of the database design and class diagrams.

Business Analysis and Modeling Approach

There are a number of different approaches and methodologies for developing business process models and completing business analysis and reorganization. The different business analysis approaches can be placed into one of two major categories that include:

- Top-down Methodology
- Bottom-up Methodology

Top-down Methodology

The Top-down Methodology, as its name implies, starts with the development of a new vision and definition of the business approach by the business leaders and senior management. The key feature of the Top-down Methodology is the initial involvement of the business leaders and senior management. Senior management provides the leadership and resources needed for development and implementation of the new business processes.

Figure 2 – Top-down Business Process Methodology presents the major activities for a top-down business process methodology. The top-down approach starts with the business leadership providing the approval and authority for developing and implementing a new business plan. The business leadership also provides:

- New goals and objectives of business,
- Definition of a new business concept,
- Guidelines for designing and implementing the new business processes,
- Metrics for monitoring the new business, and
- Selection of business improvement teams and procedures.

The business staff has the responsibility for completing the detailed design of the new system within the guidelines established by the business leadership team. The detailed definition of the desired new business processes and workflow is often used to define the system requirements for a new information technology system. Additional business process modifications may be required to align the final business processes with the capabilities of the new information system.

Figure 2
Top-down Business Process Modifications
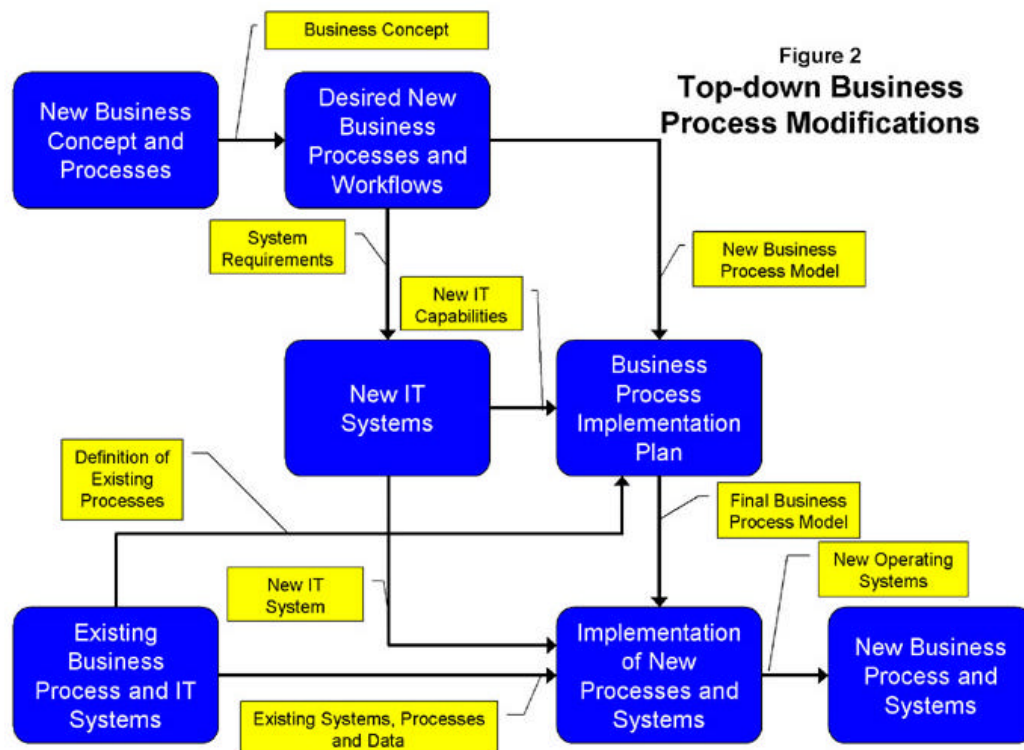
Bottom-up Methodology

The Bottom-up Methodology, presented in Figure 3 – Bottom-up Business Process Methodology, usually starts with the identification, by the business staff with approval of the management, of opportunities for improving business processes by reviewing the existing business processes. The initiation of the Bottom-up Methodology may also be started by the implementation of new information technologies or new regulations or requirements, which may require modifications of the existing business processes. The Bottom-up Methodology must include developing support of senior management for implementing the new business processes. Obtaining senior management support is often a difficult task and will usually require the staff to develop the information and business cases for justifying the implementation new business processes.

The Bottom-up Methodology usually includes the development of two business process models. The first model is a definition of the existing business processes and the identification of opportunities for improving the processes. A second business model is developed to define the new desired business processes and workflows.

Figure 3
Bottom-up Business Process Modifications
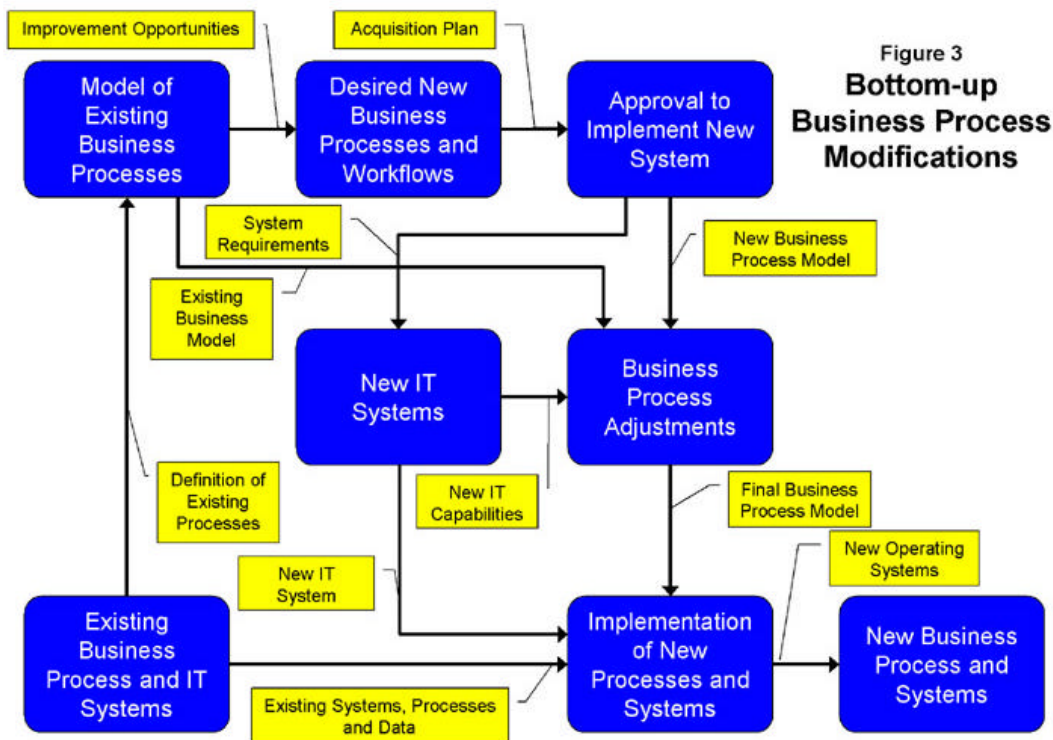
Methodology Selection

The selection of the business analysis/modeling approach and methodology is dependent on the goal of the business reorganization and the level of organizational support. The recommended business process methodologies for the different business process changes that were presented earlier are summarized in Table 1. The preferred approach for major changes in business process is clearly the Top-down Methodology due to the built-in support of senior management and the opportunity to institute major business process improvements. The identification of new business processes required for the

implementation of new information technology or responding to new regulations may best be accomplished by use of the Bottom-up Methodology as shown in Table 1.

Table 1 Recommended Approach for Achieving Business Process Changes		
	Business Analysis Approach	
Business Change Processes	**Top-down Methodology**	**Bottom-up Methodology**
Business process reengineering	Recommended	
Business process redesign	Recommended	Viable Alternative
Business process improvements		Recommended
Technology transfer		Recommended
Process standardization	Recommended	Viable Alternative

City of Austin Water and Wastewater Business Process Analysis and Modeling Procedure

A business process analysis including the development of two business process models was completed to identify the business process adjustments and modifications that were needed to effectively use the new ArcSDE and ArcGIS 8 GIS software. The Utility was upgrading the GIS from Arc/Info 7.3 to ArcGIS 8.

The Project Objectives

The project objectives were to define business processes to effectively use the new GIS technology and to improve GIS integration with the maintenance management system and the hydraulic models.

The Project Procedures

The project used a Bottom-up Methodology to complete the business processes analysis and modeling. The type of business process changes that were envisioned for the Utility was a "Technology transfer." The primary function of the project was to modify the existing GIS business processes for use with the new GIS technology. In addition, the Utility wanted to identify additional opportunities for improving efficiency.

A summary of the approach to define, present, and report the business process modifications included the following tasks:

1. Obtain initial background information from the Utility staff before initial workshops.
2. Participate in a Project Kick-off meeting and initial presentation of project procedures.
3. Complete the initial staff workshops to define the existing processes.
4. Complete follow-up interviews and workshops to refine the existing processes.
5. Prepare a business process model of the recommended new business processes.
6. Prepare and present draft business process models.
7. Revise the draft models with additional interviews.
8. Prepare the Summary Report .
9. Prepare the Final Report.

The business process modeling used a business process analysis software tool, ProVision version 4.11, from Proforma Corporation. The business process modeling tool provided the ability to capture the complex business processes while describing the business processes and their interaction using standard industry accepted models and methodologies. The business process modeling tool was used to develop detailed model documentation as well.

The modeling tool was used during interactive workshops to define and describe the business processes and workflows. Swimlane workflow diagrams were used to define the workflows and to assign various activities to different departments. All data stores or databases were identified and were described in the supporting text. The dataflow between activities and between activities and data stores were illustrated on the workflow diagrams and documented in the supporting text. The model objects' properties boxes or dialog boxes were used to describe the various processes and model elements. The business process modeling tool automatically kept track of all of the data flows and inputs into a process and also identified all of the processes and databases that received output from the process. This information was also included in the model documentation. Figure 4 –Business Processing Model Workflow and Documentation illustrates the business process model capabilities and typical documentation.
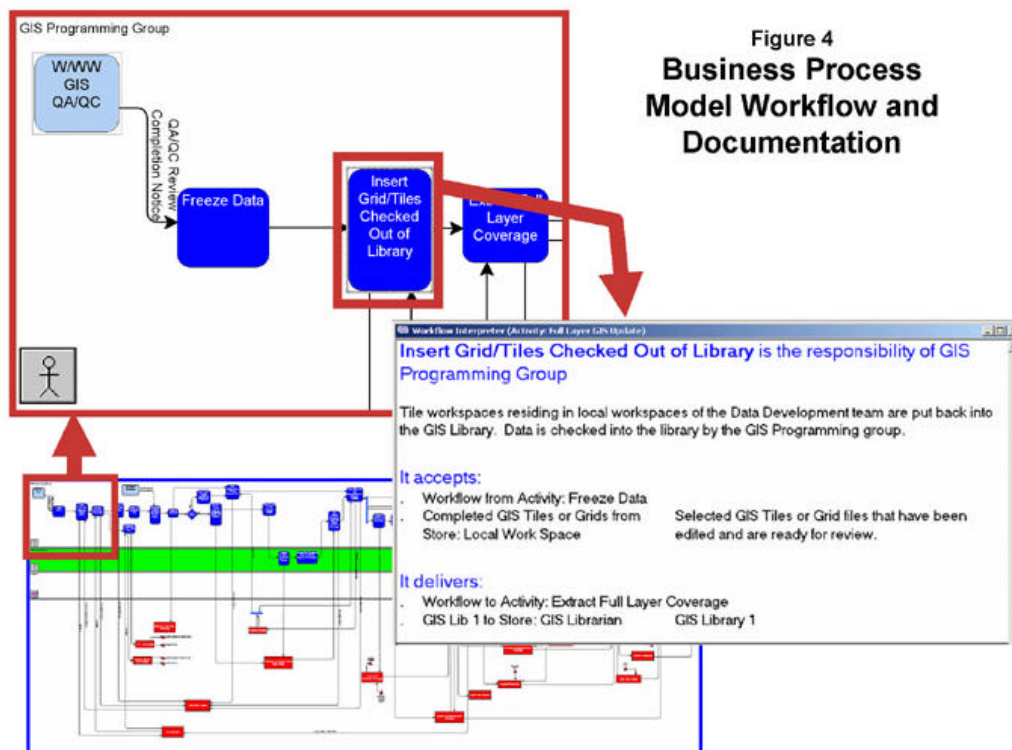

Figure 4
Business Process
Model Workflow and
Documentation

Two business process models were built. The first business process model included the definition and evaluation of the existing business processes. The existing business processes were identified in a series of interactive workshops. The existing business processes were identified and defined by the Utility staff during the workshop. The workshop facilitator recorded the process definitions and workflows in the business process modeling tool during the workshop. The business process modeler revised and reformatted the business process models after the workshop were completed and prepared a complete set of business process models for review in a later review session.

The second set of business process models identified the recommended new business processes and were developed by the business process modeler with the assistance of the ESRI project staff. A comparison of the two models identified the business processes that would require modification to align the business processes with the capabilities of the new ArcSDE and ArcGIS technology.

The Business Process Analysis Report

The business process analysis was documented by using a combination of traditional written summary reports and the corresponding computer files from the completed models. The computer files were reviewed using a conventional Internet browser. The presentation and reporting of the business process analysis for the Water and Wastewater Utility was completed in a series of reports and presentations. Reporting business process analysis is not easily accomplished in a traditional report.

Business process analysis and modeling is a multi-dimensional process in which there are many interrelationships and links. Identifying, classifying and documenting all of these links is not easily accomplished or clearly presented in traditional written or printed reports. Presenting the business process analysis in a traditional published report would result in a long, complex, and very repetitive report. However, documenting the business processes in an electronic format that can be viewed and modified for future changes in the business processes is a clear benefit of the Westin business process analysis approach.

The reporting of the business process analysis was accomplished using five different reports, summarized in the Table 2--Business Process Reports.

No.	Report Title	Description	Objective
1	Summary Report	A traditionally written report	Presented a summary of the business processes analysis, major findings and recommendations
2	Electronic Business Process Models (Exiting and To Be Models)	A compressed HTML file with all of the model's diagrams and supporting documentation. The model's files were published on a CD that could be viewed without the modeling software.	Published complete, business process model diagrams and supporting documents with electronic links to permit users to easily navigate the model with an Internet browser.
3	Visual and Verbal Presentation	The business process models were presented in a series of workshops using the electronic business process models. No additional presentation materials were developed or provided.	Conducted a visual and verbal presentation and discussion of the business process models for different groups of staff with specific areas of interest. The presentations were designed to encourage questions and facilitate discussions.
4	Model Database	Copies of the model database were provided to the Utility. In order to utilize this model database, the City was required to acquire a license for the ProVision modeling tool.	Provided the model database for future use and modifications by the Utility.
5	Executive Presentation	A presentation of the business process models, major findings and recommendations was made to the Utility's managers. This was a formal, PowerPoint slide presentation with only a very limited demonstration of the actual models. Copies of the presentation were published and provided to the participants.	Presented a summary of the business process model and identified the outcomes and recommendations of completing the business process analysis.

Table 2--Business Process Reports

Major Project Results

The business process analysis identified a number of recommended business process improvements. A summary of the major project results is presented below:

- The business process model provided an overview of the entire Utility improvement project lifecycle.

- The business process analysis identified several improvements to the existing GIS processes and developed new procedures that greatly streamlined these processes.

- The business process modeling and analysis provided essential input in the creation of the GIS database design.

- The business process analysis also provided critical requirements for several of the custom applications.

Each of the major results will be discussed in the following sections.

The Business Process Model Provides an Overview of the Entire Utility Improvement Project Lifecycle

The business process analysis provided a comprehensive definition of the entire utility system improvement project life cycle. Figure 5-High Level Dataflow Diagram is summary diagram of the recommended GIS business processes and work flows. Twenty five different business process workflow models were developed by this analysis and could be accessed from the dataflow diagram by viewing the sub-process models. The dataflow diagram in Figure 5 also summarized all of the GIS data transfers required to develop and maintain the water and wastewater system improvement projects. The large orange rectangle represented the ArcSDE database and the orange arrows identify the GIS data flows in and out of this database.

The dataflow diagram summarizes the entire process or lifecycle required to identify and develop a water or wastewater system improvement. All the major activities required to select, budget, design, construct, and maintain water and wastewater system improvements were identified in Figure 6 – Comprehensive Definition of the Entire Project Life Cycle. The major activities in the project lifecycle include:
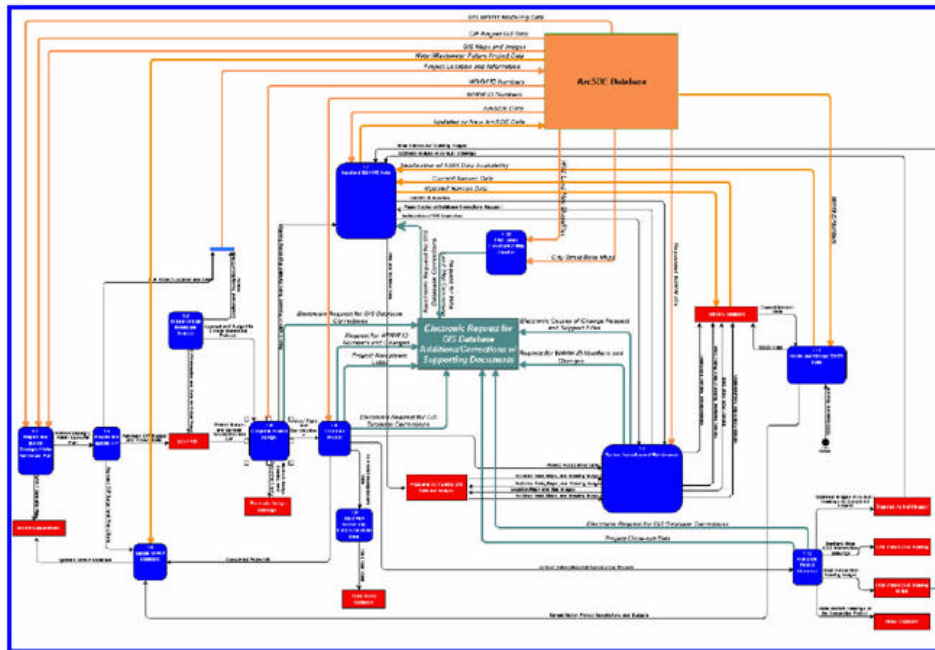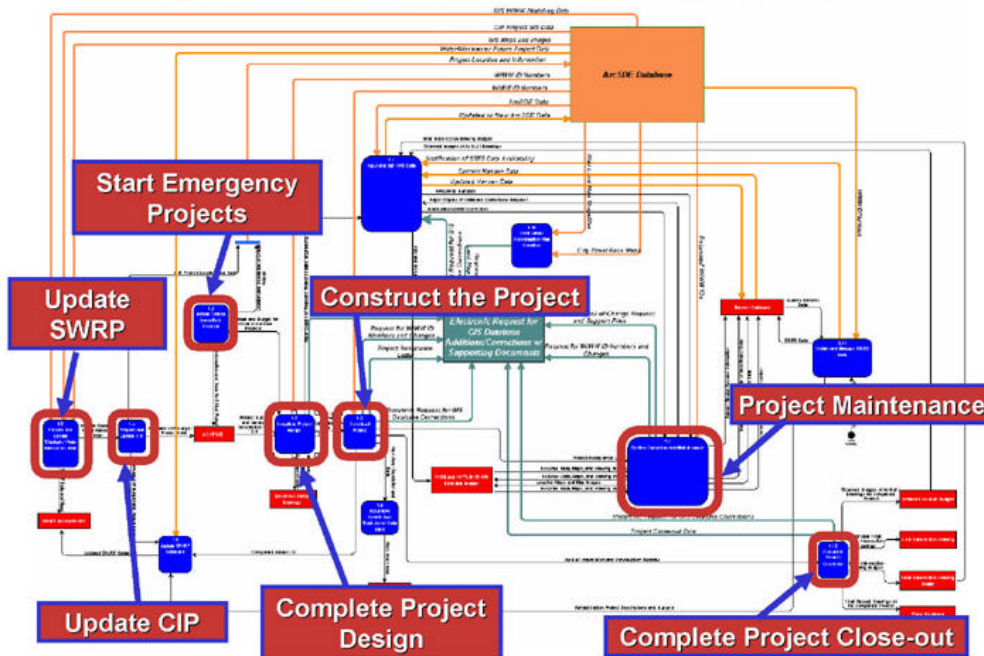
Figure 5
High Level Dataflow Diagram

Figure 6
Comprehensive Definition of the Entire Project Life-cycle

- **Update Strategic Water Resource Plan (SWRP).** This process included the engineering and modeling analysis to identify water and wastewater system improvement projects.

- **Update Capital Improvements Plan (CIP).** The high-priority projects identified in SWRP were entered into the CIP.

- **Start Emergency Projects.** These are the procedures for initiating emergency projects that are not usually included in the CIP.

- **Complete Project Design.** The business processes required for the design of a water or wastewater system improvement project.

- **Construct Project.** The activities and processes that would be needed to construct a water or wastewater system improvement scheme.

- **Complete Project Close-out.** The processes and activities required to close a construction project and to accept the new facilities included in this activity.

- **Project Maintenance.** This task included all of the processes and activities for providing maintenance to the water and wastewater system.

The business process analysis identified and modeled over 350 different processes. The rounded blue rectangles in Figure 5 and 6 represent the business processes. Most of the processes identified in this data flow diagram have additional detailed dataflow and workflow diagrams that can be accessed by a mouse click on the blue process box. The red, orange, and green rectangles represent the data stores or databases used by the business processes. The large blue-green rectangle represents a new data store for an electronic work request and data distribution system
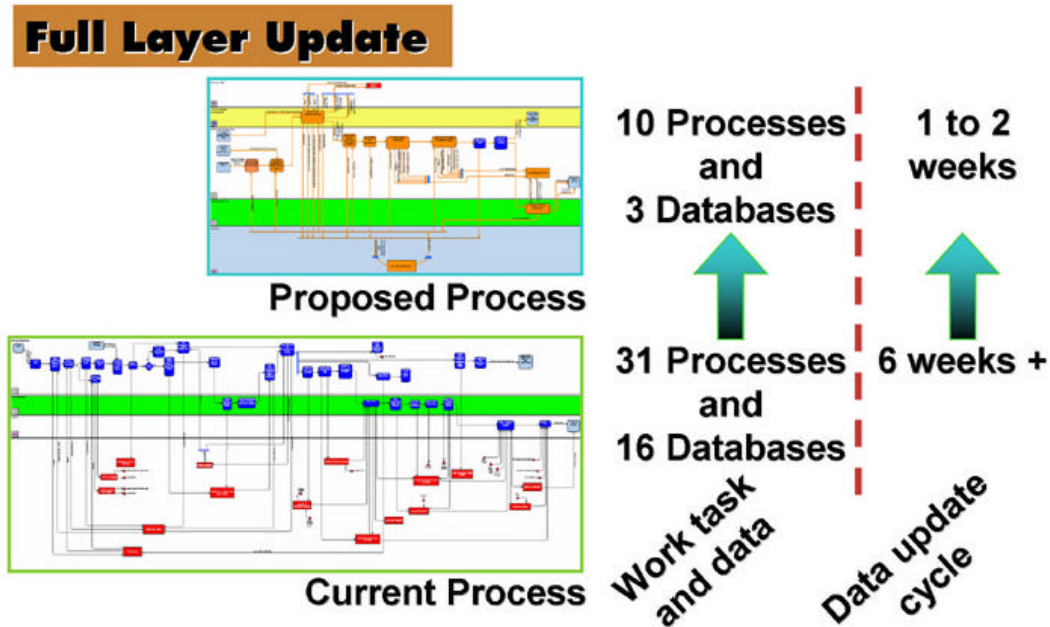
The Business Process Analysis was Able to Improve and Streamline Several Significant GIS Processes

The business process analysis identified new workflows to streamline business processes that use the new GIS technology. The most dramatic streamlining of the existing business processes involved the Full Layer Update process (affectionately referred to by Utility staff as the FLU). The current workflow is shown in the bottom chart in Figure 7. This workflow shows all of the processes and databases that are required to publish and distribute the GIS data once the GIS database changes have been completed and GIS databases have been updates.

The streamlined business processes for the Full Layer Update, showed in the top half of Figure 7, resulted in a significant decrease in the number of processes and databases required to complete this function. The 31 processes in the current workflow were reduced to 10 processes in the proposed workflow. A total of 16 different databases were required in the current process and the new process required only three databases. The most important results of this change will be the reduction in the current update cycle from approximately six weeks to one or two weeks. It is anticipated that the actual update cycle could be reduced even further with additional experience in fine-tuning of the proposed workflow.

The improved efficiency is not due to the modifications in the workflow or the implementation of the new ArcGIS and ArcSDE technology. It is the combination of the new GIS technology along with the new business processes that provided the increased efficiency. In other words, it was the alignment of the work processes with the capabilities of the new GIS that provided the increased efficiency.

Figure 7
Process Streamlining Improvements

The BPA Identified How to Use Existing Procedures with the New GIS Technology

The Business Process Analysis (BPA) identified how to use the existing GIS work scheduling program and existing QA/QC procedures with the new GIS technology. The Water and Wastewater GIS Workgroup had developed a very effective system for scheduling and monitoring the completion of GIS data editing and input assignments. In addition, the GIS staff had developed and implemented an effective quality control and quality assurance program. Both of these programs were based on managing GIS data in map tiles stored in Arc/Info files. One set of files was required for each map sheet. The workflow modeling and analysis was able to identify new workflows and procedures to allow the continued use of both of these programs and to adapt them to the new data check out and version management functions of ArcSDE.

The BPA Identified How to Use Advanced Capabilities of the New GIS Technology

The business process analysis identified how to use some of the advanced capabilities or functions of the new GIS technology. ArcSDE has a sophisticated version management system to allow multi-user data editing. The business process workflows were developed, with the assistance of the ESRI staff, to allow use of the ArcSDE versions in coordination with the GIS scheduling program and the GIS QA/QC program. The procedures for creating a new version, inputting data into the version, and checking the version back into the core database were developed an integrated with the GIS scheduling program in the QA/QC program. The workflows also allowed for the periodic backup and compression of the ArcSDE database

The Business Process Analysis and Workflow Definition Provided Important Input Into the GIS Database Design

GIS data is currently use by the water and wastewater hydraulic models and the Strategic Water Resource Plan. The transfer of data from the GIS to these business processes is difficult and time consuming. The completion of the GIS data transfer required the development of several unique files as part of the Full Layer Update process. A review of the data transfer requirements identified some database enhancements that could greatly simplify the transfer of GIS to these business processes. Several suggestions were incorporated into the GIS database design. The database design suggestions simplified the transfer of data from the GIS to the Strategic Water Resources Plan and the water and wastewater hydraulic models.

The Business Process Analysis Also Identified Several Critical Application Requirements

SSES Data Importing Workflow

The business process analysis reviewed importing the Sewer System Evaluation Study (SSES) data into both the GIS database and the maintenance management database. The City was completing a major SSES that was inspecting most of the City's sewers. This program was expected to last several years and generate a large amount of useful and very accurate sewer system data. Included in this database were the results of field inspection, smoke testing, and CCTV inspection data. The SSES program was also collecting very accurate GPS coordinate data for all of the sewer system facilities and manholes. All of this data was being verified and placed into the SSES databases and this data had to be imported into both the maintenance management database and the GIS database in a coordinated and consistent manner. The first attempt to import the SSES data into the maintenance management database failed.

The business process analysis was able to define the workflow and procedures for verifying and importing the SSES data into the GIS and maintenance management databases. Involving selected members of each group and department allowed the completion of the definition of the workflows and the development and integration of SSES data. Four major functions or processes were defined and are shown in Figure 8 – SSES Data Importing Workflow

The first process was obtaining and verifying the SSES data.

The second process was the importing of the data into the maintenance management system.

The third involved the procedures required to import the SSES data into the GIS database from the maintenance management database. The workflow modeling identified a critical GIS process that must be completed before the SSES data could be loaded into the maintenance management database. The water/wastewater IDs had to be assigned by the GIS workgroup before the data was loaded into the maintenance management database. The water/wastewater IDs must be consistent in the two databases. The water/wastewater IDs were used to complete the synchronization of the GIS and the maintenance management databases.

The fourth process was the updating of the Strategic Water Resource Plan. The projects identified as part of the SSES program included as part of the Strategic Water Resource Plan.

The definitions of the workflows resulted in the resolution of several technical issues. The use of this workflow for the next update of the maintenance management database took only a few hours and did not introduce data errors. This was a significant improvement over the first attempt to import the SSES data.

Figure 8
SSES Data Importing Workflow
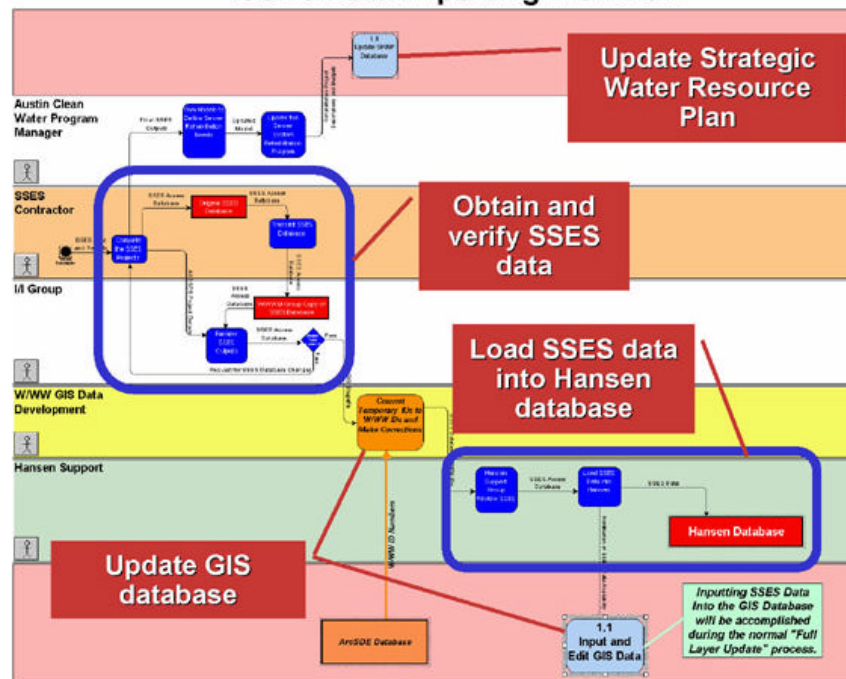
The BPA Identified the Data Synchronization Requirements and Procedures

One of the major problems that had plagued the Water and Wastewater Utility was the lack of synchronization of the data maintained in the GIS and maintenance management system. The Utility staff had developed workflows and procedures to synchronize the data during the data input process. These procedures were reflected in the business process models. However, the procedures to synchronize the changes completed after the initial data input were not in place and the two databases had drifted apart. One of the major applications to be developed included an application that would identify the differences between the two databases and provide the tools for synchronizing the two databases. The importing of SSES data also threatened to increase the number of database conflicts.

The business process analyses developed workflows that included the use of the new GIS and maintenance management database synchronization tool. The needed functions of the tool were also refined based on these workflows. These procedures were an integral part of the workflow for importing the SSES data that was discussed earlier. These same procedures also allowed the inputting of GIS and maintenance management data from new developments.

Conclusion and Observations

The completion of the business process and analysis resulted in some additional unplanned benefits.

The Business Process Analysis Increased Communications and has Already Solved Real Problems

Business process analysis and modeling increased communications, which solved some problems immediately. This was illustrated in one of the workshops that was to define the process to transfer information between the GIS and the hydraulic models. One of the hydraulic modelers identified a need to get SCADA data from the pump stations for use in the hydraulic models. The hydraulic modelers indicated that getting the SCADA data was a problem. A member of the SCADA team, who was sitting across the table said, "No problem, I will have it for you tomorrow." Problem solved!

There were many other problems that where solved by facilitating discussions between staff during the workshops. The importing of the SSES data that was discussed previously was again solved by the staff talking through the problem. The lesson learned from this; the process was as important as the results. Breaking down communication barriers solved problems and resulted in improved workflows and increased efficiencies.

The Business Process Analysis Has Defined an Integrated Enterprise System

The business process analysis defined an integrated enterprise information management system. As a result of this project three major software systems were integrated. The GIS, the water and wastewater hydraulic modeling systems, and the maintenance management system are able to share information and data. The sharing of information increased the value and accuracy of the analysis and decisions completed with each of the systems.

- The completion of the business process analysis increased communications among participants. Workflows and procedures were developed that built on these new communications and help reduced the communication barriers that are commonly found in most organizations. There was a much greater understanding of the importance of an integrated enterprise system.

- The workflows and processes developed by the business process analysis have been coordinated across a wide range of activities. The understanding of the importance of an enterprise database was clearly enhanced by participating in the development of the comprehensive set of workflows and business process definitions. Work completed in one part of the organization can now be used in other areas. The business process analysis fostered an understanding by the staff of the importance and value of an enterprise GIS database. There was an increased awareness that information and work completed by an individual is an important part of the overall enterprise data set.

- The development of a set of workflows for the entire GIS related activities has improved information access and quality. The utility staff now have a better understanding of how information is generated and a greater knowledge of the information accuracy that led to the appropriate use of the GIS data. New procedures were being implemented to capture and incorporate higher accuracy data generated by SSES program.

The success of this project was not due solely to the use of business process modeling and analysis. The business process analysis and modeling contributed to the project success. The success of the project was

due to the combination of implementing new and much more powerful GIS technology, developing specific applications to solve problems and simplify system use, and aligning the business processes with the capabilities and requirements of the various systems.

Summary

A summary of the major results of the use of business process analysis and modeling to help define new business processes to promote the effective use of the new GIS technology included the following:

1. Business process analysis provided the tools to align GIS business processes with the new GIS technology. Implementing new GIS technology alone often does not produce the desired efficiency improvements. Aligning the business processes with the capabilities of the new GIS technology provided the greatest chance of achieving the desired efficiency improvements.

2. Business process analysis was used to align the new business process with the capabilities of ArcGIS and ArcSDE. The alignment of the business process with the new GIS technology streamlined many existing business processes.

3. The business process analysis provided a comprehensive review of the business processes that generated and used GIS data and maps. The business process analysis provided a comprehensive definition of the entire Utility water and wastewater improvement project lifecycle. The business processes and that uses of GIS data were identified along with the processes that generated new GIS data.

4. The business process analysis developed new workflows that reduced cost and response time while increasing data accuracy. The most notable example was the reduction of the number of different processes and databases used to publish the GIS data for distribution throughout the City.

5. The business process analysis provided input into the GIS database design to support integration and easy data access.

6. The business process analysis identified requirements for several critical applications. Procedures were developed that allowed the importing and integration of the data from the SSES program. These same procedures also allowed the inputting of GIS and maintenance management data from new developments.

Credits

Westin Engineering, as a subcontractor to ESRI, completed the business process analyses and modeling work presented in this paper. ESRI was the project manager and responsible for development and implementation of several new GIS applications and completing the data conversion for the City of Austin. Jim McKibben, Senior Utility Manager, with AmeriCEC provided the business process modeling and workshop facilitation for this project while he was employed with Westin Engineering.

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