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16. Abstract

    This effort demonstrates business process modeling to describe the integration of particular planning and programming activities of a state highway agency. The motivations to document planning and programming activities are that: (i) resources for construction projects are used effectively; (ii) employees know where projects are in their construction life cycles and how projects may have been changed; (iii) the time of agency employees is used effectively; and (iv) the employees are working together to complete transportation projects in a reasonable time. The effort adopts the IDEF modeling capability of the BPWin software (also known as the AllFusion Process Modeler). IDEF modeling encourages consistent documentation of who generates what information, products, services; for whom; how; and for what reasons. Across the agency, the modeling is useful in prioritizing processes for change and maintenance. The modeling empowers employees at all levels, makes institutional knowledge relevant and accessible, and removes bottlenecks. It also encourages the development of integrated systems along functional lines, including administration, engineering, and operations, and focuses agency personnel on the *good* rather than the *perfect* system. Highway agencies have multiple business processes that can benefit from an integrated description of business and technology in process models. For example, the information technology division of a large highway agency maintains and develops around sixty software applications at any one time. Business process modeling helps the division improve their allocation of resources and priorities to these applications. This document provides the purpose and scope of the effort, the method behind IDEF modeling and the AllFusion software, the results and discussion of the effort, the deliverables, and the recommendations for future work. Twelve appendices provide the technical results.

    The authors identify some significant benefits that can be realized by an implementing agency in exchange for modest costs.

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FINAL CONTRACT REPORT

BUSINESS PROCESS MODELING FOR THE VIRGINIA DEPARTMENT
OF TRANSPORTATION: A DEMONSTRATION WITH THE INTEGRATED
SIX-YEAR IMPROVEMENT PROGRAM AND THE STATEWIDE
TRANSPORTATION IMPROVEMENT PROGRAM

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Virginia Transportation Research Council

NOTICE

The effort that is the subject of this report was done under contract for the Virginia Department of Transportation, Virginia Transportation Research Council. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Virginia Department of Transportation, the Commonwealth Transportation Board, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

Each contract report is peer reviewed and accepted for publication by Research Council staff with expertise in related technical areas. Final editing and proofreading of the report are performed by the contractor.

PROJECT TEAM

ABSTRACT

This effort demonstrates business process modeling to describe the integration of particular planning and programming activities of a state highway agency. The motivations to document planning and programming activities are that (1) resources for construction projects are used effectively; (2) employees know where projects are in their construction life cycles and how projects may have been changed; (3) the time of agency employees is used effectively; and (4) the employees are working together to complete transportation projects in a reasonable time.

The effort adopts the IDEF modeling capability of the BPWin software (also known as the AllFusion Process Modeler). IDEF modeling encourages consistent documentation of who generates what information, products, services; for whom; how; and for what reasons. Across the agency, the modeling is useful in prioritizing processes for change and maintenance. The modeling empowers employees at all levels, makes institutional knowledge relevant and accessible, and removes bottlenecks. It also encourages the development of integrated systems along functional lines, including administration, engineering, and operations, and focuses agency personnel on the *good* rather than the *perfect* system. Highway agencies have multiple business processes that can benefit from an integrated description of business and technology in process models. For example, the information technology division of a large highway agency maintains and develops around sixty software applications at any one time. Business process modeling helps the division improve their allocation of resources and priorities to these applications. This document provides the purpose and scope of the effort, the method behind IDEF modeling and the AllFusion software, the results and discussion of the effort, the deliverables, and the recommendations for future work. Twelve appendices provide the technical results.

INTRODUCTION

In automating many of their business processes, the information technology (IT) divisions of transportation agencies need to set priorities and allocate resources for the development and maintenance of their IT applications. Developing business process models can support the agencies in deciding which systems have the greatest impacts relative to their required investments of resources.

This research has been performed by the Center for Risk Management of Engineering Systems at the University of Virginia to support the Virginia Department of Transportation (VDOT), the Virginia Department of Rail and Public Transportation (VDRPT), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). Its purpose is to improve the business processes of the Virginia Transportation Six-Year Improvement Program (SYIP) for Construction and Development and the Statewide Transportation Improvement Program (STIP). Progress documentation was provided through an Internet web site at the University of Virginia (http://www.virginia.edu/crmes/stip). The effort is a logical sequel to the document, *Development and Financial Constraint of Virginia's STIP* (FHWA et al. 2002), which describes the federal interest in transforming the state's SYIP into the federal STIP.

This report is organized as follows. The *Purpose and Scope* section is an overview of the SYIP/STIP process and presents some recent challenges implementing the two documents. The *Methods* section describes the functionality of IDEF (Integrated Definition for Function) modeling, the development of an IDEF Worksheet, and the AllFusion/BPWin software that supports IDEF modeling. The *Results and Discussion* section provides an overview of the technical results that are presented in full detail in the appendices. The *Conclusions* section discusses the findings of the effort. The *Recommendations* section addresses implementation of the findings by three divisions of the highway agency: planning, programming, and information technology. Twelve *Appendices* provide the technical results of the effort.

PURPOSE AND SCOPE

The purpose of this effort is to demonstrate Integrated Definition for Function (IDEF) modeling for understanding and reengineering the STIP/SYIP processes of a highway agency. The scope of this demonstration is described in this section. *The details of the STIP/SYIP processes presented in this report were accurate at the time of collection. Such details are realistic and sufficient to support demonstrating IDEF business-process modeling on a complex process of the highway agency. This report has not aimed to update and reconcile all details of the STIP/SYIP to a common point in time.*

In past years, the State Transportation Improvement Program (STIP), a three-year programming document required by federal regulations, was prepared by VDOT and VDRPT as an abridgment of the Six-Year Improvement Program (SYIP), which is required by Virginia law. The Virginia Department of Transportation (VDOT) and the Virginia Department of Rail and Public Transportation (VDRPT) would in turn receive a joint letter from the Federal Highway

Administration (FHWA) and the Federal Transit Administration (FTA) giving federal approval of the Virginia STIP. Virginia's approach to the STIP of past years has been inadequate to satisfy federal regulations, which require that VDOT/VDRPT declare to FHWA and the FTA the federal dollars to be allocated in each federal fiscal year by project. To be eligible for a federal funding allocation, an applicable project needed to appear in each of the following: (1) a long-range plan, (2) regional transportation improvement program (TIP), and (3) the Virginia STIP. In recent years, significant projects appearing in the SYIP, and consequently in the STIP, could not be undertaken because the financial constraint used in SYIP/STIP development was not meaningful. In programming, objective and technical evidence were increasingly dominated by short-term fiscal and other expediencies.

The FHWA, FTA, VDOT, and VDRPT reviewed the development process of the Virginia STIP, with particular attention to the financial constraint specified by federal regulation (23 CFR 450) (FHWA 2002). First, the review documented the processes utilized to develop the Virginia SYIP and the Virginia STIP. Second, it provided a series of recommendations with accompanying implementation strategies in the categories of timing, technology, format, financial, education, and process. The recommendations of the review are presented in Table 1.

While the 2002 report of FHWA et al. is definitive in characterizing the past and future of the SYIP and STIP development processes, the following is some useful additional background on the research performed on this project.

The SYIP articulates an overall funding strategy for the Commonwealth; it does not allocate federal funding. The SYIP reflects six-year funding and financing strategies that are internal to the Commonwealth and which are typically not needed in the federal oversight of the annual allocations of federal funds. In contrast, the STIP articulates the intentions of VDOT and VDRPT to allocate federal funds to highways and transit by federal fiscal year. The STIP document compiles project listings of the eleven Metropolitan Planning Organization (MPO) transportation improvement programs (TIPs), the SYIP, the federally funded Secondary System programs, federally funded forest programs, and other participating programs. Federal regulations require STIPs to be submitted every two years, but the Virginia STIP has been submitted annually.

Currently, the TIPs are not generated in a common format, although some MPOs use the relevant sections of the SYIP as their TIP. A particular challenge to harmonizing the MPO TIPs is that the Northern Virginia MPO (the Metropolitan Washington Council of Governments) also encompasses parts of Maryland and the District of Columbia.

Beginning with fiscal year (FY) 2003, the Virginia SYIP and STIP were distinct documents. A SYIP developed in an electronic environment will contain the data needed for generating the STIP. The Virginia STIP would no longer include the future allocation of federal funds. For example, past STIP submissions showed the accrual of funds in each fiscal year, such as when $10 million was reserved in each of three years and relegated to an allocation of $30M in the 3rd year of the STIP. The STIP, a three-year program, is amended multiple times between its biennial submissions and approvals. Amendments to the STIP are straightforward when air quality is not affected. Typically, amendments are neutral in this respect: e.g., projects of

alignments and turning lanes. For FY 03, 2002 federal allocations were not ready for distribution until April 2003. Projects that had been removed in December 2002 due to financial constraints were hurriedly resubmitted in 2003 to address the revised allocations.

Efforts to revise the business processes of VDOT and VDRPT have been addressing issues such as:

- What is the best format for the compilation of the STIP, and its submission to the FHWA and FTA, from the former SYIP, the Secondary System programs, and the eleven MPO TIPs?
- How can the STIP submission, which had been a stack of separate documents in a variety of formats, be integrated and made available to the public?
- What can be learned from other states?
- How can the various planning and programming efforts be harmonized?
- How can the need for SYIP/STIP revision be balanced with the need for a stable platform in the near term?
- How will innovative financing techniques be accommodated by the SYIP and STIP processes?
- How can the process of amending the STIP be streamlined?

A committee of VDOT, VDRPT, FHWA, and FTA has been implementing the 21 recommendations of the FHWA 2002 report. There are three subcommittees: (1) Procedures, (2) Finance, and (3) Public Involvement/Education. An oversight group includes the Chief of Planning and the Environment, VDOT, and VDOT's Chief Financial Officer. In December 2002, VDOT and VDRPT submitted the first actual STIP to the FHWA and FTA for approval. In 2003, a member of the committee undertook to compile the STIP electronically and completed an initial version of an electronic SYIP. With respect to STIP development, a memorandum of agreement between Virginia and federal agencies was signed in late 2003. Pre-allocation hearings in the fall of 2003 served as test beds of the evolving SYIP/STIP public involvement process.

IDEF modeling will be useful to describe the SYIP/STIP because of its integrated perspective of business and technology. It allows employees to have increased control over their roles in the STIP/SYIP and to locate potential bottlenecks in them. IDEF modeling will help the Department of Transportation allocate adequate resources to STIP and SYIP activities.

Table 1. 21 Recommendations of the FHWA/FTA/VDOT/VDRPT Review (FHWA 2002)

Timing:
1. The schedule for the SYIP should be modified to better facilitate development of the STIP.
2. Develop a standard STIP/TIP/SYIP development cycle and consider implementing a two-year STIP/TIP cycle.

Technology:
3. Provide the SYIP to the MPOs in an easy-to-use electronic format.
4. Prepare the SYIP in an electronic environment that would facilitate development of the STIP and the demonstration of financial constraint.

Format:
5. Develop a standard STIP/TIP format in conjunction with Virginia MPOs.
6. Develop and incorporate into the STIP a financial summary table including a narrative discussion of the process and detailed annual allocations by program category and obligation. These annual allocations should align with project allocations and would support timely FHWA/FTA review and approval.
7. After development of an electronic format, consider the implementation of an e-STIP.

Financial:
8. VDRPT and transit operators need to provide three years of programming for STIP/TIPs as required in 23 CFR 450.
9. Demonstrate financial constraints of individual TIPs as well as the STIP.
10. Incorporate results of the VDOT Cost Estimate Task Force into the FY2004 STIP.
11. Account for innovative financial techniques in the STIP/TIPs (i.e., AC, FRANS, bonds, flex-funding, etc.) and their impacts on current and future funding.

Education/Outreach:
12. Educate the Commonwealth Transportation Board on the STIP process.
13. Develop an educational component of this review for FHWA, FTA, VDOT, VDRPT, and other partners.

Process:
14. Establish a VDOT/VDRPT STIP Working Group to maintain communication between divisions in the STIP process.
15. Revise public involvement policy regarding the STIP to align with revised STIP development procedures.
16. Strengthen the MPO and statewide planning processes to serve as the foundation for the programming process by establishing priorities for implementation.
17. Develop and maintain documented statewide planning and programming procedures.
18. Maximize programming of state-/district-wide "line item" or "grouped" projects, as eligible.
19. Develop standard STIP modification procedures to reduce FHWA/FTA involvement in minor STIP modifications and amendments.
20. Provide Virginia's MPOs with the information necessary to prepare an Annual Listing of Projects as required by 23 CFR 450.
21. Develop a three-year rather than a six-year STIP.

METHODS

Overview

This section describes the functionality of the IDEF (Integrated Definition for Function) modeling technique, its origin and several uses, the translation of IDEF models to simulation models, the development of an IDEF worksheet used to generate the models in the *AllFusion/BPWin* software created by Computer Associates (CA), and the details of that software.

IDEF Functionality

Shown in Figure 1, the IDEF model breaks the activities or functions of the organization or system into its component parts. IDEF is a graphical language that assists in identifying the functions that are performed, the various elements needed to perform those functions, and what is efficient and inefficient about the system under study. Describing the SYIP and STIP processes in the *BPWin* software has several benefits. The high-level outputs of IDEF models are charts of activities and organizations. Underlying such charts are the characteristics of activities (objectives, titles of responsible individuals, inputs, rules/controls including relevant legislation, mechanisms for data acquisition, outputs, receiving individuals, key decisions, impacted activities, and days to complete). IDEF is thus consistently supporting a business analysis to describe STIP/SYIP and other processes (e.g., cost estimation). Once the processes are described in IDEF, their evolutions are more easily communicated to organizations such as highway agencies. IDEF is implemented in *BPWin* software. This comes from the same vendor as the model manager, data shopper, and related applications used by the highway agencies, and increasingly by the "data stewards" across agency divisions. A business process is generally of broader scope than the portion of it that is to be automated. Process description helps to set priorities and analyze the feasibility of what can be done toward automation. Use of the IDEF standards (implemented by *BPWin*) may evolve into a common practice across the highway agency. For now, it expects that these standards will assist with understanding the end users. The benefits of this project are that it prepares agency personnel to apply IDEF process descriptions to other critical processes of planning and finance.
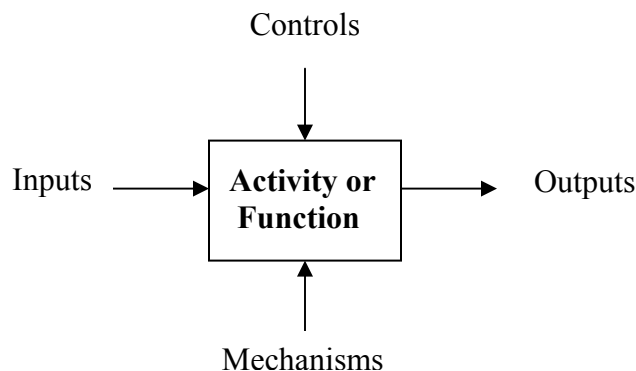

Figure 1. IDEF Mapping Format.

Origin of IDEF

Specifically, IDEF was produced by the Integrated Information Support System (IISS), projects designed to create an information-processing environment that could be run in various physical computer settings. DeWitte et al. (1992) show that IDEF came about in hopes of creating general systems that could be understood by multiple parties, such as the US Air Force, the Department of Defense, and defense contractors. As breakthrough technology innovations emerge, IDEF is shifting towards utilizing process modeling techniques that also incorporate Java and Open Database Connectivity (ODBC). This will help the IDEF standard to continue to be versatile across various computing environments.

Relationship of IDEF Modeling to Process Simulation

In the past five years, there has been a shift in business-process modeling to incorporate process simulation. According to Ding et al. (2003), there is a need and capability to build web-based simulation systems for enterprising business-process models. Instead of using standard components as IDEF does, this web-based simulation builds process models by describing the general architecture of the system, analyzing the principle design patterns of the key modules, and implementing the defined modules. Simulation allows for more flexibility in the types of business-process models that can be described, but it also leads to many complications. The key disadvantage is that these web-based mechanisms pursue more of an *ad hoc* approach instead of standardized one. Building process models using the IDEF standard will enable more people to understand a given model. Models shifting towards simulation would be designed using IDEF3, which has the capability to simulate business-process flow models. These models would encompass the process flow and the relationships among processes. Simulation of IDEF3 models is advantageous when gathering outcomes of hypothetical dynamic business-process scenarios. From such scenarios, descriptive statistics about the outcome of the process can be gathered without physically implementing it. Using simulation can help people predict the effectiveness of business processes before they are implemented.

Uses of IDEF Modeling

The focus of IDEF modeling needs to extend to business-process reengineering. The first step in reengineering a process is to know what is currently being done, and the next is to analyze the process to see where it can be improved. There is a need for these processes to be analyzed and discussed by those people who actually perform the work. It is an effort to glean a lot of data from written sources and high-level employees, but there is a need to go into greater depth and discern the inner mechanisms of each sub-process.

Another use of IDEF modeling is determining the activities that should be examined in more detail. For example:

1. Determine the best way to calculate times for the completion of each activity.
2. Determine the cost of each activity.
3. If the cost is based on how long the process takes, determine the elements that go into each activity.

Recommendations should be made to convert all the processes electronically to arrive at a virtual picture. The entire system should be updated from the handling of documents, through the workflow, to approvals.

An IDEF Worksheet for Data Collection and Synthesis

A worksheet was developed to display information gained from interviews from persons working with the STIP/SYIP processes. The form of the worksheet allows its data to be transformed into the IDEF0 format in the *AllFusion* software. An example of this worksheet is provided in Appendix B of this report.

Each row in the IDEF worksheet represents a new activity or role in the STIP/SYIP process. Each column is a different component of the activity. Those used for the IDEF0 model in the *AllFusion* software are: Activity, Inputs, Controls, Mechanisms, and Outputs. The other characteristics of the activities (objectives, titles of responsible individuals, key decisions, impacted activities, days to complete) are gathered to help better understand the role and purpose of the activity in the STIP/SYIP process. The STIP/SYIP processes were classified into different groups, including: STIP Process, Amendment Process, Public Involvement, Construction Process, MPO Process, and Environmental Process. The classification of the STIP/SYIP process was undertaken for a better understanding of how the different tasks of each division at VDOT fit into the flow charts in the appendices of the *Development and Financial Constraint of Virginia's STIP* (FHWA 2002).

Information on the worksheet is collected through personal or telephone interviews with personnel working directly on the STIP/SYIP process in different divisions of the highway agency. The worksheet is an important tool for transferring the information gained from these interviews into the IDEF0 format before entering the data into the AllFusion software.

Overview of *AllFusion/BPWin* Software

IDEF0 is a function-modeling method for analyzing and communicating the functional perspective of a system; it is used in the Computer Associates (CA) *AllFusion* software. CA describes the IDEF process as one that "allows you to systematically analyze your business, focusing on normal day-to-day functions and the controls that support these functions."

CA claims that the following distinctive features set the *BPWin* software apart from competitors that offer IDEF0 process-modeling software:

1. It has an easy-to-use point-and-click, drag-and-drop interface.
2. It allows users to automate the design of IDEF0 models.
3. It provides integration with its Process-flow and Dataflow modeling portions of the *AllFusion* software applications.

The basic capabilities of IDEF0 in *BPWin* are represented by boxes and arrows. A box represents one activity, while an arrow's meaning varies, based on where it is connected to the

model. An activity can be described with a single action verb plus a common noun, for example: "Approves Budget." Four types of arrows are used in *BPWin:*

1. *Input:* An Input arrow is anything that is consumed or transformed by the given activity. For example, some inputs to "Approve Budget" could be the draft budget documents.
2. *Control:* A *Control* arrow is anything that is a constraint in the activity. Examples are the amount of money available for allocation, or the laws and regulations that define how government money may be spent.
3. *Output:* An *Output* arrow is anything that results from the activity, such as an approved or rejected budget.
4. *Mechanism:* A *Mechanism* arrow shows how the activity is completed, but is not in itself consumed by the process. Examples would include the person who has final say in the approval, or the public input process, or project-cost support documents.

The *inputs*, *controls*, *outputs,* and *mechanisms* should be straightforward, derived from interviews with the people involved in each activity.

The following are the three basic elements of creating an IDEF0 model. According to Computer Associates, once these are defined, the model should be easy to build:

1. Identify the purpose.
2. Define the viewpoint.
3. Find the appropriate depth and scope of the project.

There are other IDEF0 modeling products that can be evaluated for use. *AI0 WIN* by KBSI is one of the software packages that mirror the capabilities of *AllFusion/BPWin.*

IDEF3, also referred to as Process Flow or Workflow modeling, is used to graphically represent and document all aspects of a business process. It captures information on process flow, inter-process relationships, and other vital factors that interact in the business flow process. Using IDEF3 is particularly useful for reengineering business processes, developing a methodology to complete deliverables, and collecting information on policies and procedures in the business.

IDEF3 allows the user to create real-world scenarios. This application is particularly functional for any type of business in the sense that the user can shape the model to directly fit the needs of a company. For example, the user can map out all parts of the process to develop a plan to implement an alternative traffic pattern in a given urban area. These mapped scenarios not only organize processes in a reader-friendly fashion for department staff, they also open communication pathways between departments within the company.

IDEF3, like IDEF0, allows the user to create an activity called a Unit of Work, or UOW. However, IDEF3 broadens the use of the word "activity" to include a process, action, decision, or other procedure performed in a system or business within an IDEF3 model.

IDEF3 has the ability to create junctions, in which more than one process can merge into another process *(fan-in junction)* and conversely, more than one process can result from a single process *(fan-out junction)*. Junctions in process-flow diagrams allow the user to create such events. Different types of *in* junctions include Asynchronous AND, Synchronous AND, Asynchronous OR, and XOR (Exclusive OR). In *fan-in,* Asynchronous AND means that all preceding processes must be complete, and in *fan-out,* it means that all following processes must start. In *fan-in,* Synchronous AND means that all preceding processes complete simultaneously, and in *fan-out,* it means that all following processes start simultaneously. In *fan-in,* Asynchronous OR means that one or more preceding processes must be completed, and in *fan-out,* it means that one or more of the following processes must start. In *fan-in,* Synchronous OR means that one or more of the preceding processes complete simultaneously, and in *fan-out,* it means that one or more following processes start simultaneously. In *fan-in,* XOR, or Exclusive OR, means that exactly one preceding process completes, and in *fan-out,* it means that exactly one of the following processes starts.

The steps to build an IDEF3 model are similar to those for an IDEF0 model. The most distinctive difference in the IDEF3 models is the use of the junctions. Junctions add depth to the diagram and allow for more complex process structures.

Another tool includes the *use referents,* or objects in an IDEF3 diagram where additional information is stored outside the process flow. For example, if the air quality has to be checked before a new road can be built; the results of the check would be stored in a component of this model.

Data Flow Diagrams, or DFD, are used to complement IDEF0 models. The DFD lays out a blueprint of a company's development tasks, thus documenting the movement and processing of information within the firm. The DFD describes data-process functions, the data involved, and the entities that interact with sales and data processing tables. DFD components include activities, arrows, data stores, and external references.

The visualization tool for BPWin supports imported graphics of the bitmap type. If the graphic is not in bitmap form, the image can be converted from most common extensions into the correct bitmap format. Importing bitmaps allows the user to apply them to diagram objects along with various display options.

AllFusion/BPWin also allows the user to export models to Arena, a simulation software tool of Systems Modeling Corp. Simulation is useful for visualizing what is happening in a complex business model. Simulation enables the modeler to generate statistical information about the business process.

RESULTS AND DISCUSSION

The major categories of results are (1) development of the IDEF Worksheet, (2) displays of STIP/SYIP in IDEF format, (3) tutorials for transforming interviews to the integrated

definition (IDEF) standard using case studies of metropolitan planning organizations, urban programs, secondary roads, and the public involvement process, and (4) software packages relevant to future automation of the business processes of the highway agency.

Appendices A through J present the details and results of this project, as follows:

- **Appendix A** provides the IDEF Worksheet Questions Webpage, the IDEF Worksheet Questions Coding, and the IDEF Worksheet Questions Methodology. These questions were used during interviews to better organize the information gained into IDEF format.
- **Appendix B** provides the IDEF Worksheet that was compiled containing all the different sub-processes involved in the SYIP/STIP. The IDEF Worksheet was created to retain all the information gathered during interviews with VDOT personnel. This worksheet provided an intermediate format that enabled the team to transform this information into the IDEF format.
- **Appendix C** provides examples of planning and programming activities displayed in IDEF format and data-flow diagrams. The *AllFusion* software outputs were created by integrating the data-flow diagrams found in the appendices of the FHWA 2002 Report and the IDEF Worksheet. The decomposition of the STIP development process is shown below in Figure 2.
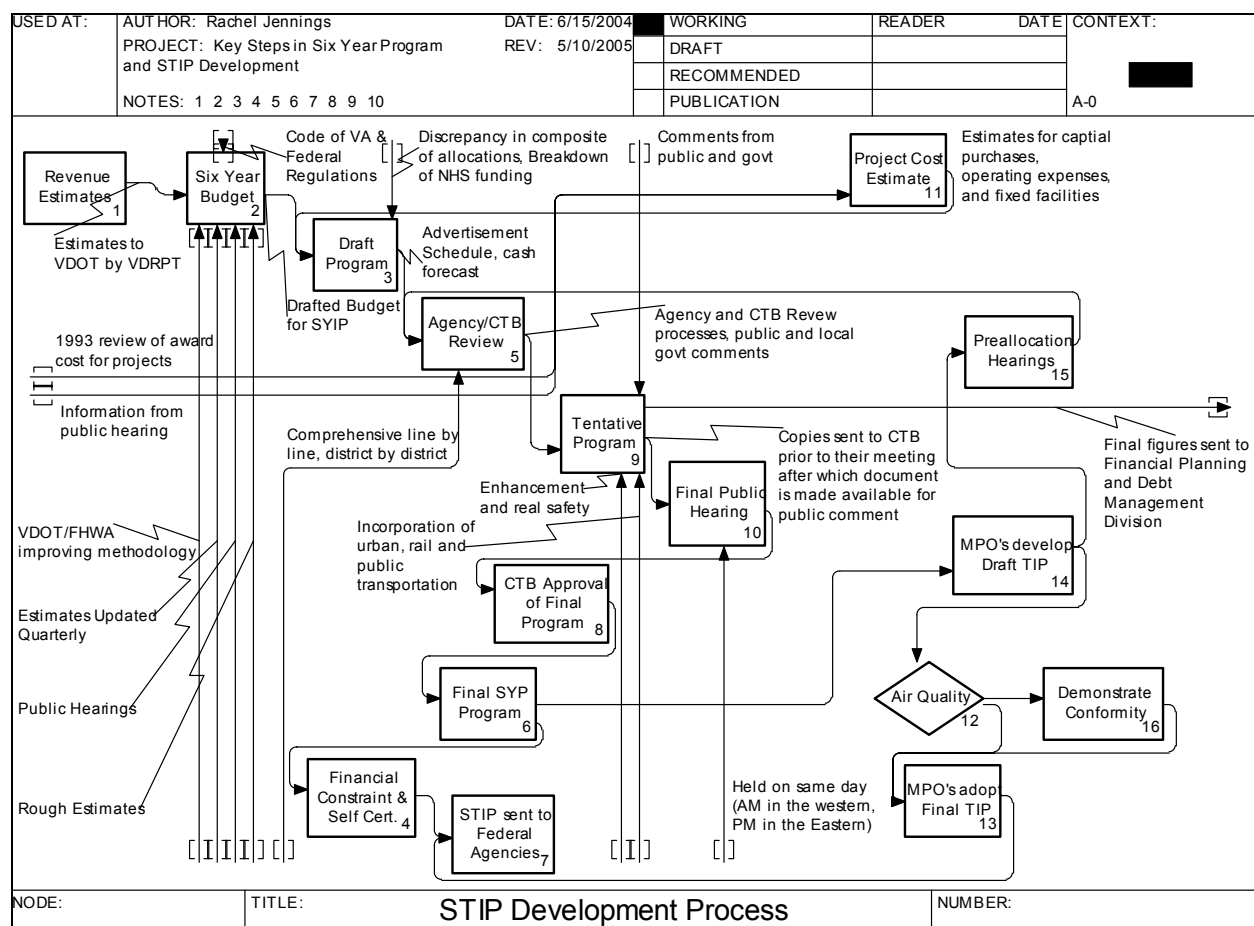
Figure 2: The Decomposition of the STIP Development Process, Including All Inputs, Controls, Mechanisms, and Outputs for Each Activity.

- **Appendix D** describes *AllFusion's* compatibility with simulation software and gives an example of exporting a model from *AllFusion* into this software. Figure 3 shows how the model looks in IDEF3 format and Figure 4 shows how it appears after being exported into *Arena*. Appendix D also provides details of how the transformation is performed.
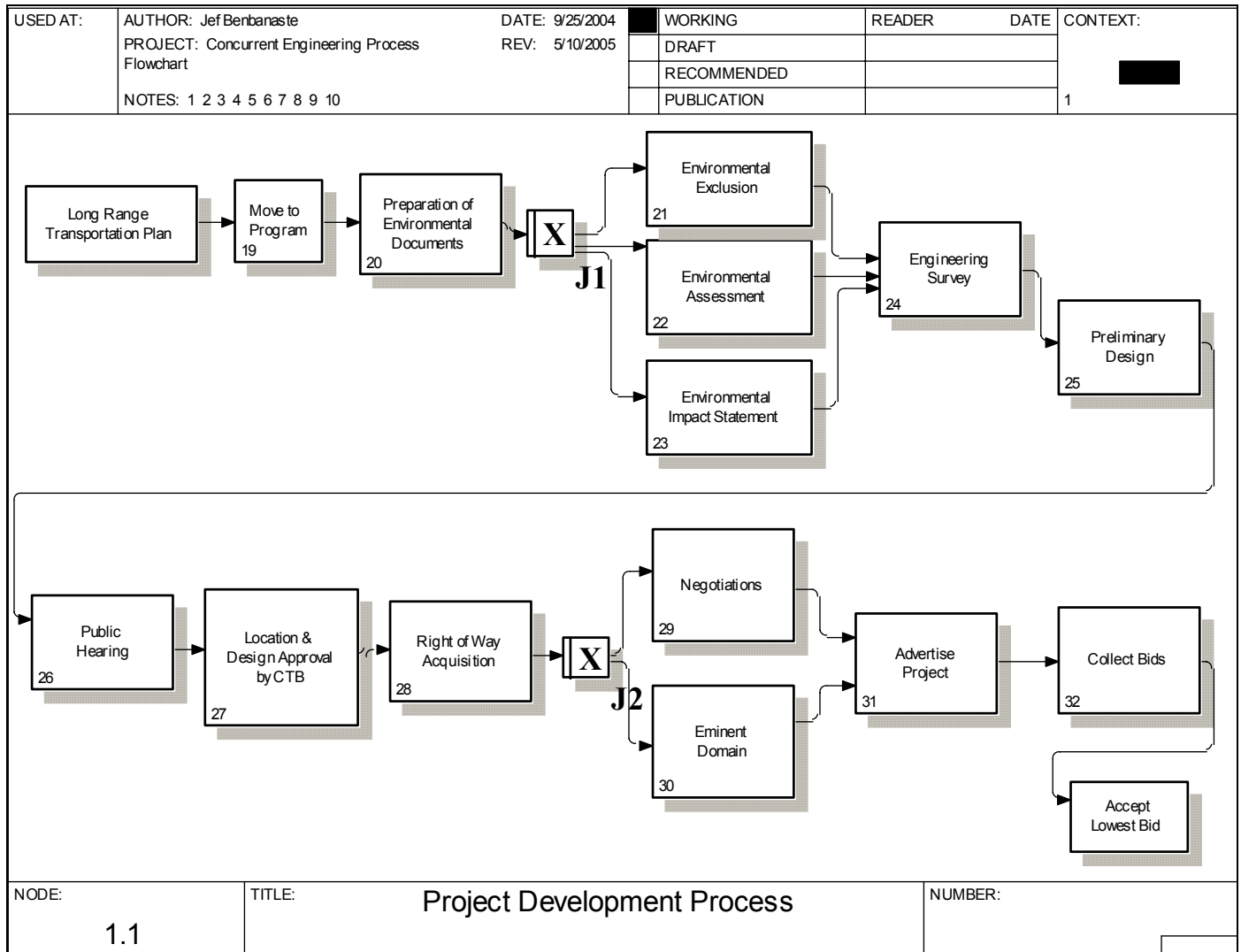
Figure 3: Demonstration of *AllFusion* Capabilities: IDEF3 Model of VDOT Flowchart, Fact Sheet, and an Interview with a VDOT Employee.
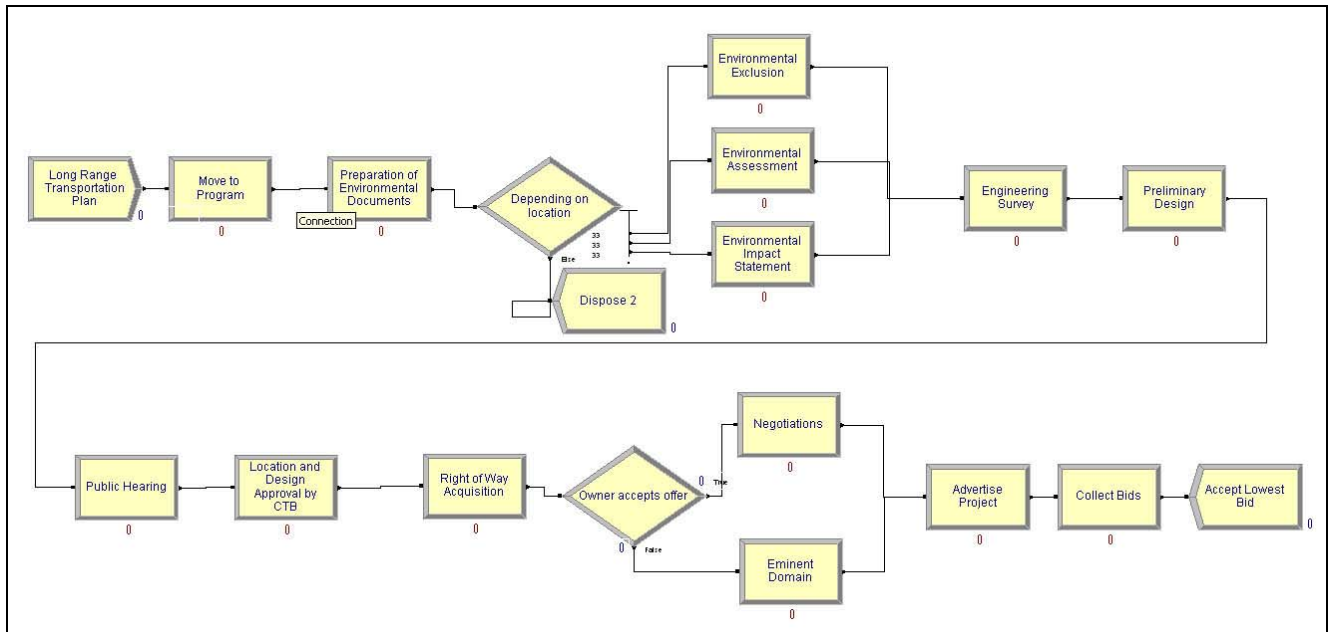
Figure 4: Demonstration of *AllFusion* Capabilities: Simulation Model in Arena Imported from AllFusion IDEF3.

- **Appendix E** provides a tutorial on transforming narrative interviews to the integrated definition (IDEF) standard: a case study on the Metropolitan Planning Organization (MPO). The results in Appendix E describe the methods used to conduct the interviews with individuals working on the MPOs and then to convert those interviews into IDEF0 format. Figure 5 shows a decomposition of the MPO process into three main activities.
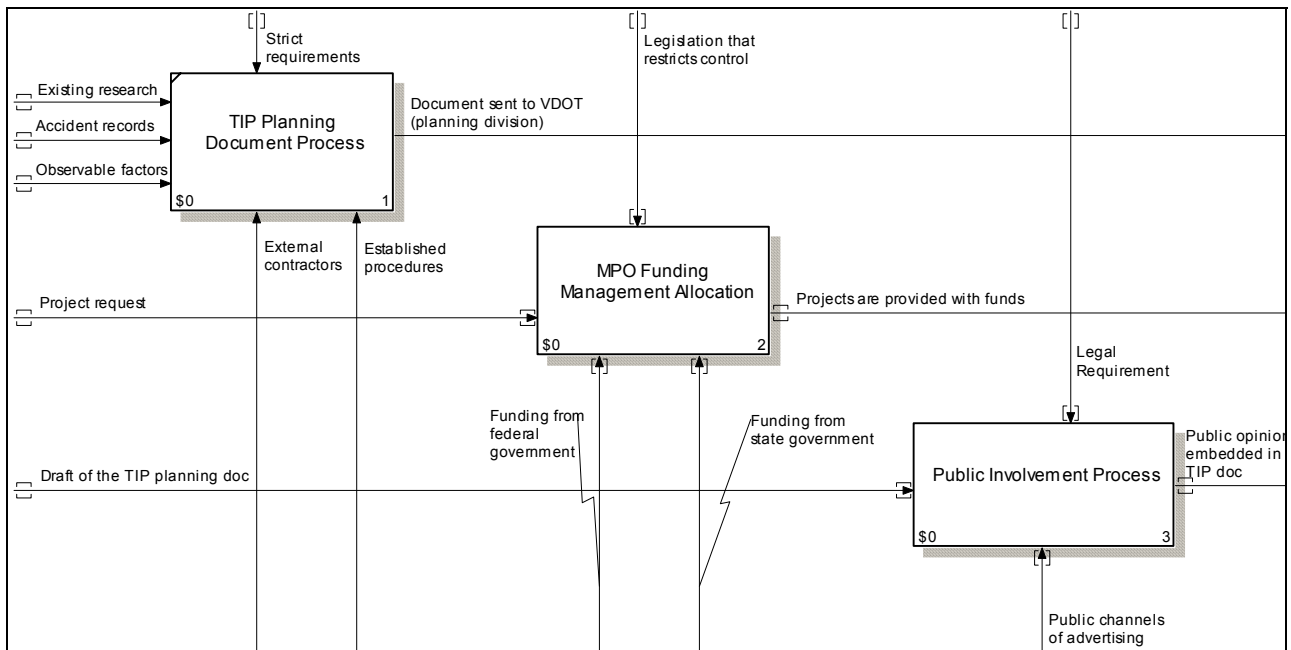
Figure 5: IDEF0 Model of Subordinate Activities for MPO Processes.

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- **Appendix F** provides a tutorial on transforming interviews to the integrated definition standard: *A Case Study on Urban Programs.* The results in Appendix F describe the methods used to conduct interviews with employees of VDOT working in the urban programs process, and then to convert those interviews into IDEF0 format. Figure 6 displays the comprehensive IDEF0 model for urban programs.
- **Appendix G** provides a tutorial on transforming interviews to the integrated definition standard: *A Case Study on Secondary Roads.* The results in Appendix G describe the methods used to conduct interviews with employees of VDOT working in the secondary roads process, and then to convert those interviews into IDEF0 format. Figure 7 displays the second level of the secondary roads process.

Figure 6: Comprehensive IDEF0 Model of Urban Programs Processes.

USED AT:	AUTHOR: James J Perry	DATE: 10/7/2004	WORKING	READER	DATE	CONTEXT:
	PROJECT: Secondary Roads	REV: 10/7/2004	DRAFT			
			RECOMMENDED			
	NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			A-0

Budget Section 33.1-23.1 COV | Secondary Road Requirements 33.1-23.4 COV | Advertisement Rules | Code of Virginia Sections 33.1-70.01 | Budget Section 33.1-23.1 COV | Secondary Road Requirements 33.1-23.4 COV

Board of Supervisors Work Session $0 1 → Draft of Six Year Plan → **Public Hearing** $0 2 → Revised Draft Six Year Plan → **Approve STIP Recommendations** $0 3 → Approved Six Year Plan

Resident Engineer | County Staff | Board of Supervisors | Board of Supervisors | Resident Engineer | Board of Supervisors

| NODE: A0 | TITLE: Secondary Roads Process | NUMBER: |

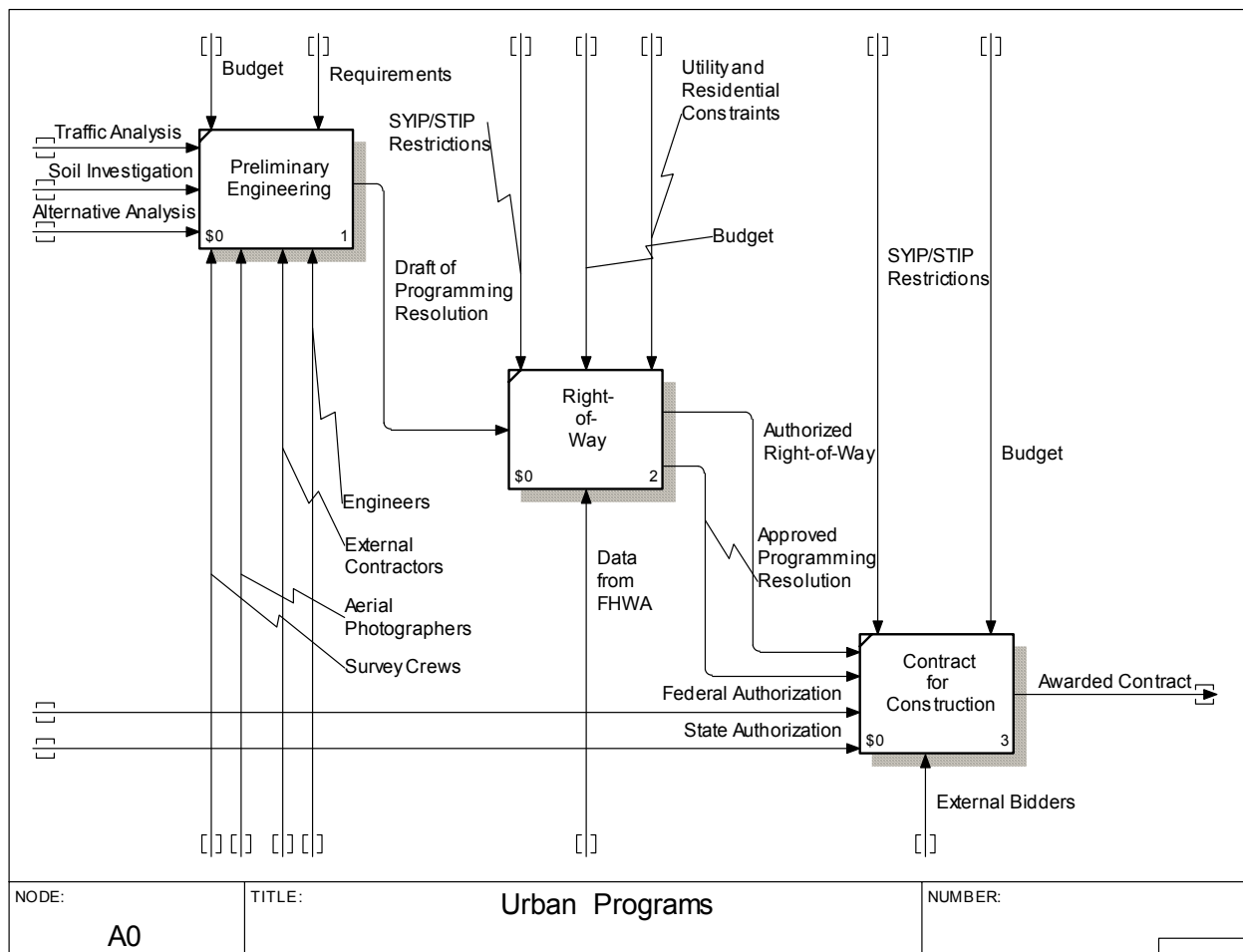**Figure 7: Second Level of Secondary Roads Process.**

- **Appendix H** provides a tutorial on transforming interviews to the integrated definition standard**:** a case study on VDOT's public involvement process. The results in Appendix H describe the methods used to conduct interviews with the VDOT employees working on the public involvement process, and then to convert those interviews into IDEF0 format. Figure 8 displays the IDEF0 model of VDOT's public involvement process.

Time Requirement

Legal Requirement

Legal Requirement

Legal Requirement

Legal Requirement
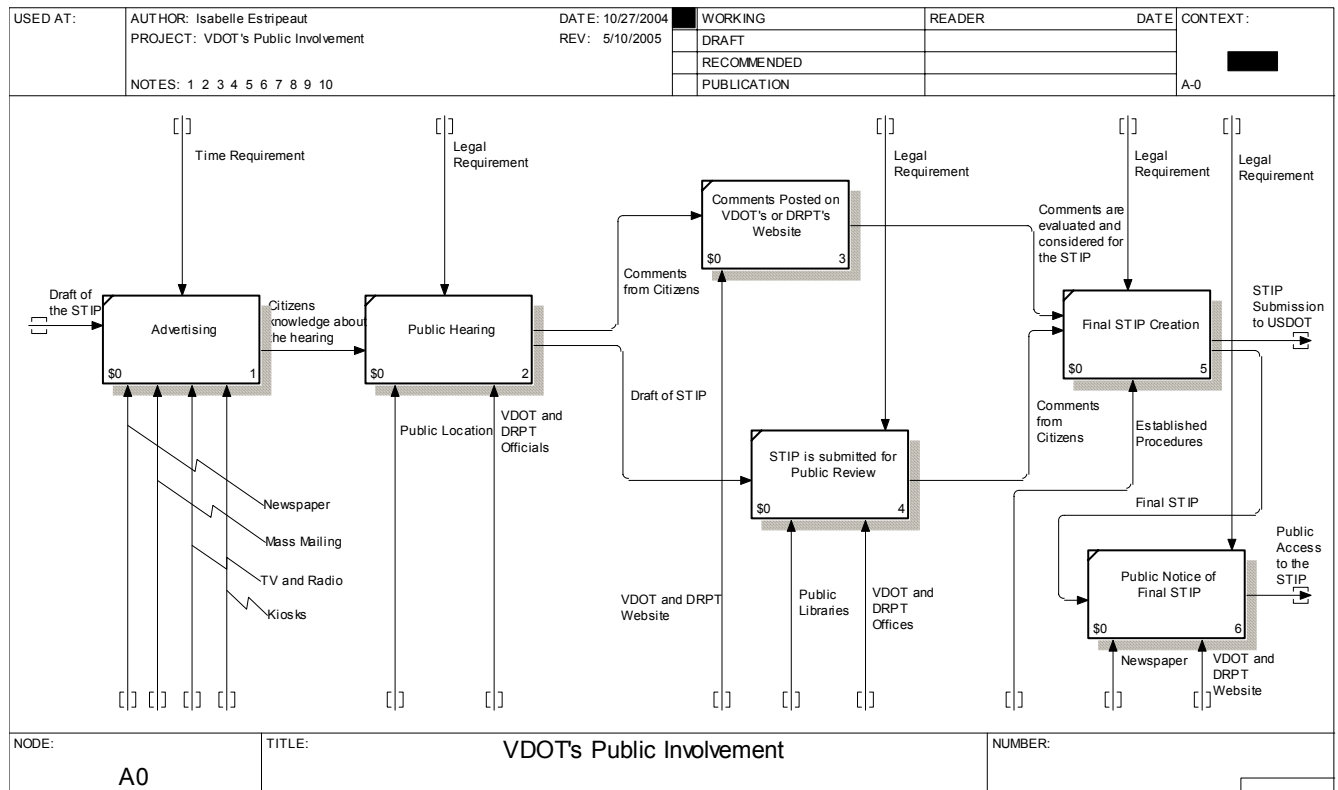
Draft of the STIP

Advertising $0 1

Citizens knowledge about the hearing

Public Hearing $0 2

Comments Posted on VDOT's or DRPT's Website $0 3

Comments from Citizens

Comments are evaluated and considered for the STIP

Final STIP Creation $0 5

STIP Submission to USDOT

Draft of STIP

STIP is submitted for Public Review $0 4

Comments from Citizens

Established Procedures

Final STIP

Public Notice of Final STIP $0 6

Public Access to the STIP

Public Location

VDOT and DRPT Officials

Newspaper
Mass Mailing
TV and Radio
Kiosks

VDOT and DRPT Website

Public Libraries

VDOT and DRPT Offices

Newspaper

VDOT and DRPT Website

NODE: A0 | TITLE: VDOT's Public Involvement | NUMBER:

Figure 8: IDEF0 Model of VDOT's Public Involvement Process.

- **Appendix I** describes and recommends locating the Statewide Transportation Improvement Program (STIP) and Six-Year Improvement Program (SYIP) business process models at the Central Office Website (COWEB) at VDOT.
- **Appendix J** describes some software packages relevant to future automation of STIP/SYIP project management. These include document management software, planning and programming software, and business-process management software for business-process modeling.

CONCLUSIONS

This research demonstrated the use of business-process models to understand and support the reengineering of the STIP/SYIP development processes at VDOT. The findings were as follows:

1. Previous efforts to model the STIP and SYIP were incomplete and less formal.
2. Business-process modeling is an effective method for describing who does what, how, and why in major business processes for highway agencies.
3. Process modeling can support priority setting for aid and resource allocation to automate business processes using information technologies.

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4. There are potential uses of business-process modeling for other complex processes of the transportation agency.

RECOMMENDATIONS

The following recommendations for implementing the results of the research should be considered by three divisions of the highway agency: Planning, Programming, and Information Technology. The agency should consider:

1. Using IDEF methodology (and the *AllFusion* software or its equivalent) to document a variety of business processes;
2. Training selected personnel to develop and interpret IDEF models; and
3. Implementing software to streamline collecting information for IDEF models. An interface software application would allow the user to bypass the task of transcribing interviews by entering that information into the developed Excel worksheet, and then transferring that same information into the *AllFusion* software.

COSTS AND BENEFITS ASSESSMENT

This study has demonstrated the use of business process modeling to understand and improve transportation agency processes associated with the six-year improvement program and the statewide transportation improvement program. Adoption of business process modeling across the agency provides documentation of who does what, with what authorization or mandate, with what inputs and outputs, and with what mechanisms. The potential benefits of business process modeling in the transportation agency include: (1) reduced costs associated with training of employees, (2) reduced costs in the generation of requirements and elsewhere in the development lifecycle for information technology applications that support particular business processes, and (3) improved communication of agency business processes with agency stakeholders and partners including private contractors, metropolitan planning organizations and planning district commissions, local governments, and the federal government.

The costs of increasing the adoption of business process modeling in the transportation agency are minimal and include (1) possible but not obligatory purchase of software to assist in the modeling, and (2) brief introduction of the methodology to relevant staff using the report developed in the current study.

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APPENDIX A

IDEF Worksheet Questions Webpage
IDEF Worksheet Questions Coding
IDEF Worksheet Questions Methodology

This appendix describes what parameters are needed to explain each of the activities of the STIP/SYIP business processes. It provides the IDEF Worksheet Questions, Coding, and Methodology. It also describes and displays the IDEF Worksheet Questions Webpage that was created to gather information from employees working on or with the STIP/SYIP, so that information could be converted into IDEF format.

IDEF Worksheet Questions Webpage

Each row of the IDEF worksheet represents a new IDEF0 (Integrated Definition for Function Modeling) activity. IDEF0 is the technique that breaks down the activities or functions of the organization or system into their component parts, as shown in Figure 1. It is a graphical language that assists in identifying the functions that are performed, the various elements needed to perform those functions, and what is efficient and inefficient about the system under study.
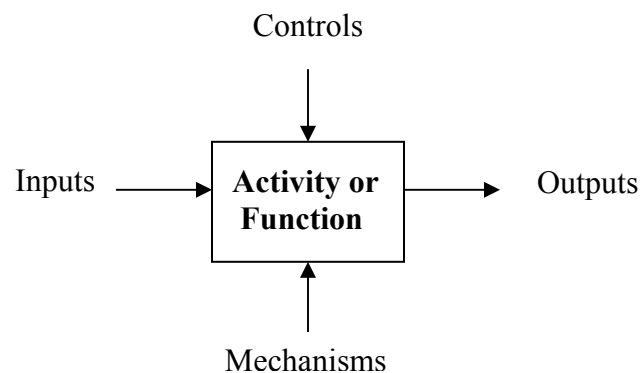
Figure A-1: Description of IDEF0 Mapping Format.

The worksheet form entries contain the IDEF0 standards as well as supplementary material.

Your name: First Joseph　　　　　　　Last Paulus

Your email address: jpaulus@hrpdc.org

Title of your position: Principal Transportation Planner

Field 1: Name of Activity

Name or title for activity or function.

Fund Allocation Process

Field 2: Inputs

Something consumed or modified in the process. (i.e., schedules, costs, drafts).

Project requests calling for CMAQ and RSTP funds; proof of environmental benefits each project might contribute

Field 3: Controls

A constraint on the operation of the process. Represents the objects that govern the manner in which inputs are transformed yet are not themselves transformed by the activity. Consists of legislation, regulations, and policies related to the system (i.e., codes, restrictions).

Money and legislation restricting available funding

Field 4: Mechanisms

Something used to perform the process, but is not itself consumed. The elements that accomplish the actions of the process, such as people, manual or automated tools, established procedures for holding hearings, etc. (i.e., software applications, email exchange, etc.).

Currently using pdf files, databases are considered for the future to keep project allocation information in an organized and accessible manner

Field 5: Outputs

Something resulting from the process. Shows what an activity produces or creates.

Funds are allocated to local transportation projects

Field 6: Objective

The goal of the function or activity.

Get transportation projects necessary for each community implemented to meet public needs

Field 7: *BPwin* Diagrams

Link to the activity in BPWin format.

IDEF0 Model of MPO Processes (Includes Fund Allocation Process):
http://www.virginia.edu/crmes/stip/MPO%20IDEF%20Process.bp1

Field 8: Title of Responsible Person(s)

Person(s) in charge of the function or activity.

To be determined in a future interview

Field 9: Key Decisions

Possible choices for the outcome of the activity or function.

To be determined in a future interview

Field 10: Duration

Time/length of the activity.

To be determined in a future interview

Field 11: Transcripts/Interviews

Link to a document that shows an outline description of the activity, interview, or a memo on the activity.

IDEF0 Worksheet of MPO Activities: http://www.virginia.edu/crmes/stip/IDEF%20Worksheet.MPO.xls

Field 12: External Links

Links to sites outside the CRMES website that are pertinent to the activity.

```
N/A
```

Field 13: Diagrams/Models

Diagram showing detail of the activity.

```
To be determined with future research
```

Field 14: Reviews

Notes or reports available on the activity.

```
To be determined with future research
```

Field 15: Potential Recommendation

Any recommendations on how to improve the activity.

```
Provide MPOs with more control over the management of funds.
Give more decision power to transportation planners rather than
politicians.
```

Field 16: Miscellaneous

Any other information or files available on the activity that did not fit into the fields above.

```
Interview of Joseph Paulus:
http://www.virginia.edu/crmes/stip/Joseph%20Paulus%
20Interview.doc
```

[Submit Questionnaire]

Please contact Professor Lambert with any further questions:
- Email: lambert@virginia.edu
- Office phone: 434-982-2072
- Office Assistant phone: 434-924-0960

IDEF Worksheet Questions Coding

Following is all the coding for the IDEF Worksheet Questions Webpage.

```
<HTML>
<HEAD>
<TITLE>IDEF Worksheet Questions</TITLE>
</HEAD>
<BODY>
<H1>IDEF Worksheet Questions</H1>

    <BASE HREF="http://www.virginia.edu/crmes/stip/">
<p>The purpose of this document is to describe what parameters we need from you
    about each of your activities
    <br>
    and/or roles that go into the STIP/SYIP integration.  Please
    <br>
    complete one of these forms for each of your activities and/or roles.</p>
    <p>Each row on the worksheet represents a new IDEF0 (Integrated Definition for
    Function Modeling) activity. <br>
    IDEF0 is the technique that breaks down the activities or functions of the organization
    or system into its
    <br>
    component parts. It is a graphical language that assists in identifying the
    functions that are performed, the
    <br>
    various elements needed to perform those functions, and what is efficient and
    inefficient about the system <br>
    under study, (i.e., What are your roles in generating the STIP?)
    <br>
    For more information on IDEF please go to <a
href="http://www.idef.org">www.idef.org</a></p>
    <p><img src="idef.gif" width="351" height="176">
    <br>
    <strong><font size="2">Figure 1: IDEF0 Description - Description of IDEF0 Format
    of Mapping</font></strong></p>
    <p>The columns contain the IDEF0 standards as well as supplementary material.
    <br> <hr width="600" align="left"><FORM action="http://www.virginia.edu/crmes/stip/cgi-
bin/uploadform.pl" METHOD="post" enctype="multipart/form-data">
  <P> <b>Your name:</b> <font size="1">First</font>
    <INPUT TYPE="text" NAME="firstname" >
    <font size="1" face="Times New Roman, Times, serif">Last</font>
    <input type="text" name="lastname">
  </P>
    <P>
    <b>Your email address:</b>
```

```
<INPUT TYPE="text" NAME="from" >
</P>
 <P>
<b>Title of your position:</b>
<INPUT TYPE="text" NAME="position" >
</P>
<P> <b>Field 1: Name of Activity</b>
<br><font size ="2">Name or title for activity or function.</font>
<br>
<INPUT TYPE="text" NAME="activity"></p>

 <P><b>Field 2: Inputs</b> <br>
 <font size="2">Something consumed or modified in the process. (i.e., schedules,
 costs, drafts)</font> <br>
 <TEXTAREA NAME="inputs" WRAP="physical" ROWS=5 COLS=70></TEXTAREA>
 <br>
 <br>
 <b>Field 3: Controls</b> <br>
 <font size="2">A constraint on the operation of the process. Represents the
 objects that govern the manner <br>
 in which inputs are transformed yet are not themselves transformed by the
 activity. Consists <br>
 of legislation, regulations, and policies related to the system. (i.e., codes,
 restrictions)</font> <br>
 <TEXTAREA NAME="controls" WRAP="physical" ROWS=5 COLS=70></TEXTAREA>
 <br>
 <br>
 <b>Field 4: Mechanisms</b> <br>
 <font size="2">Something used to perform the process, but is not itself consumed.
 The elements that accomplish <br>
 the actions of the process, such as people, manual or automated tools, established
 procedures for <br>
 holding hearings, etc. (i.e., software applications, email exchange, etc.)</font>
 <br>
 <TEXTAREA NAME="mechanisms" WRAP="physical" ROWS=5
COLS=70></TEXTAREA>
 <br>
 <br>
 <b>Field 5: Outputs</b> <br>
 <font size="2">Something resulting from the process. Shows what an activity
 produces or creates.</font> <br>
 <TEXTAREA NAME="outputs" WRAP="physical" ROWS=5 COLS=70></TEXTAREA>
 <br>
 <br>
 <b>Field 6: Objective</b><br>
 <font size="2">The goal of the function or activity.</font> <br>
```

```
<TEXTAREA NAME="objective" WRAP="physical" ROWS=5 COLS=70></TEXTAREA>
<br>
<br>
<b>Field 7: BPwin Diagrams</b> <br>
<font size="2">Link to the activity in BPwin format.</font> <br>
<INPUT TYPE="file" NAME="bpwinfile">
<br>
<br>
<b>Field 8: Title of Responsible Person(s)</b> <br>
<font size="2">Person(s) in charge of the function or activity. <br>
<INPUT TYPE="text" NAME="responsible">
</font> <br>
<br>
<b>Field 9: Key Decisions</b> <br>
<font size="2">Possible choices for the outcome of the activity or function.
<br>
<TEXTAREA NAME="decisions" WRAP="physical" ROWS=5 COLS=70></TEXTAREA>
<br>
<br>
</font> <b>Field 10: Duration</b> <br>
<font size="2">Time/length of the activity.</font> <br>
<INPUT TYPE="textarea" NAME="duration" VALUE="">
<br>
<br>
<b>Field 11: Transcripts/Interviews</b> <br>
<font size="2">Link to a document that shows an outline description of the
activity, interview, or a memo on the activity.</font> <br>
<INPUT TYPE="file" NAME="transcriptsfile">
<br>
<br>
<b>Field 12: External Links</b><br>
<font size="2">Links to sites outside the CRMES website that are pertinent
to the activity.<br>
<TEXTAREA NAME="links" WRAP="physical" ROWS=5 COLS=70></TEXTAREA>
</font> <br>
<br>
<b>Field 13: Diagrams/Models</b> <br>
<font size="2">Diagram showing detail of the activity.</font> <br>
<INPUT TYPE="file" NAME="diagramsfile">
<br>
<br>
<b>Field 14: Reviews</b> <br>
<font size="2">Notes or reports available on the activity.</font> <br>
<INPUT TYPE="file" NAME="reviewsfile">
<br>
<br>
```

```html
<b>Field 15: Potential recommendation</b> <br>
<font size="2">Any recommendations on how to improve the activity.<br>
<TEXTAREA NAME="recommendations" WRAP="physical" ROWS=5
COLS=70></TEXTAREA>
</font> <br>
<br>
<b>Field 16: Miscellaneous</b><br>
<font size="2">Any other information or files available on the activity that
did not fit into the fields above.<br>
<TEXTAREA NAME="miscellaneous" WRAP="physical" ROWS=5
COLS=70></TEXTAREA>
<br>
<br>
<input type="file" name="miscellaneousfile">
</font>
<p></p>
<input type="submit" value="Submit Questionnaire">
</form>
<p>Please contact Professor Lambert with any further questions:
</p>
<ul>
<li>Email: <a href="mailto:lambert@virginia.edu">lambert@virginia.edu</a></li>
<li>Office Phone: 434-982-2072</li>
<li>Office Assistant Phone: 434-924-0960</li>
</ul></BODY>
</HTML>

</html>
```

IDEF Worksheet Questions Methodology

The following describes how the scripts for the server were written and which Scripts/Programs were useful in creating the server. This section also recommends tools and books for beginners at programming and gives an overview of how the server receives and submits information.

In order to effectively use forms on the internet, one needs to be able to receive and process the information on the forms. The most common way this is done is by Common Gateway Interface (CGI) scripts or programs, and the most common programming language used for these scripts is Perl.

The research team's first task was trying to make a form for VDOT officials to send information on various IDEF activities to personnel in the Systems Department. We hoped to use an existing script that was available over the Internet, but unfortunately could not find one with all the tasks necessary for the form. For example, many scripts sent the form's information by email, but none of them allowed file uploads. Those that did allow file uploads did not send email to multiple addresses. Next, we tried to adjust some of the pre-existing scripts to fit the form's needs, but this also proved to be unsuccessful.

The next step was to learn the basics of Perl programming. The first step was to study a book called *Teach Yourself CGI in 24 Hours* by Rafe Colbourn. Although it did have important information regarding CGI scripts and where they need to be stored on a server, this book proved to be too advanced for this project.

A CGI-script often has a "cgi" or ".pl" extension. It is stored in the default directory for CGI scripts on a server. This is almost always called a "/cgi bin," but there was no "/cgi bin" already set up on the server. ITC.virginia.edu advised us that the server would be able to process scripts once a "/cgi-bin" was set up by giving it the proper permissions.

Setting permissions for the "/cgi-bin" is done in the following way. Basically, when a file is uploaded to a server it is generally set so that only the owner can read and write to it, and everyone else can only read it. In order for others (i.e., any browser) to be able to access it, one needs to change the permissions. This can be done by a telnet to a server or by using an FTP client to do the job.

Elizabeth Castro's book *Perl and CGI for the World Wide Web* helped the team learn how to create a CGI script that accomplished all of the necessary tasks.. The book gave an excellent introduction to Perl programming and enabled us to apply some C++ and Java knowledge to the server. This book is part of a series called *Visual Quick Start Guides.* Other Quickstart guides were also used to learn HTML programming, *Javascript* programming, and Macromedia's *Dreamweaver.* These books are incredibly useful and can be especially recommended to beginners.

Tasks of the Script

The script takes information from the form located at www.virginia.edu/crmes/stip/IDEFform.htm. Pressing the submit button brings up a new page that tells the user what was just entered in the form. All of the information is written to a log file on the server labeled with the user's name and the date. If any files are chosen to be uploaded they are also written to a folder under the file's original name.

Each time a form is filled out, the user receives an email thanking him or her for submitting a questionnaire. A separate email is also sent to notify a Systems employee that a questionnaire was submitted. The email also includes the location of the logfile that was created and tells all of the information that the user entered (the same information that can be found in the logfile). The only important script located in the cgi bin is called *uploadform.pl* - everything else is a testing script that was used along the way to figure out how to write the uploadform.pl file.

APPENDIX B: IDEF WORKSHEET

This appendix displays the IDEF Worksheet that the team created to convert research and interviews with personnel working on or with the STIP/SYIP into IDEF format. It describes the activities that go into the STIP Process and the Amendment, Public Involvement, Construction, MPO, and Environmental Processes.

Table B-1: Worksheet of the STIP Process for the Integration into IDEF

STIP PROCESS	* Denotes IDEF Field of Information														
Initials of Author	Activity	Inputs*	Controls*	Mechanisms*	Outputs*	Objective	BPWin Diagram	Title of responsible person(s)	Key Decisions	Funding for construction	Start/ End Date	Interview Transcript	External Links	Diagram /Models	Reviews	Potential Recom.
ELI - 022304	Revenue Forecasting	TBD	TBD	TBD	Estimates to VDOT by VDRPT	Calculation for Allocation of funds for construction and non construction purpose	Revenue Forecast Process Model	FTA: annual apportionments for State RABA Adjust apportionments	Estimates and Allocation of funds	Funding for construction	1/01/04 -- 5/01/04**					
ELI	Drawing a Six Year budget	Estimates from Revenue Forecast	Code of Virginia and Federal regulations	Rough Estimates, Public Hearings Estimates updated quarterly. VDOT/FHWA improving methodology	Drafted budget for SYP	Allocate funds over a period of six years	TBD	VDOT	Allocations	Funding for construction						
ELI	Planning and Engineering Estimates	1993 review of award cost for projects, info from public hearing	TBD	TBD	Estimates for capital purchases, operating expenses, fixed facilities	Rough Estimates	TBD	PPMS	TBD	Drafted SYP						
ELI	Draft Six Year Program	Estimates from Planning and Eng. estimates	Discrep. in composite of allocations (Financial Planning and Debt Mangment Division) Breakdown of NHS funding	TBD	Advertisement Schedule, cash forecast	Updated cost estimates in PPMS	TBD	P & S, VDRPT	Estimates and Allocation of funds	Cost and Estimates, Public Hearings						
ELI	Planning and Progr. meetings	Advertis. Schedule	TBD	TBD	TBD	Provide a forum for citizens and officers to meet	TBD	CTB	TBD	TBD						

ELI	Agency Review of Program Allocations	TBD	TBD	Comprehensive, line by line, district by district	TBD	Review of Cost estimation and Allocation	TBD	Reviewed by VDOT leadership. Financial Planning and Debt Management Division runs forecast to determine if the program is balanced to cash	Determin. of balanced cash in program	TBD
ELI	Review Program with the Common-wealth Transp. Board	TBD	TBD	TBD	Changes incorporated into tentative program	Review of program draft copies (again)	TBD	CTB members	TBD	TBD
ELI	Tentative Program	Agency and CTB review processes, public and local govt comments	Comments from public and govt	Incorp. of urban, rail and public transport, enhancement and real safety	Final Figures sent to Financial Planning and Debt Management Division, copies sent to CTB prior to their meeting after which document is made available for public comment	TBD	TBD	TBD	Basically review of all projects	TBD
ELI	Final Public Hearing	TBD	TBD	Held on same day: Morning in the western, Afternoon in the Eastern	TBD	TBD	TBD	TBD	TBD	TBD

AMENDMENT PROCESS

Initials of Author	Activity	* Inputs	* Controls	* Mechanisms	* Outputs	Objective	BPWin Diagrams	Title of responsible person(s)	Key Decisions	Duration	Transcripts / Interviews	Misc.	External Links	Diagrams/ Models	Review	Potential Recom.
RPT - 012004	Need for an Amend	Advertising, Change in cost of original project, New projects		Programming Division sends out Request for Amendment		To get the ball rolling on getting a new project into the STIP	see Diagrams/ Models						http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr450_03.html	amendment.htm		
RPT - 012504	Project revised w/ new estimate		Only done when the original project estimate has seen an increase of at least %10			The project revision is necessary to get reapproved and put into the STIP	see Diagrams/ Models	TBD			Amendment Review Process.doc		http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr450_03.html	amendment.htm		
RPT - 012504	MPO needs to ammend TIP		Only done when a new project is being proposed			The MPO needs to amend his/her TIP so it accurately reflects information in the STIP	see Diagrams/ Models	Regional MPO		30-day minimum, according to TIP meetings and the public review process.	Interview Transcript w Gene Wells.doc		http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr450_03.html	amendment.htm		
RPT - 021004	Letter of Approval is sent to Ken Lantz	Draft is constructed by VDOT staff member		Letter is sent via mail	Decision on approval		see Diagrams/ Models	Ken Lantz, Transportation Planning Division Administrator	Approve amendment as is, Approve amendment w/ changes, Reject amendment	Duration of approval depends mostly on the commissioner	Nov 17,2003doc.doc		http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr450_03.html	amendment.htm		Make Amendment Approval process more automatic/ electronic
RPT - 022304	Letter of Approval is sent to Jeff Southard	Draft is constructed by VDOT staff member		Letter is sent via mail	Decision on approval	To gain a better scope of the amendment review process	see Diagrams/ Models	Jeff Southard, Assistant Transportation Commissioner	Approve amendment as is, Approve amendment w/ changes, Reject amendment	Duration of approval depends mostly on the commissioner	Nov 17,2003doc.doc		http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr450_03.html	amendment.htm		Make Amendment Approval process more automatic/ electronic

RPT - 030104	Letter of Approval is sent to the VDOT Commiss ioner	Draft is constructed by VDOT staff member	Never sent on Friday	Letter is sent via mail	Decision on approval		see Diagrams/ Models	Philip Shucet, VDOT Commissioner	Approve amendment as is, Approve amendment w/ changes, Reject amendment	Duration of approval depends mostly on the commissioner	nov17a,200 3doc.doc	http://www.a ccess.gpo.g ov/nara/cfr/ waisidx_03/ 23cfr450_03 .html	amendment. htm	Make Amendment Approval process more automatic/ electronic
RPT - 030404	Letter of Approval is sent to Roberto Fonseca-Martinez	Draft is constructed by VDOT staff member		Letter is sent via mail	Decision on approval		see Diagrams/ Models	Roberto Fonseca-Martinez, FHWA Division Administrator	Approve amendment as is, Approve amendment w/ changes, Reject amendment	Duration of approval depends mostly on the commissioner	nov17a,200 3doc.doc	http://www.a ccess.gpo.g ov/nara/cfr/ waisidx_03/ 23cfr450_03 .html	amendment. htm	Make Amendment Approval process more automatic/ electronic
RPT - 030704	Amend. is approved						see Diagrams/ Models					http://www.a ccess.gpo.g ov/nara/cfr/ waisidx_03/ 23cfr450_03 .html	amendment. htm	
RPT -	Money is authorize d for project						see Diagrams/ Models					http://www.a ccess.gpo.g ov/nara/cfr/ waisidx_03/ 23cfr450_03 .html	amendment. htm	
RPT -	New project enters the STIP						see Diagrams/ Models					http://www.a ccess.gpo.g ov/nara/cfr/ waisidx_03/ 23cfr450_03 .html	amendment. htm	

Table B-3: Worksheet of the Public Involvement Process for the Integration into IDEF

Initials of Author	Activity	* Inputs	* Controls	* Mechanism	* Outputs	Objective	BPWin Diagram	Title of responsible person(s)	Key Decision	Duration	Transcripts / Interviews	Misc.	External Links	External Links	Diagram / Models	Review Documents	Reviews	Potential Recom.
RTS - 022004	SYP - Draft SYP (11): Review District/ Division Input to See What Projects Can Be Added	Six Year Advertment Schedule		Mail and Via the internet	Complete Draft Program	Determine if new projects need to be added to the Draft Program.							Utah's STIP Development Process.pdf - Detailed description of the process for development of the STIP and MPO documents in Utah	Development and Financial Constraint of Virginia's STIP (p.7-8).pdf	Draft SYP - Included in the Six Year program process	Public Involvement Techniques for Transportation Decision Making.htm - Identifies various techniques that can be useful in the implementation of public involvement.	Public Involvement Technique Summary	Public Involvement Toolkit (Minnesota)
RTS - 022204	SYP - Tentative Program (9) MPO (4) STIP (5): Pre-allocation Hearing	Public and Local Government Comments and Advertment Schedule	Federal Guidelines under $450.212 of the Statewide Transport. Planning Rule Published under the Code of Federal Regulations	A meeting is held in each of the nine districts and oral comments are limited to 3 minutes	Changes to be implement in the Draft Program	Provide a forum for citizens and officers to meet		District Administrators, CTB board, Fin.Plng and Debt Mgmt., L&D, public affairs					STIP Public Involvement Regulations and VDOT PI Policy.pdf - Includes the federal guidelines driving the public involvement process.	Development and Financial Constraint of Virginia's STIP (p.9, 12-14).pdf	Tentative - Included in the Six Year program process	Assessment of VDOT's Public Involvement Practices.pdf (Phase II report) - Provides recommendations and feedback for the public involvement practices of VDOT.	Notes from Public Hearing Attended	Recommendations from VTRC Phase II report
RTS - 022304	SYP - Tentative Program (1): Tentative Program made available for public comment	CTB Approval and the Tentative Program		Full information is provided on projects listed via the internet	Draft of Final Program	Obtain feedback from the proposed schedule of projects planned		VDOT Residency Staff						Development and Financial Constraint of Virginia's STIP (p.9).pdf	Tentative - Included in the Six Year program process	Public Involvement Techniques for Transportation Decision Making.htm - Identifies various techniques that can be useful in the implementation of public involvement.	Public Involvement Technique Summary	

ID	Name												
RTS - 022304	STIP (11) SYP - Urban (14) :Final Public Hearing	CTB Approval, the Tentative Program, and public and local comments	Federal Guidelines under $450.212 of the Statewide Transport. Planning Rule Published under the Code of Federal Regulations	Held on same day: Morning in the western (Salem), Afternoon in the Eastern (Richmond)	Changes to be incorporated into the final program	Provide a forum to provide feedback on the Tentative Program	Resident Engineer CTB Management	Changes made to Program based on public input		Development and Financial Constraint of Virginia's STIP (p.8-9).pdf	STIP - Derived from the process for the STIP		
RTS - 022504	SYP - Secondary Roads (1): Public Requests/ Public Comments	Public Input		Via the internet, Mail, and Conversations with public officials	Recommendations for Transportation Projects	Obtain public feedback for secondary road planning	County Staff, Board of Supervisors, and VDOT Residency Staff		Utah's STIP Development Process.pdf - Detailed description of the process for development of the STIP and MPO documents in Utah	Development and Financial Constraint of Virginia's STIP (p.10-11).pdf	Secondary - Included in the Six Year program process	Public Involvement Techniques for Transportation Decision Making.htm - Identifies various techniques that can be useful in the implementation of public involvement.	Public Involvement Technique Summary
RTS - 022604	SYP - Secondary Roads (11): Public Hearing (Draft Revision)	Draft SYP and Public priority	Secondary Road Act, 1977 State Legislation	Conducted between October and December	SYP revisions	Obtain public feedback for secondary road planning	Board of Supervisors		STIP Public Involvement Regulations and VDOT PI Policy.pdf - Includes the federal guidelines driving the public involvement process.	Development and Financial Constraint of Virginia's STIP (p.10-11).pdf	Secondary - Included in the Six Year program process		
RTS - 022604	MPO (12): Public Hearing Review	SYP Program	Federal Guidelines under $450.212 of the Statewide Transport. Planning Rule Published under the Code of Federal Regulations	Public Involvement Process conducted individually by each MPO.	Submission of TIP for Air Conformity Analysis and Approval	Obtain public feedback for development of the TIP			STIP Public Involvement Regulations and VDOT PI Policy.pdf - Includes the federal guidelines driving the public involvement process.	Development and Financial Constraint of Virginia's STIP (p.12-14).pdf	MPO - Derived from the process for the STIP and TIP	Assessment of VDOT's Public Involvement Practices.pdf (Phase II report) - Provides recommendations and feedback for the public involvement practices of VDOT.	Recommendations from VTRC Phase II report

Table B-4: Worksheet of the Construction Process for the Integration into IDEF

CONSTRUCTION PROCESS																			
Initials of Author	Activity	* Inputs	* Controls	* Mechanisms	* Outputs	Objective	BPWin Diagram	Title of responsible person(s)	Key Decision	Duration	Transcripts / Interviews	Misc	External Links	External Links	Diagram/ Models	Review Document	Reviews	Potential Recom.	
RTS - 042904	Develop and Prepare estimates for the project	Intrinsic Cost estimate, List of Items	Items that are 65% of Bid price are analyzed	Made by a Rational Estimate that factor in location, market conditions, quotes, etc	Schedule of Items, Estimate to compare against Bidding	Make an estimate to compare against bids		Contract Engineer								Estimating Guideline Procedures - VDOT website			
RTS - 042904	Get FHWA approval for Federal Funds	Estimated Cost	Must Fit Financial Constraint of the STIP		Federal Approval to continue to Bidding Process	Make sure that estimates fit with financial issues										Plan Review - VDOT website			
RTS - 043004	Document and Advertise on Monthly Advertisement Schedule	Schedule of Items, Location and Description	Must have 5 days to modify an estimate prior to advertisement	Via the internet or mail	Bids to compare against the estimate	Obtain bids to use in the selection of contractors		Contract Engineer								Document Production - VDOT website			
RTS - 043004	Adjustments made to Bid	Contract Bids	Submit for federal reapproval if bid exceeds 7% over estimate or 20% under estimate		Federal Approval to award a contract	Re-check if new cost fits financial constraint of STIP										Bid Letting - VDOT website			
RTS - 043004	Award Contract	Division Approval		Notice to Proceed - Issued 30-45 days after award of contract, contractor must begin construction within 10 days of notice.	Contract completion for Construction	Award a final contract for construction		District Administrator, Chief Engineer								Contract Engineer - VDOT website			

Table B-5: Worksheet of the MPO Process for the Integration into IDEF

MPO PROCESS					
Initials of Author	**Activity**	**PowerPoint Presentations**	**Flow Charts**	**Flow Charts**	**Word Documents**
ELI	MPO Process Information	SYIP Public Hearing Presentation	MPO Flow Chart 1	MPO Flow Chart 2	Metropolitan Planning Transportation Improvement Program
SHC - 092404	**CMAQ Allocations** (Congestion Mitigation and Air Quality)				
SHC - 092404	**RSTP Allocations** (Regional Surface Transportation Program)				

MPO PROCESS																		
Initials of Author	**Activity**	*** Inputs**	*** Controls**	*** Mechanisms**	*** Outputs**	**Objective**	**BPWin Diagram**	**Title of responsible person(s)**	**Key Decisions**	**Duration**	**Transcripts/ Interviews**	**Misc**	**External Links**	**External Links**	**Diagram/ Models**	**Review Document**	**Reviews**	**Potential Recom.**
SHC - 092404	CMAQ Allocations (Congestion Mitigation and Air Quality)	Project requests; proof of environmental benefits	money; legislation;	Currently using pdf files; in future, maybe database	Local projects allocated funds	Get projects implemented	n/a	Joseph Paulus	none really - lots of politics involved	year-long process	Interview -Joseph Paulus		http:// www. hrpdc .org/					more money and control to the MPOs; less politics
SHC - 092404	RSTP Allocations (Regional Surface Transportation Program)	Project requests	money; legislation;	Currently using pdf files; in future, maybe database	Local projects allocated funds	Get projects implemented	n/a	Joseph Paulus	none really - lots of politics involved	year-long process	Interview -Joseph Paulus		http:// www. hrpdc .org/					more money and control to the MPOs; less politics
IE - 092904	Planning Documents	Existing research, Accident records, Observations of elements that might affect project	stringent requirements for planning document	external contractors, established procedures for submitting plans	Final planning document sent to planning division of VDOT	Get planning documents approved	n/a	Bill Albright	what projects to do research / prepare documents for	year-long process	Interview -Bill Albright							deemphasize the politics involved in getting projects approved; automate processes
IE - 092904	Managing Funding	projects that need funding	legislation that restricts control over funds	1) funding directly from government; 2) funding from fed to state to MPO	the source of funding for each project	Get funding for projects	n/a	Bill Albright	how to allocates monetary resources	year-long process	Interview -Bill Albright							give more control over funds
IE & SHC - 100504	Public Involvement	Planning document	Federal guidelines that state that there has to be 14 days for public review	Publicize through the newspaper, and they make the document available in public libraries	Take the comments from the public hearing and incorporate them into the planning doc	Give a voice to the public in terms transport. projects carried out in their areas	n/a	Larry Hagan, Principle Planner in charge of the STIP (Richmond MPO)	When to advertise, and hold the public hearing	2-4 weeks	Interview -Larry Hagan		www. richm ondre gional .org					

Table B-6: Worksheet of the Environmental Process for the Integration into IDEF

ENVIRONMENTAL PROCESS																		
Initials of Author	**Activity**	*** Inputs**	*** Controls**	*** Mechanisms**	*** Outputs**	**Objective**	**BPWin Diagram**	**Title of responsible person(s)**	**Key Decisions**	**Duration**	**Transcripts/ Interviews**	**Misc**	**External Links**	**External Links**	**Diagram /Models**	**Review Documents**	**Reviews**	**Potential Recom**
RKJ - 062404	Air Quality Conformity	Computer Models (travel demand and air quality emissions); Schedules; Costs	Clean Air Act (40 CFR 93, 40 CFR 51); National Environmental Policy Act (NEPA); TEA-21	Travel Demand Forecasting (TT+); Mobile 6.2 (emission model); Conformity Analysis Tool (CAT); Post Processor	Conformity Report for LRP and TIPs in each ozone nonattainment / maintenance area	Transportation Conformity - demonstrate compliance with an area's STIP as required by the Clean Air Act		Amy Costello, Air Quality Program Manager	Conforming (Succeed); Not Conforming (Fail) - not in compliance b/c too much emissions or conformity lapse (fail to pass w/in time constraint)	Technical/ internal review - 2 months; Public review - 2 wks - 20 days; Federal Review/ approval (EPA) - 45 days; total 4 to 6 months	Ahmet Anday and Amy Costello Interview	Confo rmity Trigg ers			Standard Operatin g Procedur es (DRAFT)	Conformi ty Standard Operatin g Procedur es		Need to link planning and NEPA processes; put more resources in ISYP; need error checking; let people know their project will need air quality conformity
RKJ - 062404	Transport. Modeling for Air Quality Conformity	Projects contained within the STIP	National Air Quality Standards (NAQS); EPA air quality rules	TT+ Software	Vehicle Miles Traveled (VMT); Speeds	Meeting Air Quality Standards		Michael Hester, Air Quality Planning Manager	Pass or Fail	4 to 6 months								

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**APPENDIX C: PLANNING AND PROGRAMMING ACTIVITIES
DISPLAYED IN IDEF FORMAT**

This appendix presents examples of planning and programming activities displayed in IDEF format and data-flow diagrams using the business-process modeling program AllFusion. It presents the integration of the STIP/SYIP from the appendices in the FHWA 2002 report and the IDEF Worksheet shown in Appendix B. On the left side of the figures is a list of all the activities in the STIP Development Process and any sub-activities.

Figure C-1: STIP Development Process.
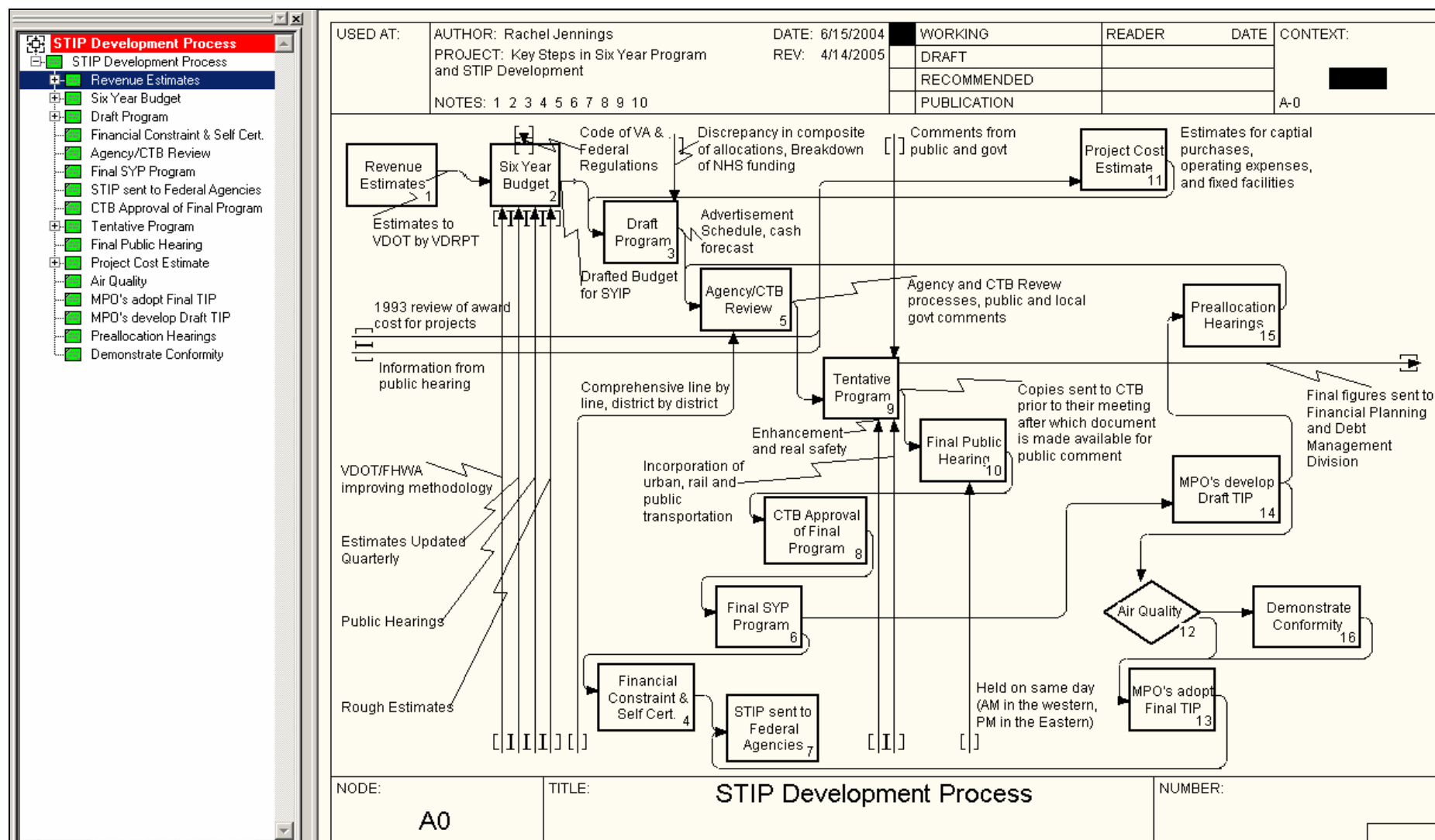
Figure C-2: The Decomposition of the STIP Development Process, Including All the Inputs, Controls, Mechanisms, and Outputs for Each Activity.
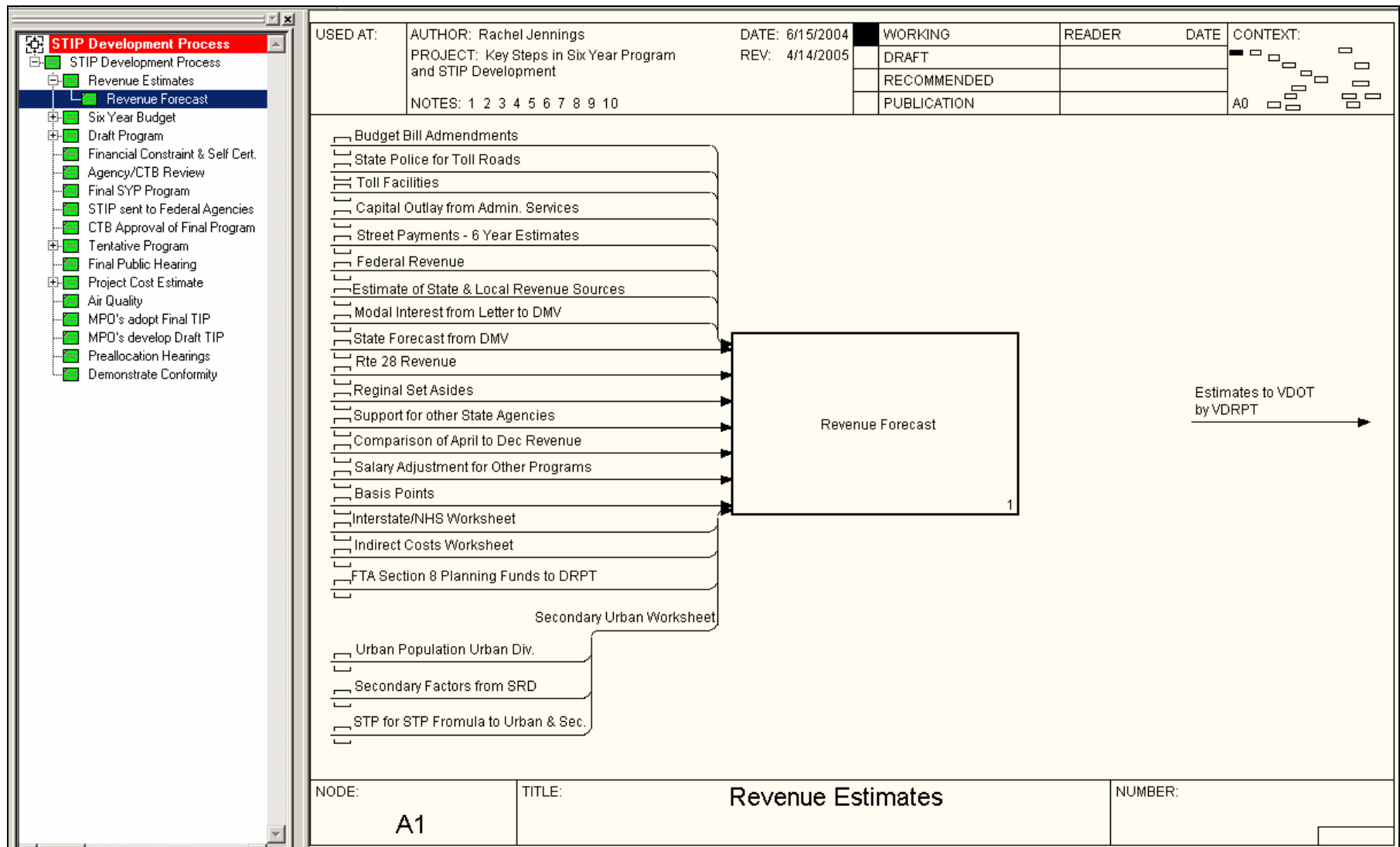
Figure C-3: The Decomposition of the Activity Revenue Estimates, Including All the Inputs and Outputs for This Activity.

Figure C-4: The Decomposition of the Activity Six-Year Budget, Shown as a Data-Flow Diagram Instead of an IDEF Model as Found in the Previous Three Figures.

Figure C-5: The Decomposition of the Activity Draft Program, Shown as a Data-Flow Diagram.
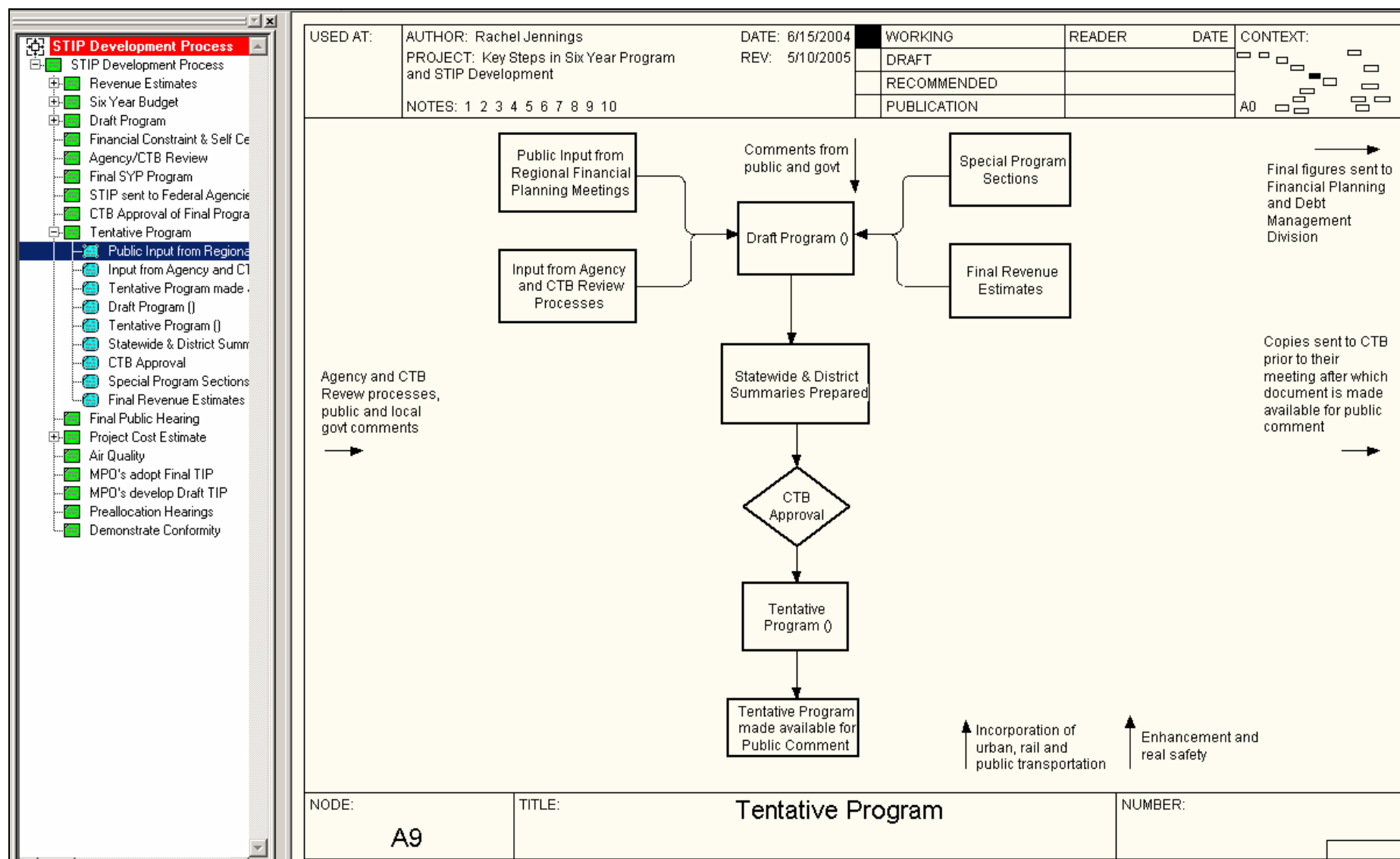
Figure C-6: The Decomposition of the Activity Tentative Program, Shown as a Data-Flow Diagram.

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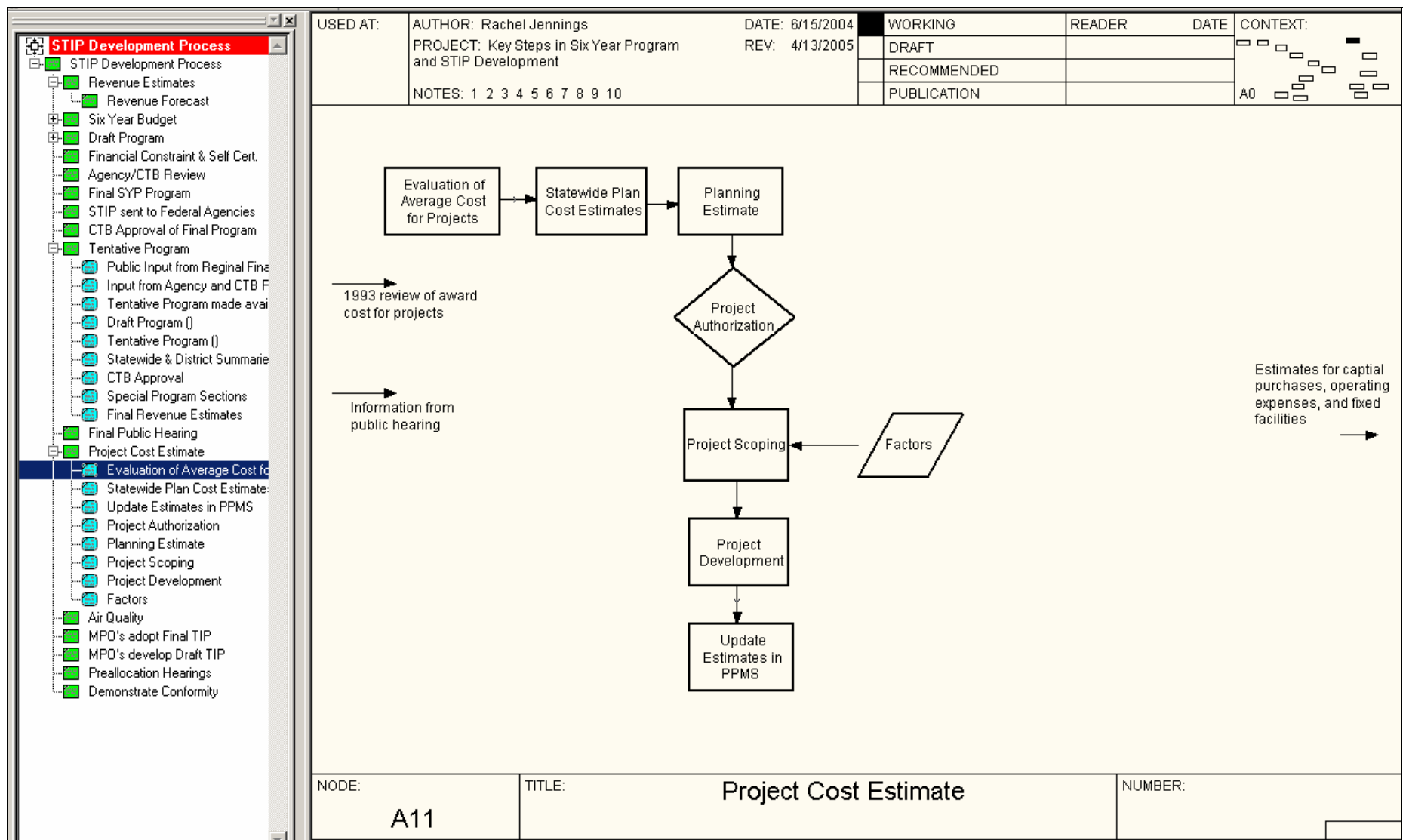
Figure C-7: The Decomposition of the Activity Project Cost Estimate, Shown as a Data-Flow Diagram.

APPENDIX D: COMPATIBILITY OF *ALLFUSION* WITH SIMULATION SOFTWARE

Purpose and Overview

This appendix describes how the compatibility of the *AllFusion* Process Modeler with other programs can provide a wider range of options and opportunities when modeling the STIP development process. It also a demonstrates how to convert a flowchart into IDEF3 format and then export the IDEF3 model into *Arena* Simulation Software.

Simulation programs are especially important because they can be used for analysis and gather invaluable information and statistics on processes. Simulation is a technique of re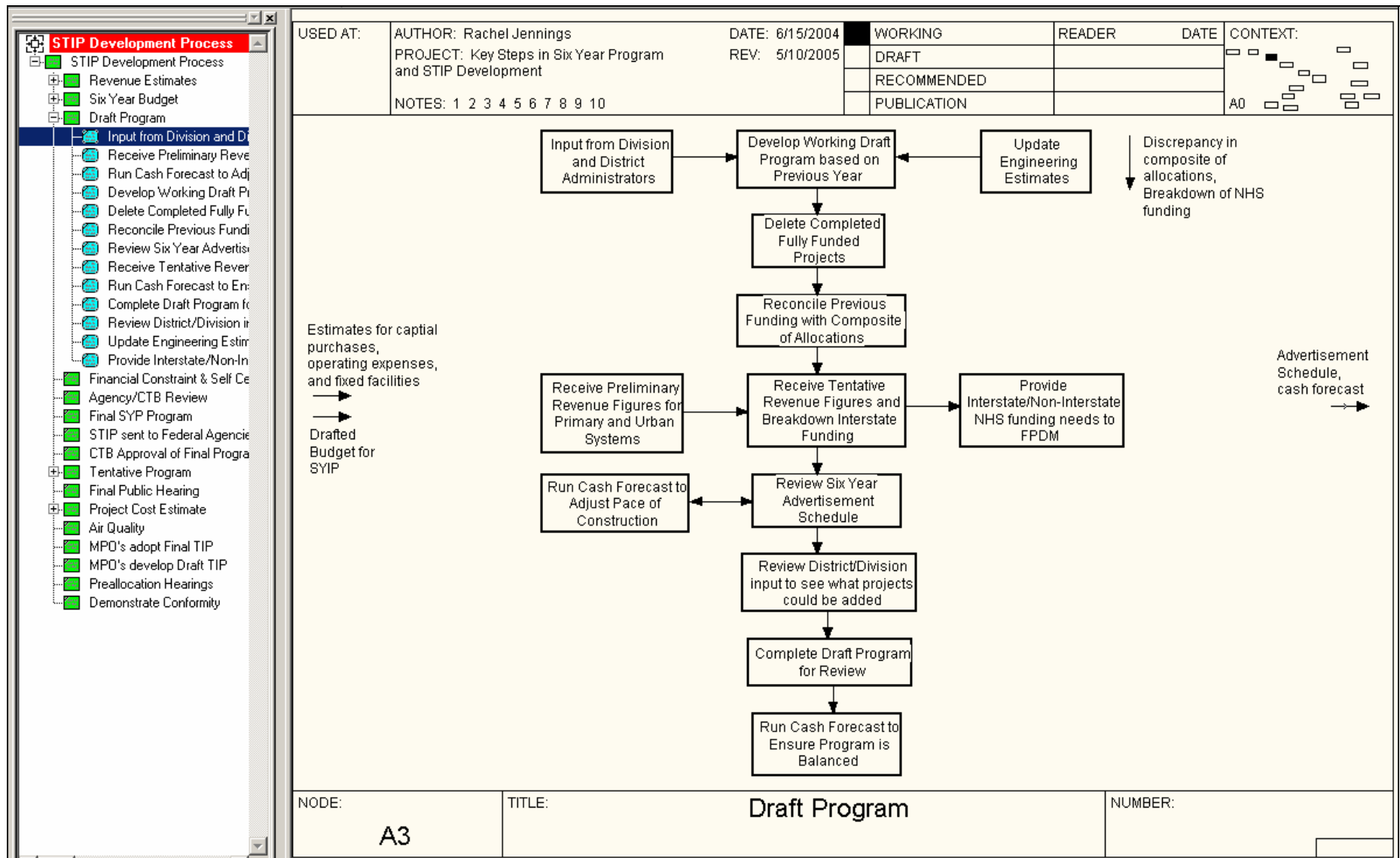presenting a real-world system by a computer program to gain insight into the system's operation. Simulation programs are very effective when analyzing business, service, or manufacturing processes or flows. Examples of applications are listed below:

- Documenting, animating, and demonstrating the variability and dynamics of a process map such as those done in VISIO or other static drawing packages (such as *AllFusion*);
- Analyzing business processes typically related to customer or paperwork handling, such as front- and back-office procedures in insurance, finance, or banking industries; and
- Analyzing simple (non-material-handling intensive) manufacturing process flows.

Simulation can be used to model the SYP and STIP life-cycles to provide information and visualizations that can help determine bottlenecks, decrease project development time, and further understand these processes. This report analyzes the compatibility of AllFusion and the simulation program Arena while demonstrating their possible use for the Virginia Department of Transportation.

Approach

AllFusion is capable of creating three different types of models: process flow (IDEF3), the business process (IDEF0), and data-flow diagrams (DFD).

This appendix describes the IDEF3 *process-flow model, which* captures precedence and causality between activities. It provides a way to show the sequence and timeline of events. Only IDEF3 models can be simulated since the other models do not depict a strict order of events. IDEF3 models created in *AllFusion* can be exported to the simulation program for further analysis. Important points to note before attempting to integrate these models are as follows:

- Interface will map a single IDEF3 diagram (hierarchy will not be supported at this time).
- Not all objects in an IDEF3 diagram will necessarily map to a simulation model.
- Not all objects in the simulation model can be modeled with IDEF3.

Although there are shortcomings in mapping from IDEF3 to the simulation software, manual adjustment of the simulation model can quickly fix these problems.

A base mapping table from *AllFusion* to the simulation program *Arena* is depicted in Table D-1. More information on mappings can be found on the document *AllFusion to Simulation Program (Arena) Mappings* available at www.virginia.edu/crmes/stip/materials.html, posted on October 7, 2004.

Table D-1: Compatibility of *AllFusion* with simulation software; base mappings from *AllFusion* to *Arena*.

AllFusion Object	*Arena* Object
Referent (link from)	Create Module
Referent (link to)	Dispose Module
UOB (IDEF3 activity)	Process Module
Junction (XOR or Sync OR) where links (arrows) fan in	Decide Module
Junction (& or Async OR) where links (arrows) fan out	Batch Module
Any diagram object dictionary	Resource Module
Arrows (inputs to UOBs representing Process Modules)	Resource or Set repeat group
No direct equivalent	Assign Module
No direct equivalent	Record Module

An example of exporting to the simulation program has been prepared based on the Virginia Department of Transportation's memorandum on the preliminary engineering project-development process. Dated September 15, 2003, this memorandum specifically focuses on project management, milestones in the project development process, and team meeting guidelines. It is available at www.virginia.edu/crmes/stip/materials.html as the original document of the concurrent engineering process-flowchart that was posted on August 30, 2004. A link to the document is also available in the reference section.

Concurrent Engineering Process Flowchart
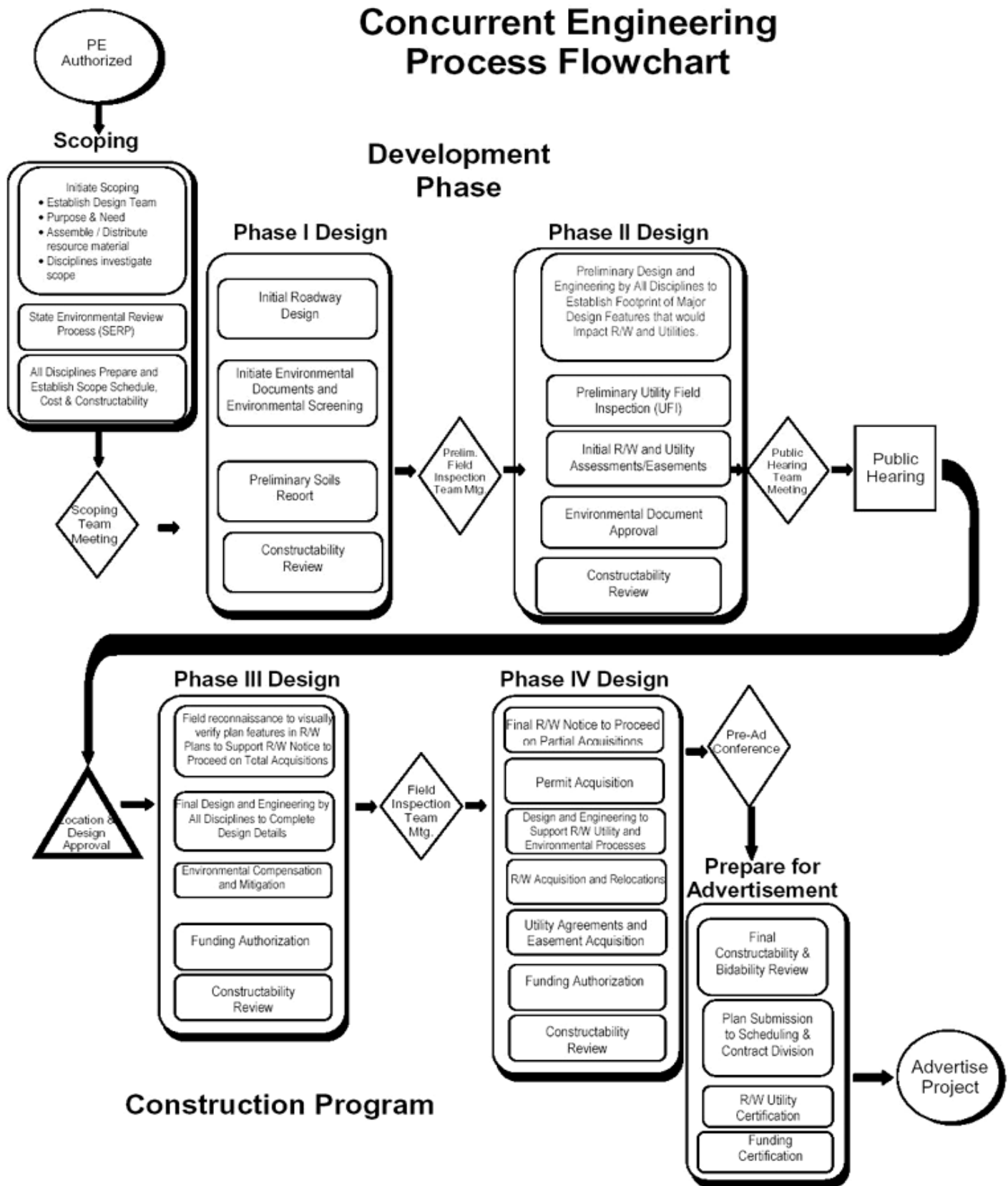
Figure D-1: Demonstration of *AllFusion* Capabilities: Concurrent Engineering Process Flowchart from VDOT Memorandum.

Information from the flowchart in Figure D-1 is from the VDOT memorandum *How a Road Gets Built Fact Sheet* from VDOT's website. This was synthesized with an interview with a VDOT employee on project development to create an IDEF3 model. Links to these materials can be found in the reference section. The model was created to project the tasks that had to be accomplished in sequence. For example, the VDOT employee indicated that the preliminary engineering phase had to be completed before right-of-way acquisition, which in turn precedes the construction phase. The IDEF3 model in Figure D-2 was developed by filling information from the flowchart and fact sheet between these steps. Although some activities depicted might occur concurrently, it serves as a good example of a model that can be exported to the simulation program.
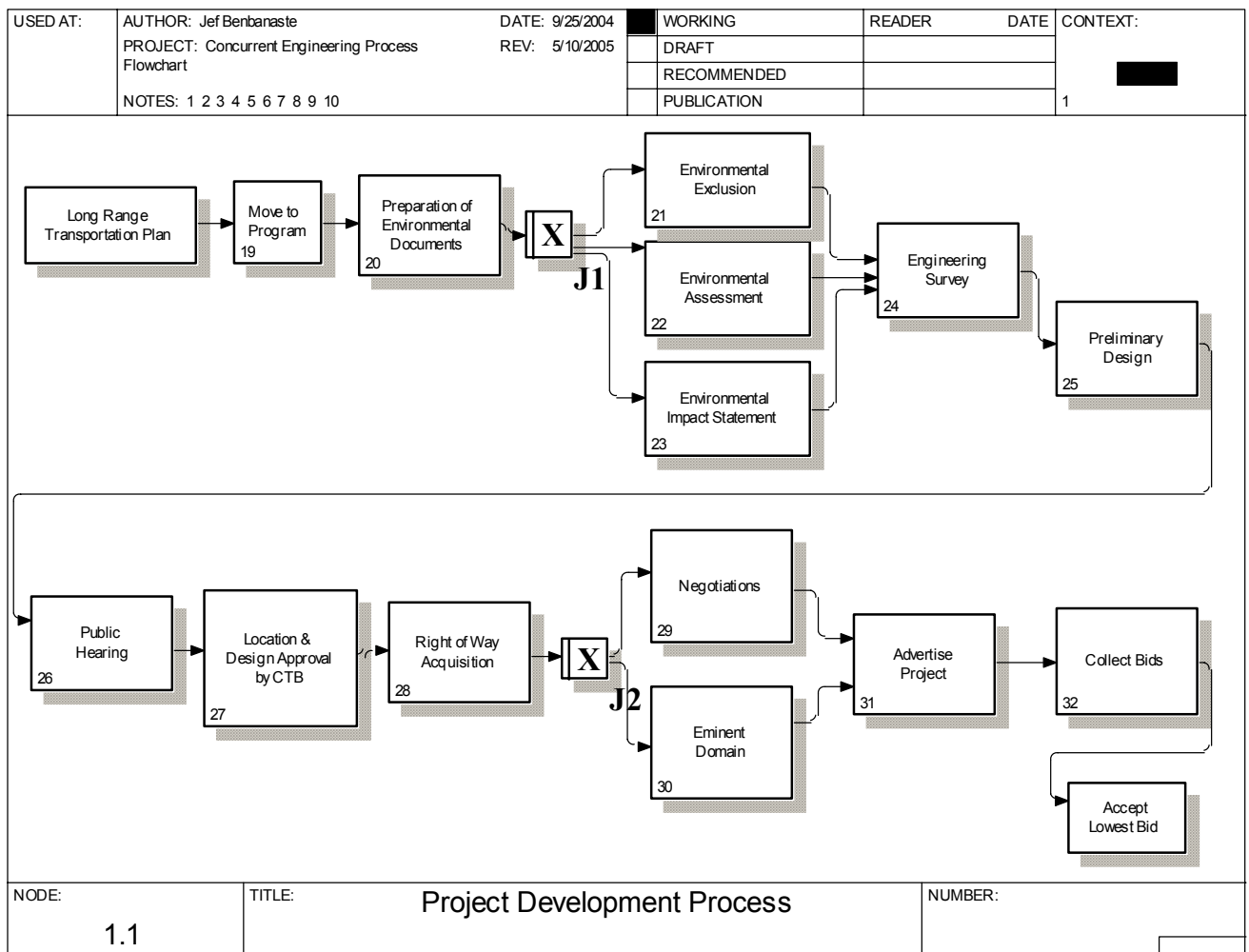
Figure D-2: Demonstration of *AllFusion* Capabilities: IDEF3 Model of VDOT Flowchart, Fact Sheet, and an Interview with a VDOT Employee.

Referents play an important role when developing an IDEF3 model. They represent the external sources of information that are needed to complete the specific tasks in the process flow. Since the process starts with a long-range transportation plan, a referent box should be used to introduce this information into the model, as can be seen in Figure D-3. Similarly, a referent at

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the end of the process indicates that the lowest bid has been accepted and there is an information flow out of the model at that point.
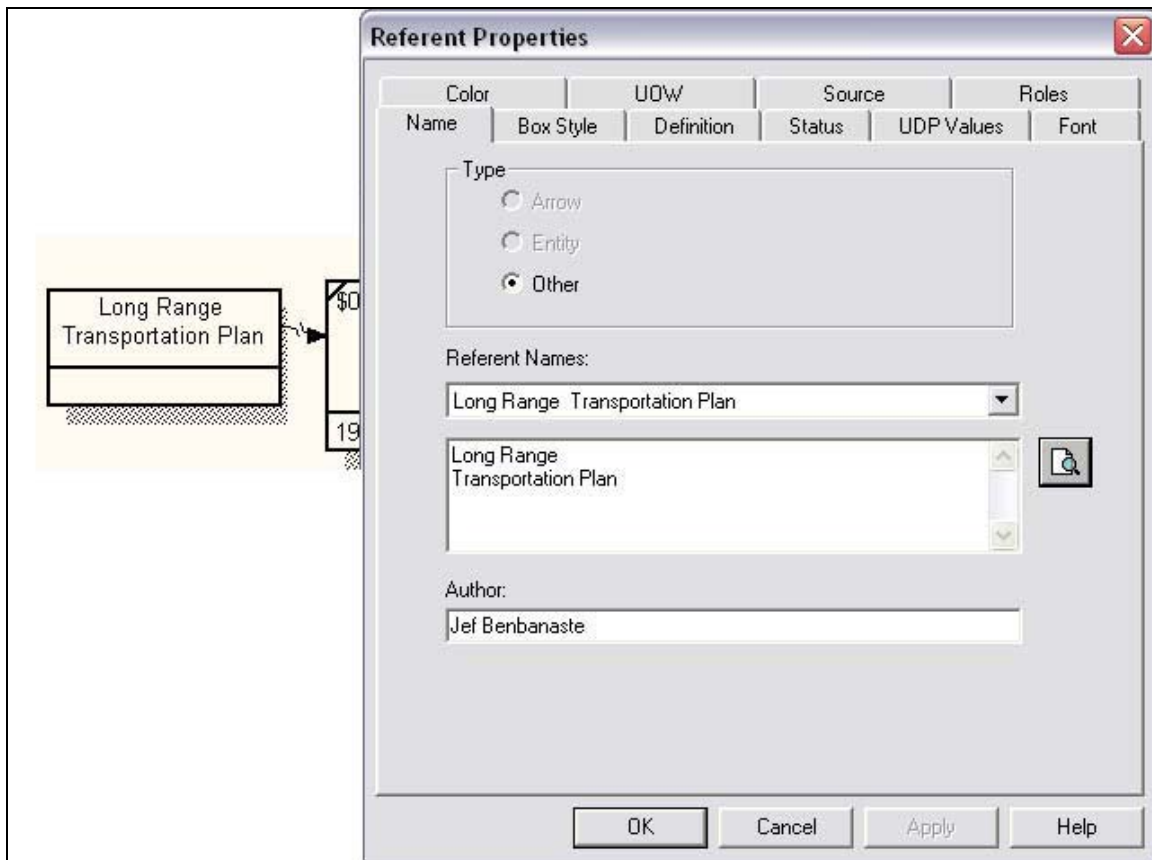
Figure D-3: Modeling the STIP Process: "Referent" Introducing the Long-Range Transportation Plan to the Model.

All activities within the model are represented with activity boxes. Costs of these activities can also be entered into the system. For this illustration, none of the activities has costs. Figure D-4 shows two activities: the public hearing and the location and design approval by the Commonwealth Transportation Board **(**CTB).
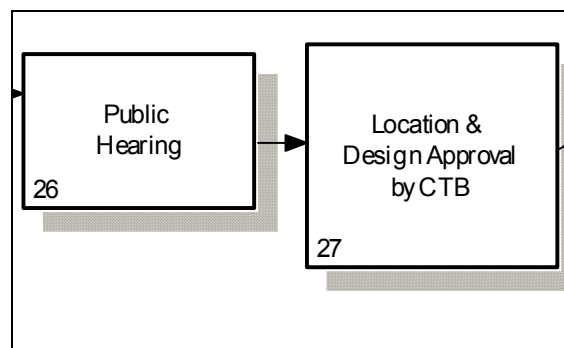
Figure D-4: Modeling the STIP Process: "Activity" Boxes.

In Figure D-5 below, the boxes marked with the letter "X" are "Exclusive OR" (XOR) junctions where the flow can go through only one of the branches. For example, when environmental documents are prepared, either an exclusion, assessment, or impact statement is prepared, depending on the environmental situation. The junction in Figure D-5 breaks the path down into three branches. The flow then continues on from one of the three.
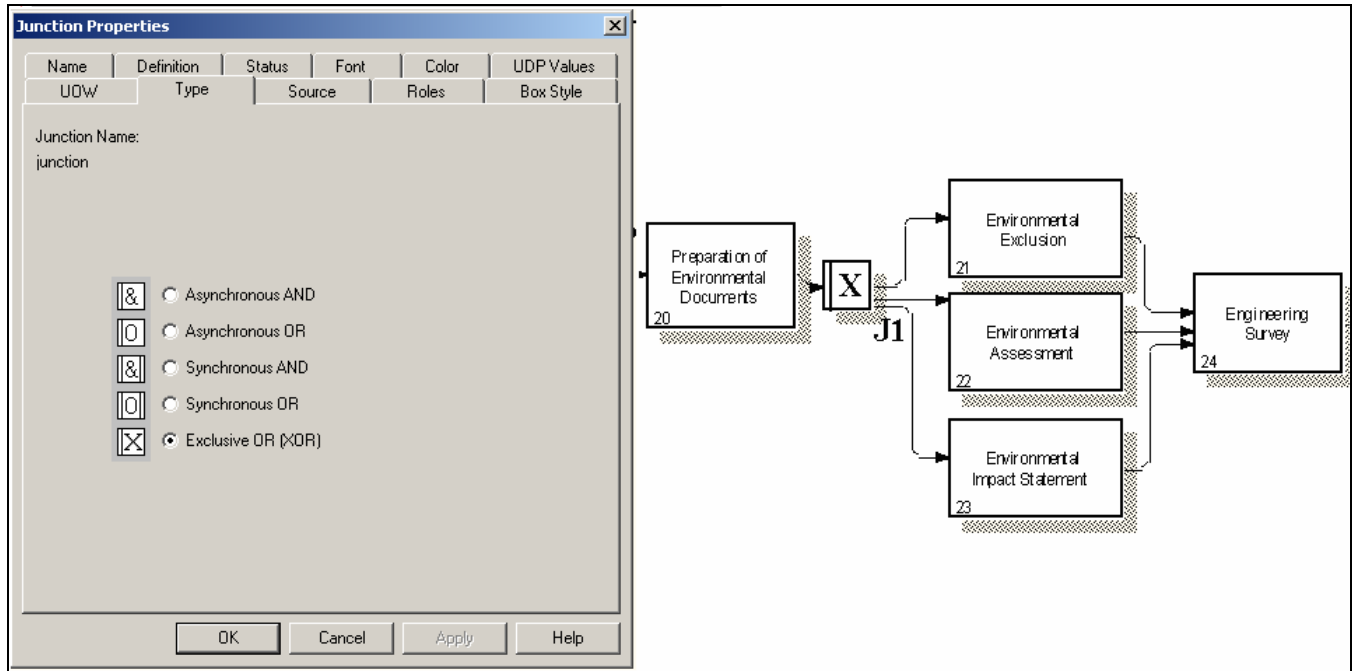
Figure D-5: Modeling the STIP Process: "Exclusive OR" Junction Restricting Flow to One Branch Only.

To successfully export a model to the simulation program, the time it takes to complete each activity must be entered into the IDEF3 model. User-defined properties (UDPs) as shown in Figure D-6 have to be created before translation into the simulation program. The correct names for the UDPs to be translated are listed in the *AllFusion to Simulation Program (Arena) Mappings* document available at www.virginia.edu/crmes/stip/materials.html, posted on October 7, 2004.

Figure D-6: Exporting to Simulation Program: User-Defined Properties.

After these steps have been completed, the model is ready to be exported. Selecting *File->Export->Arena* quickly translates the model into the simulation program seen in Figure D-7. *Arena* must be installed for this command to work.
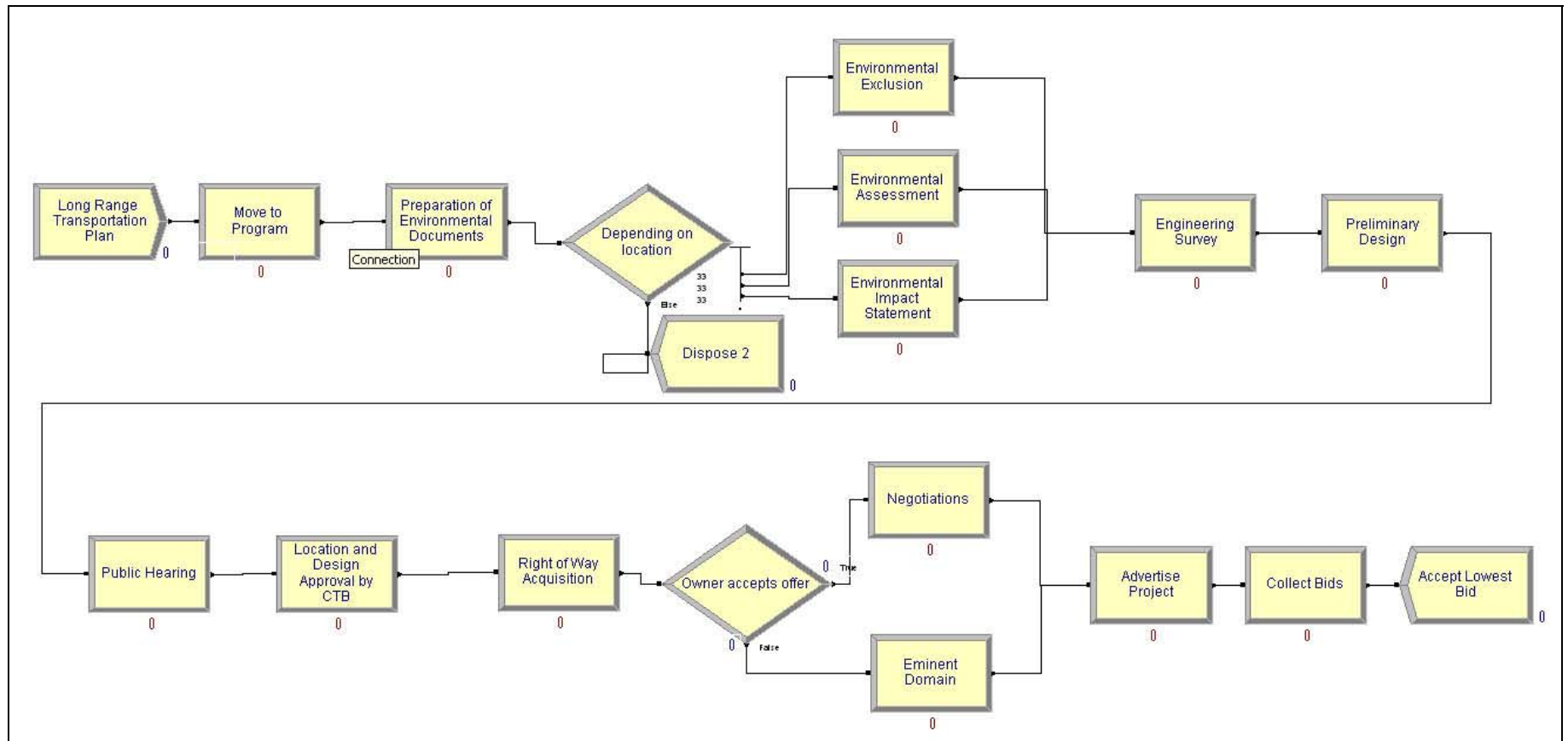
Figure D-7: Demonstration of *AllFusion* Capabilities: Simulation Model in *Arena* Imported from *Allfusion* IDEF3.

The *Arena* simulation model is very similar to the IDEF3 model in appearance. A *create* and a *dispose* node have taken the place of the referents mentioned before. These are points where entities are created and then disposed in the system. The entities flowing through the model will be individual projects going through the development process. Since the duration of activities could not be defined with the information available, running the simulation shows only the flow of projects through the system; it does not reflect how long each activity takes. Estimated process completion times can be added to a more comprehensive model for further analysis and to identify bottlenecks.

Conclusion and Recommendations

This section explored *AllFusion's* compatibility with simulation programs and demonstrated how it would contribute to the Virginia Department of Transportation's efforts to model the SYP and STIP processes.

Although the models developed have not been fully tailored to reflect the actual system, they are representative of a possible model. The compatibility of *AllFusion* with a powerful simulation program such as *Arena* can facilitate the analysis of models through simulation. This would serve both as a visual aid and a strong statistical tool to determine how a project evolves through its life cycle and where bottlenecks occur. VDOT can then use this information to speed up or improve its SYP and STIP development.

APPENDIX E: A TUTORIAL ON TRANSFORMING INTERVIEWS TO THE INTEGRATED DEFINITION STANDARD: A CASE STUDY ON THE METROPOLITAN PLANNING ORGRANIZATION (MPO)

Purpose and Overview

     This appendix describes the process of finding and synthesizing information on *business processes* through research and interviews, and converting that information into the Integrated Definition (IDEF0) standard. This will allow personnel to understand how to 1) effectively analyze information for any business model and 2) then build a concise framework to describe it. The content of the IDEF0 models is of special interest to the VDOT and the Center for Risk Management of Engineering Systems because of the potential impact these models have on the Six-Year Improvement Program (SYIP). This appendix relates this model to the Metropolitan Planning Organizations (MPOs).

Approach

     The following discusses the approach used to convert the information gathered from the MPOs to IDEF0 models. To best describe the entire process, we use a case study showing how information on the MPOs was gathered. Following is the general methodology for gathering such information:

1) An interview is set up with a high-level MPO employee.
2) A set of questions and objectives from the IDEF0 standard is prepared for the interview.
3) Members of the team conduct the interview.
4) The team verifies the information gathered from the interview with any existing information on the process, such as local district websites or VDOT websites.
5) The information is dissected into specific elements, as described by IDEF0.
6) The team uses the information to build the IDEF0 models for MPOs.

     The most effective way to set up an interview is to find a list of contacts through the Internet or other sources and to call people directly. Persistence is important since the potential interviewee usually will not expect such a call. If the voice mailbox comes up, it is more effective to call back rather than leave a message. Further, it is important to interview people who have a strong grasp of their organization's internal processes as well as those processes that affect outside parties. In this case, the targeted MPO candidates were people heavily involved with the planning process for the SYIP in Virginia.

     In order to conduct an effective interview, preparation is required. Certain specific aspects must be covered, such as the various business activities and the inputs, constraints, mechanisms, and outputs of those activities. Most interviews cannot be conducted by simply asking direct questions about these things because of the unfamiliarity of these technical terms, which will be interpreted differently from person to person. Therefore, it is important to make the interview feel as conversational as possible. The most effective method found was to ask about the business processes performed, and then guide the discussion by asking clarification questions so that the needed aspects are covered. More often than not, the interviewee will have more than enough to say about the business processes involved and the problems that exist. In the MPO example, the first interview conducted tried to ask a strict set of questions. When that

proved difficult to follow, the team decided to make the interviews more conversational and fluid.

It is most effective to have at least two team members present at an interview, one to take notes and play a less active role, and the other to carry on the conversation and ask follow-up questions. Having two members present allows for a check-and-balance system to ascertain that the information is correct and the necessary aspects are covered.

The information gathered from the interview then needs to be checked with any existing information to make sure that everything fits together. This activity will help clarify any confusion that came about from the interview and check the accuracy of the information. In the first interview conducted for the MPOs, there was confusion as to the differences between Congestion Mitigation and Air Quality (CMAQ) and Regional Surface Transportation Program (RSTP), but this was clarified by examining the Hampton Roads District MPO site.

After verifying the information, a framework needs to be built to display the information by the IDEF0 standard. The most important aspect is actual business activity or function. From there, the aspects that need to be covered include the inputs into the activity, the outputs, the constraints, and the mechanisms involved. To clarify, *constraints* specifically cover the legal constraints involved in the activity, while *mechanisms* cover the means for performing the activity (such as software applications). Further, any activities that might have additional activities within them need to be captured as well. With the MPOs, it was extremely difficult to understand how to model business processes after the first interview. Focusing on the important aspects to cover in the second and third interviews made it a lot easier to build the framework.

With the data organized into different elements, the last step is to actually build the IDEF0 model using *BPWin* from Computer Associates, and specifically using the IDEF0 standard. First, the overall business activity needs to be captured. Figure E-1 shows the introductory screen of the business activity for the MPOs.

Next, subordinate activities are shown in Figure E-2. Third, the inputs, constraints, mechanisms, and outputs need to be implemented. As in Figure E-3, the inputs are placed left of the activity, the constraints at the top, the mechanisms at the bottom, and the outputs to the right. This can be done for every business process that is available.

Lastly, any additional notes or details, such as the source of information, can be captured in the Notes section for each element or process, shown in Figure E-4.
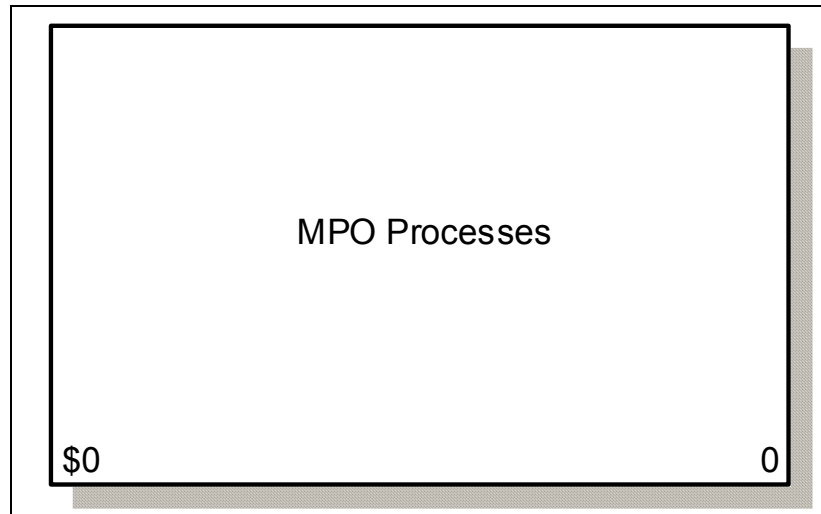
Figure E-1: Implementing IDEF0 models for SYIP/STIP - MPO processes.
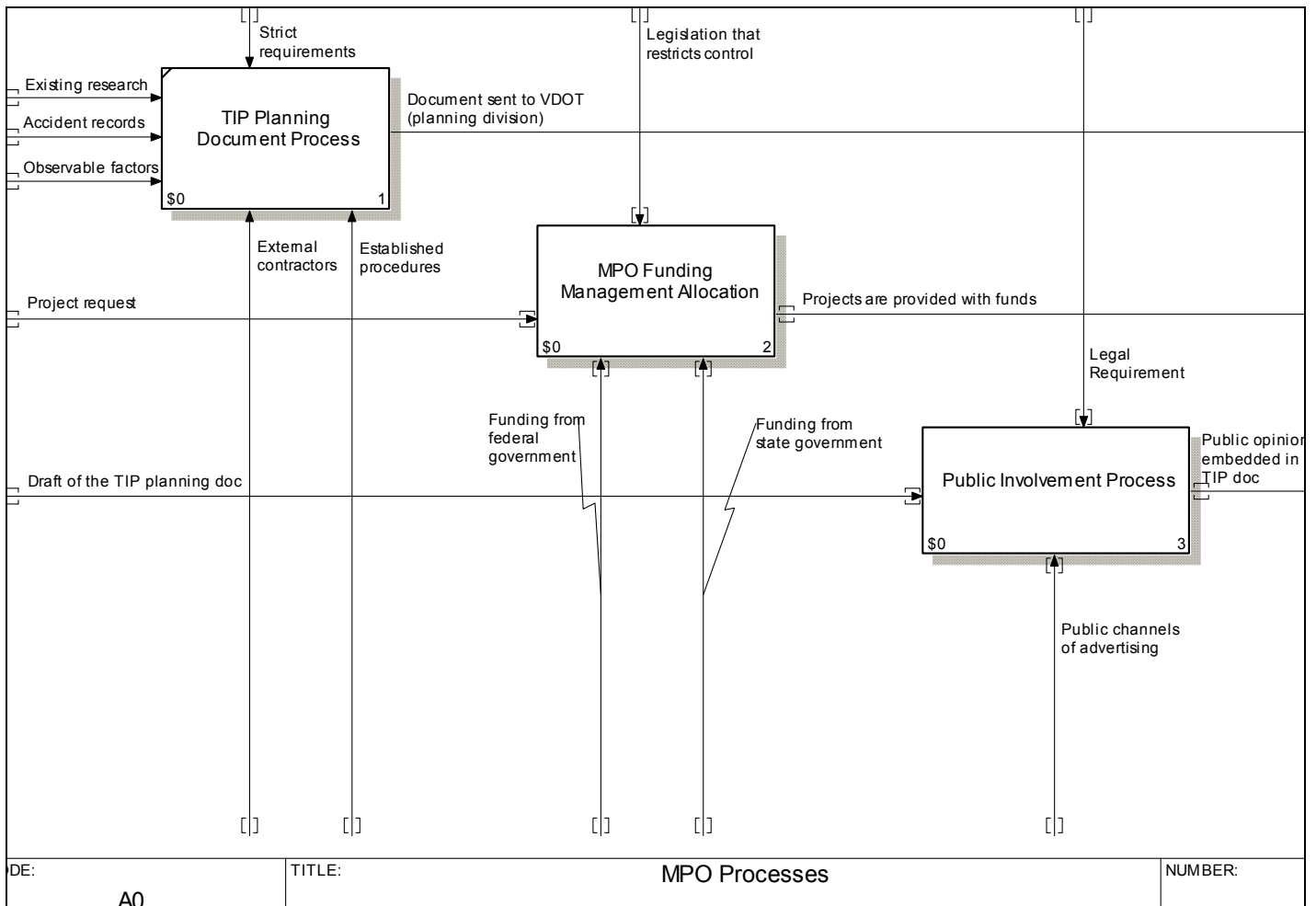
Figure E-2: IDEF0 Model of Subordinate Activities for MPO Processes.
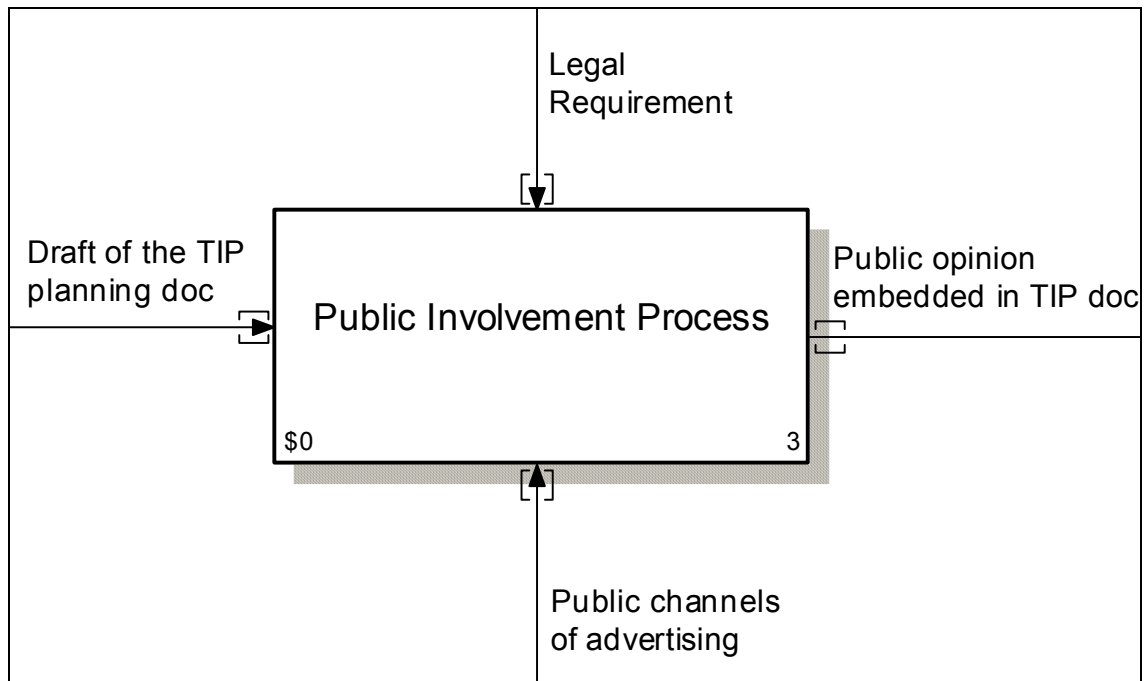
Figure E-3: IDEF0 Model Specifying Inputs, Constraints, Outputs, and Mechanisms. For the Process Detailing Public Involvement (Start from Left, Clock-Wise).

Figure E-4: Notes for Public Involvement Activity.

Results

      This section examines the results from three interviews conducted with members from different big city MPOs. It is important to note the issues MPO members face in developing the TIP documents that are later combined to form the STIP document.

      The chief results obtained from the interviews include descriptions of the main activities MPOs carry out in relation to the SYIP/STIP. These include the TIP planning document process, MPO funding management allocation, and the Public Involvement Procedure. The TIP planning document is required by state law to be submitted every year by each MPO in the State of Virginia. Most MPOs use the existing format from the SYIP to generate the TIPs since no other format has been developed for it. The inputs used in generating the TIP document include existing research, accident records, and any other observable factors that can affect the included transportation projects. Figure E-5 shows the IDEF0 model for the TIP planning document process.

USED AT: AUTHOR: Seon-Ho Choi and Isabelle Estripeaut
PROJECT: MPO Process

NOTES: 1 2 3 4 5 6 7 8 9 10

Strict requirements

Existing research

Accident records

Observable factors

TIP Planning Document Process

$0

1

Document sent to VDOT (planning division)

External contractors

Established procedures
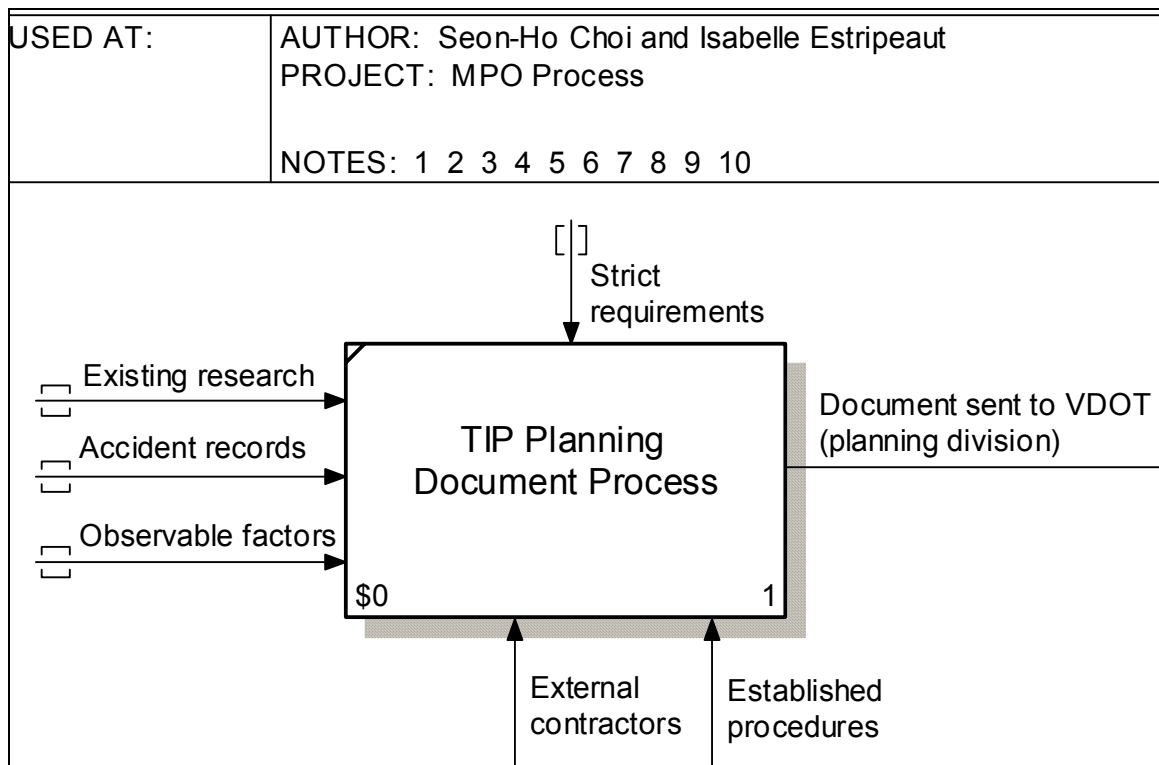
Figure E-5: IDEF0 Model for the TIP Planning Document Process.

      For the transportation projects they propose in the TIP, MPOs have two primary sources of funding, Congestion Mitigation and Air Quality (CMAQ) and Regional Surface Transportation Program (RSTP) allocation funds. MPOs only have control of between five and ten percent of the total funds they receive. Only the MPOs of the biggest areas in Virginia get RSTP funds. These areas have over 200,000 people and transportation programs managed by the Richmond, Hampton Roads, Northern Virginia, and Tri-Cities MPOs. RSTP funds provide $9-10M per year. CMAQ funds grant $3-4M per year, and only to areas that fall in the non-

attainment classification according to air quality measurements set up by the Environmental Protection Agency (EPA). The main purpose of CMAQ funds is to improve the air quality of the area. State and federal funds are also provided to very important projects. However, MPOs have absolutely no control over CMAQ funds. CMAQ funds are provided after evaluating the transportation projects presented in the STIP document at a state level. Figure E-6 shows the funding processes for the CMAQ and RSTP allocation funds.
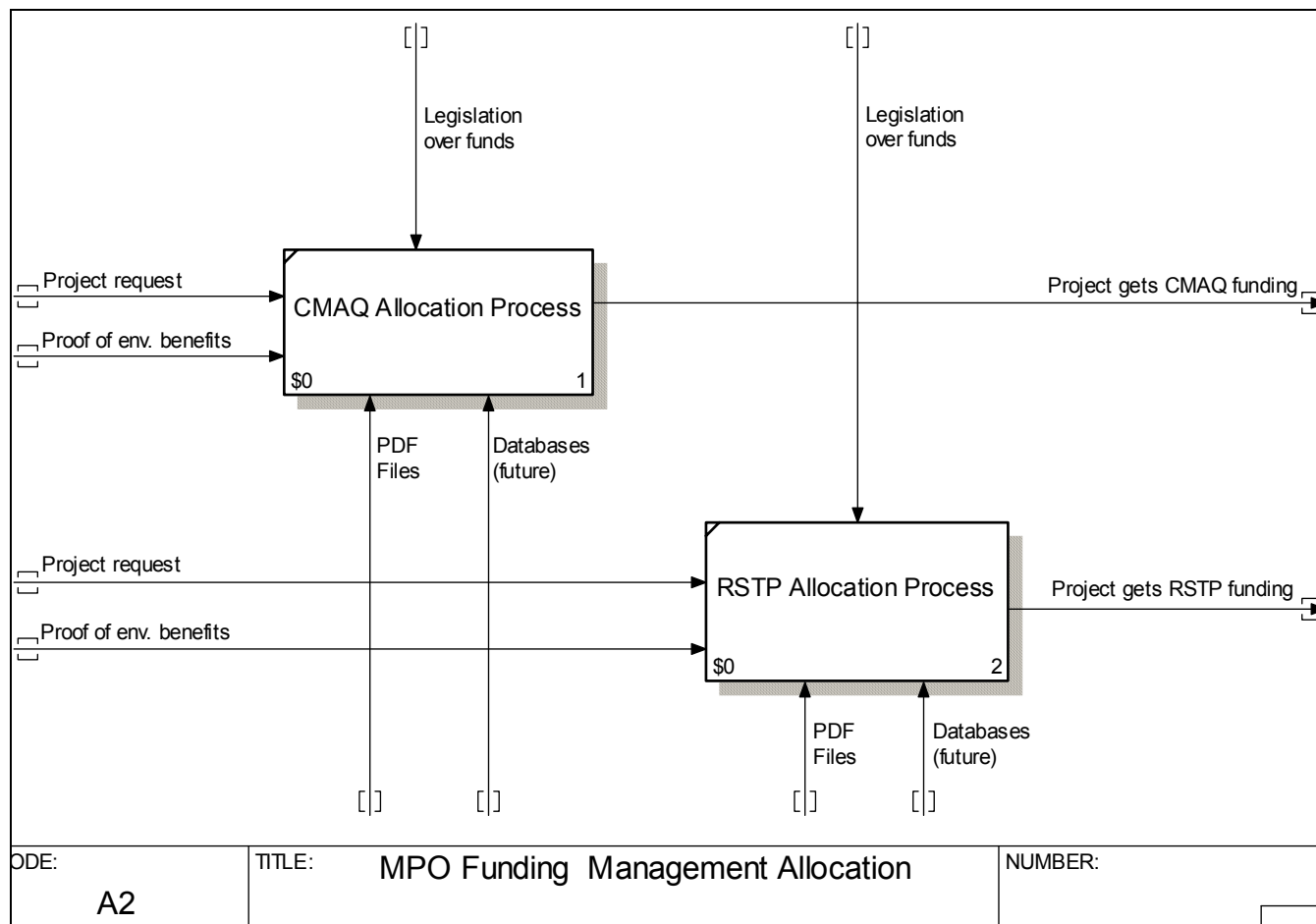
Figure E-6: IDEF0 Model of the CMAQ and RSTP Funding Allocation Processes.

The public involvement procedure requires every MPO to carry out a public hearing in a public location before it submits the TIP planning document to VDOT. The main purpose is to give a voice to the public regarding the MPO projects. The public hearing needs to be advertised in local newspapers at least 14 days before it is carried out. In addition, prior to the hearing, a draft of the TIP document has to be submitted to all the public libraries in the area, city, or district managed by that particular MPO. After the hearing, the comments submitted by the public are embedded in the TIP document. Figure E-7 illustrates the public involvement process in IDEF0 form.

ODE: A3	TITLE: Public Involvement Process	NUMBER:

In the diagram:

- Minimum advertising time
- Draft of the TIP planning doc
- **Advertisement** $0 1
- Public Awareness about Public Hearing
- Legal Requirement
- **Public Hearing** $0 3
- Comments Embedded in Final TIP doc
- Newspaper
- Minimum time requirement
- Public Understanding and Criticisms of the TIP doc
- Draft of the TIP planning doc
- **TIP Submission to Public Library** $0 2
- Public Location
- Public Library Access

Figure E-7: IDEF0 Model of the Public Involvement Process.

Discussion

This section discusses important external factors that affect the performance of MPOs in STIP-related activities along with recommendations to improve them. These issues were addressed by different big-city MPO members during three interviews. They were not included in the IDEF0 model since they are not processes, but they do affect activities that are depicted in the model.

Three of those interviewed stressed the following points, respectively:

- It is difficult for MPOs to supply all the information VDOT asks for when generating the TIP, since some of it is not accessible to them, it does not apply to their task, or is simply really hard to input in the TIP. The main problem is that MPOs do not document with a file format that is compatible with what VDOT uses to generate the STIP. In addition, valuable time is lost in reformatting files and copying and pasting information manually just to have their TIPs approved by VDOT.

- Funds for transportation projects are politicized. In other words, political representatives needed to like the projects suggested in the TIPs in order to "sponsor" them and get the necessary approval from higher authorities. The interviewee suggested that

transportation planning should be achieved through research and the use of computer programs in order to meet real needs without turning to politics. Additionally, he said that MPOs should have more authority over the planning and funding activities instead of letting funds go to local governments and having them politicized. Planners, not politicians, should gain control of federal and state money.

- Recommendations for improving the monitoring of MPOs concerned the projects the TIPs indicate should receive funding. It would be helpful to know how much money was used in carrying out each of the projects. Actually, MPOs request specific amounts of funding for their projects, but after the funding is approved they no longer know anything about the projects. For example, MPOs ignore the final sum allocated to the project,, the start date, completion date, and project stage. The interviewee also talked about the fact that VDOT has two divisions dealing with the STIP. One is the Programming Division, which deals with financial information, and the other is the Planning Division, which submits the STIP to the federal government and requires amendments to the MPOs. It would be better if one division handled everything because currently, knowledge that is required for tasks is available to only one division, and communication is inefficient. Finally, he suggested that an electronically accessible, automated, and easy-to-use format be developed for generating the TIP document.

**APPENDIX F: A TUTORIAL ON TRANSFORMING INTERVIEWS
TO THE INTEGRATED DEFINITION STANDARD:
A CASE STUDY ON
URBAN PROGRAMS**

Purpose and Overview

This appendix describes the procedures for 1) finding information on business processes related to *urban programs* through research and interviews, and 2) converting that information into the Integrated Definition (IDEF) standard. The IDEF standard is particularly useful in providing an organized structure for business process information, thus allowing users to efficiently analyze a detailed process and build a concise framework to describe it. The procedure is applied to a case study involving urban programs.

Approach

The approach to data collection is identical to the approach described in Appendix E.

Results

Detailed information was gathered about the intricacies of urban programs and how they pertain to the STIP from an interview with the urban programs manager for Hampton Roads Southside. This is a large state district that includes Chesapeake, Virginia Beach, Norfolk, Portsmouth, Suffolk, Franklin, Emporia, Smithfield, and Chincoteague, and the interview provided insightful comments on urban program business processes.

Questions asked during the interview flowed in an organized top-down fashion. First, introductory and overview questions were asked to receive background information and a better understanding of urban program processes. Next, to transition into more specific questions, the interviewee identified an outline for the activities of urban program processes. When these were established, a more detailed description of each activity was explored. Placing each activity into the inputs, controls, mechanisms, and outputs provided a systematic progression of questions as well as the groundwork for future applications of the activities into IDEF.

After collecting and gathering information by applying the business process modeling methodology to the case study of Urban Programs, a comprehensive IDEF0 model was constructed, Figure F-1. The figure shows the resulting IDEF0 model for Urban Programs. From the IDEF0 model, a user can immediately notice that there are three activities within Urban Programs denoted by the boxes. The activities under Urban Programs include preliminary engineering, right-of-way, and the contract for construction. Each activity has respective inputs, controls, mechanisms, and outputs, denoted by the arrows.

A key take-away from looking at the comprehensive IDEF0 model is the importance of the relationship among activities. From the big-picture model, a user will notice the interconnectivity among the activities as seen by the arrows. The output from the preliminary engineering activity is the input for the right-of-way activity and the outputs from the right-of-way activity are the inputs for the contract for construction activity. Essentially, as the business process within Urban Programs progresses; the activities depend on the output of their successor to function.

Another key take-away from analyzing the IDEF0 model is the role of inputs, controls, mechanisms and outputs for each activity. Each activity has the respective elements, but they are unique to the activity. The IDEF0 model presents a way to visually represent the elements associated with a given activity. From the IDEF0 model, a user can easily identify the inputs, controls, mechanisms and outputs for the preliminary engineering, right-of-way and contract for construction activities within Urban Programs.
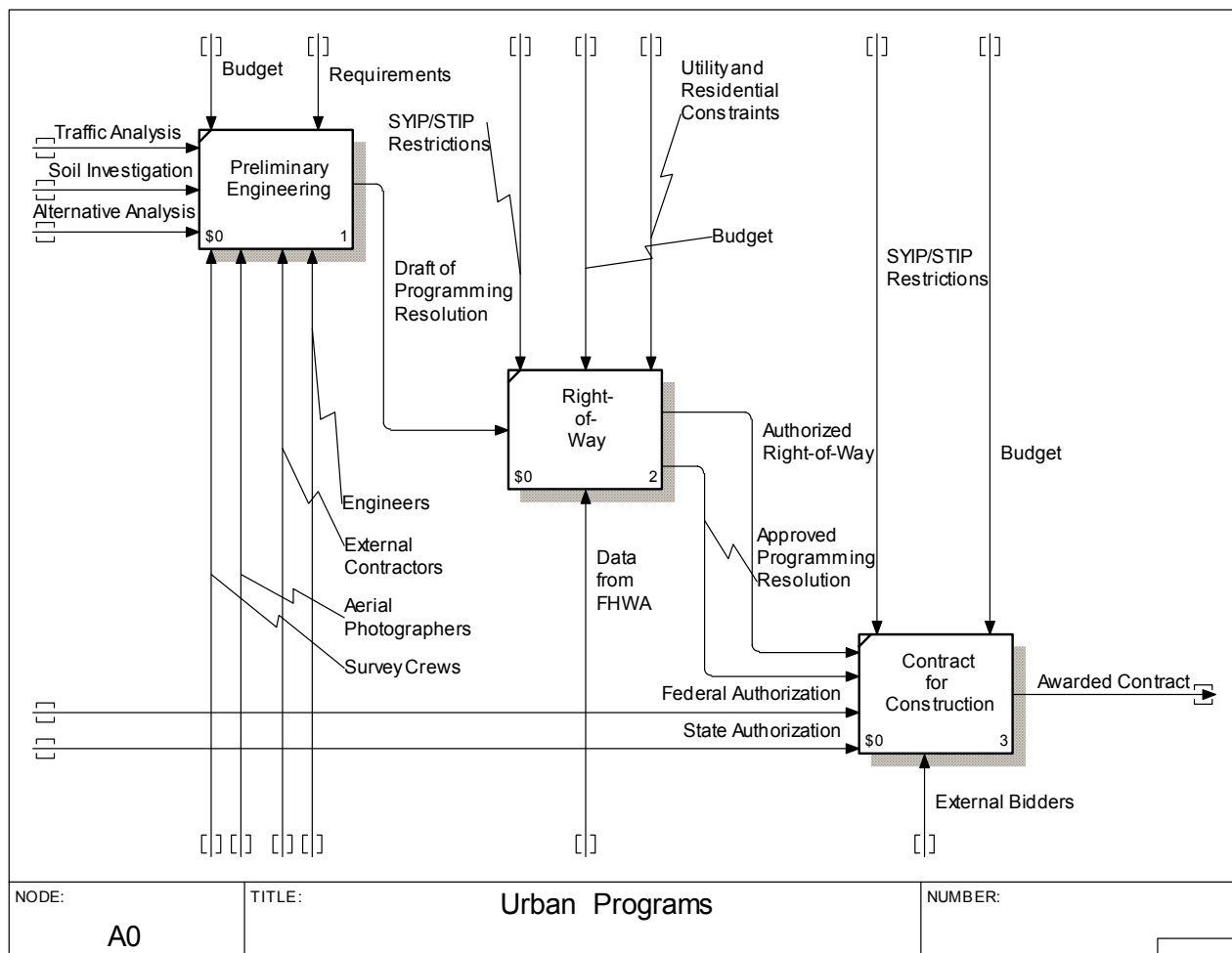
Figure F-1. Comprehensive IDEF0 Model for Urban Programs.

Discussion

The procedures described above outline a general methodology to gather business-process information and convert it into IDEF standards. The key factor is the amount of information gathered. To obtain as much information as possible, the interviewer must be persistent. Continually searching for the next interview or another resource will open doors to new information. IDEF has specific standards, but it can be applied across many applications. Gathering information that focuses on individual elements of the IDEF model aids the effort to concentrate on one application, and will ultimately lead to a comprehensive business-process model in IDEF.

**APPENDIX G: A TUTORIAL ON TRANSFORMING INTERVIEWS
TO THE INTEGRATED DEFINITION STANDARD:
A CASE STUDY ON SECONDARY ROADS**

Purpose and Overview

This appendix describes the procedures to 1) find information on business processes related to *secondary roads* through research and interviews and 2) implement that information in the Integrated Definition (IDEF) standard. The IDEF standard is used to provide an organized structure to display business-process information. It allows users to view and analyze detailed processes and build concise frameworks to describe them. Due to the impact the models may have on the Six-Year Improvement Program (SYIP) and the Statewide Transportation Improvement Program (STIP), the content of the IDEF business-process models would interest parties such as the Virginia Department of Transportation (VDOT), the Virginia Transportation Research Council, and the Center for Risk Management of Engineering Systems.

Approach

The approach is identical to the approach described in Appendix E.

Results

Figures G-1 to G-5 are the final IDEF models that were created using information obtained from interviews and documentation located on the VDOT Central Office website (CoWeb). This model provides a comprehensive overview of the activities and the requirements for each activity (Input, Output, Controls and Mechanisms).

USED AT:	AUTHOR: James J Perry	DATE: 10/1/2004	WORKING	READER	DATE	CONTEXT:
	PROJECT: Secondary Roads	REV: 10/7/2004	DRAFT			
			RECOMMENDED			TOP
	NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			

Code of Virginia
Sections
33.1-70.01

Secondary Roads Process

$0   0

| NODE: A-0 | TITLE: Secondary Roads Process | NUMBER: |

Figure G-1: First Screen for Secondary Roads IDEF0 Model.

AUTHOR: James J Perry	DATE: 10/7/2004	WORKING	READER	DATE	CONTEXT:
PROJECT: Secondary Roads	REV: 10/7/2004	DRAFT			
		RECOMMENDED			
NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			A-0

Budget
Section
33.1-23.1
COV

Secondary
Road
Requirements
33.1-23.4 COV

Advertisement
Rules

Code of Virginia
Sections
33.1-70.01

Budget
Section
33.1-23.1
COV

Secondary
Road
Requirements
33.1-23.4 COV

Board of Supervisors
Work Session

Draft of Six
Year Plan

Public Hearing

Revised Draft
Six Year Plan

Approve STIP
Recommendations

Approved Six
Year Plan

$0   1

$0   2

$0   3

Resident
Engineer

County
Staff

Board of
Supervisors

Board of
Supervisors

Resident
Engineer

Board of
Supervisors

| NODE: A0 | TITLE: Secondary Roads Process | NUMBER: |

Figure G-2: Secondary Roads Process Levels.

AUTHOR: James J Perry	DATE: 10/7/2004	WORKING	READER	DATE	CONTEXT:
PROJECT: Secondary Roads	REV: 10/7/2004	DRAFT			
		RECOMMENDED			
NOTES: 1 2 3 4 5 6 7 8 9 10		PUBLICATION			A0

Budget
Section
33.1-23.1
COV

Budget
Section
33.1-23.1
COV

Secondary
Road
Requirements
33.1-23.4 COV

VDOT
Requests

Public
Requests

Gather Requests

Recommendations
for Projects to be
included in SYIP

Evaluate Requests

Preliminary Priority
List

Draft Six Year Plan

Draft of Six
Year Plan

$0   1

$0   2

$0   3

County
Staff

Resident
Engineer

Board of
Supervisors

Board of
Supervisors

Resident
Engineer

| NODE: | TITLE: Board of Supervisors Work Session | NUMBER: |

Figure G-3: Board of Supervisors Work Session Sub-Process.

USED AT: | AUTHOR: James J Perry   DATE: 10/7/2004 | WORKING | READER   DATE | CONTEXT:
PROJECT: Secondary Roads   REV: 10/7/2004 | DRAFT
  | RECOMMENDED
NOTES: 1 2 3 4 5 6 7 8 9 10 | PUBLICATION | A0

Code of
Virginia
Sections
33.1-70.01

Draft of Six Year Plan → **Public Input** → Revised Draft Six Year Plan

$0   1

County
Citizens

[ ]

NODE: | TITLE: Public Hearing | NUMBER:
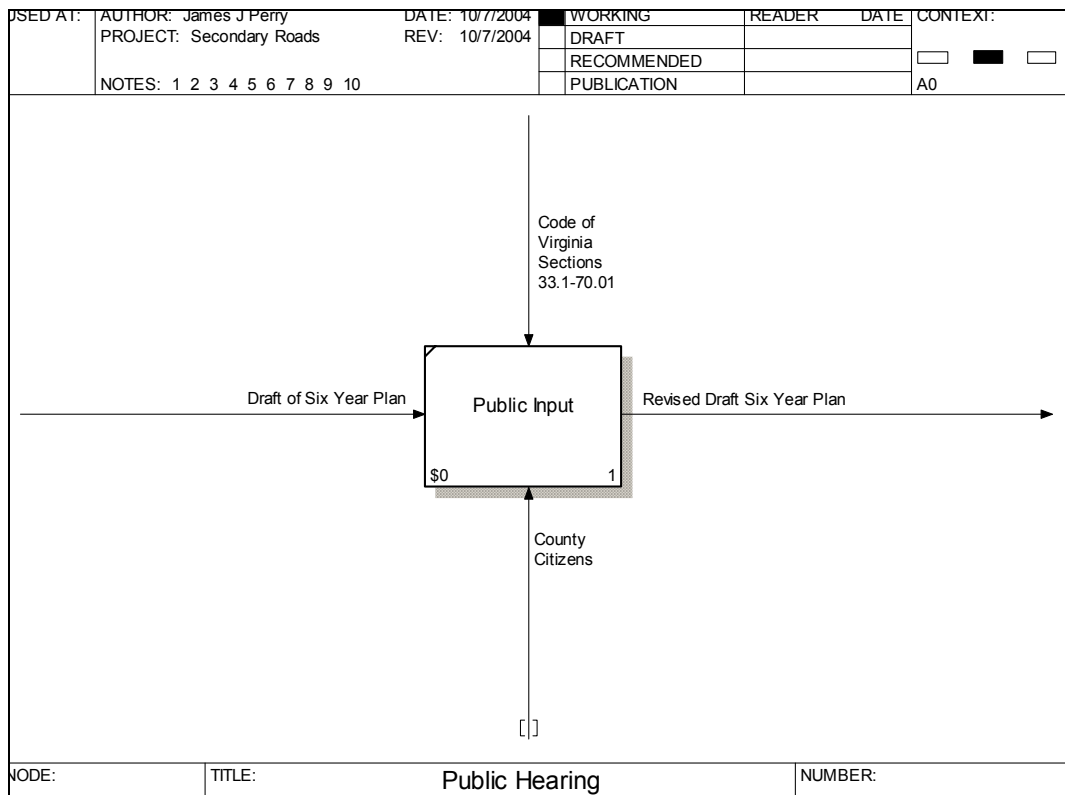
Figure G-4: Public Hearing Sub-Process.

USED AT: | AUTHOR: James J Perry   DATE: 11/8/2004 | WORKING | READER   DATE | CONTEXT:
PROJECT: Secondary Roads   REV: 5/11/2005 | DRAFT
  | RECOMMENDED
NOTES: 1 2 3 4 5 6 7 8 9 10 | PUBLICATION | A0

Budget
Section
33.1-23.1
COV

Secondary Road
Requirements
33.1-23.4 COV

Revised Draft Six
Year Plan → **Sign Approved Plan** → Signed SYIP → **Send Copy to District and SR Division** → Signed SYIP → **Notify SR division via E-mail of Submission to SRD Server** → Approved Six Year Plan

$0   1 $0   2 $0   3

County
Administrator,
Chairman, or
BOS

Board of
Supervisors

Board of
Supervisors

[ ]   [ ]

NODE: A3 | TITLE: Approve STIP Recommendations | NUMBER:

Figure G-5: STIP Recommendations Approval Sub-Process.

Discussion

       The above diagrams are the final outputs for the secondary road business process. These models meet the requirements of the IDEF0 standard. Figure G-1 is the introductory screen. Figure G-2 is a high-level view of the processes that are involved in creating secondary roads recommendations. These low-level processes are the board of supervisors work sessions, public hearings, and approval. The final three figures, (G-3-G-5), are the low-level processes. These figures indicate how each of the main processes is completed.

**APPENDIX H: A TUTORIAL ON TRANSFORMING INTERVIEWS
TO THE INTEGRATED DEFINITION STANDARD:
CASE STUDY ON VDOT'S PUBLIC INVOLVEMENT PROCESS**

Purpose and Overview

This appendix describes how agency officials can make an IDEF0 model of a process that is familiar to their field of work. It focuses on the Public Involvement Process VDOT follows before submitting the final STIP to the federal government.

Approach

To convert the information gathered from VDOT to IDEF0 models, the person responsible for creating the IDEF0 model should closely examine the tasks to be modeled together with the officials that execute those tasks. Interviews could be held to examine each task so that the model accurately represents the agency's procedure.

Step 1:
The modeler names the activities that compose the process.
<u>Process 1</u>
Public Involvement Process, composed of the following tasks:
- – Advertising period
- – Public hearing
- – Comment-posting
- – Submission of the STIP for public review
- – Submission of the final STIP
- – Public notice of final STIP

Step 2:
The modeler provides a description of each activity with known details.
<u>Advertising period</u>
- • Advertising requirements for VDOT:
  - – 30 days in advance
  - – 1 week before the hearing
- • Mechanisms used for advertising:
  - – Newspapers
  - – TV
  - – Radio
  - – Kiosks
  - – Internet

<u>Public Hearing</u>
- • VDOT or DRPT presents STIP projects in a public location
- • Information is provided on how to make follow-up comments
- • VDOT submits a draft of the STIP for public revision
  - – VDOT and DRPT offices
  - – Public libraries

<u>Comment-Posting</u>
- • Comments from the public hearing:
  - – Posted on VDOT's and DRPT's website
  - – Evaluated and embedded in the STIP

STIP Public Review
- Draft of the STIP:
  - Submitted for public review
  - Access in public libraries and VDOT and DRPT offices
- Citizens submit comments

Final STIP
- Corrected version of the STIP based on the comments made by the public
- Formatted to fit federal requirements
- Submitted to USDOT
- Submitted for public access

Public Notice of Final STIP
- The public can access the final STIP for personal reference
- VDOT and DRPT use newspapers and their websites to announce the final STIP

Step 3:
The modeler builds the IDEF Worksheet described in Appendix B.

Step 4:
Then the modeler should build the IDEF0 models of each activity by separate functions, as in Figures H-1 through 4.
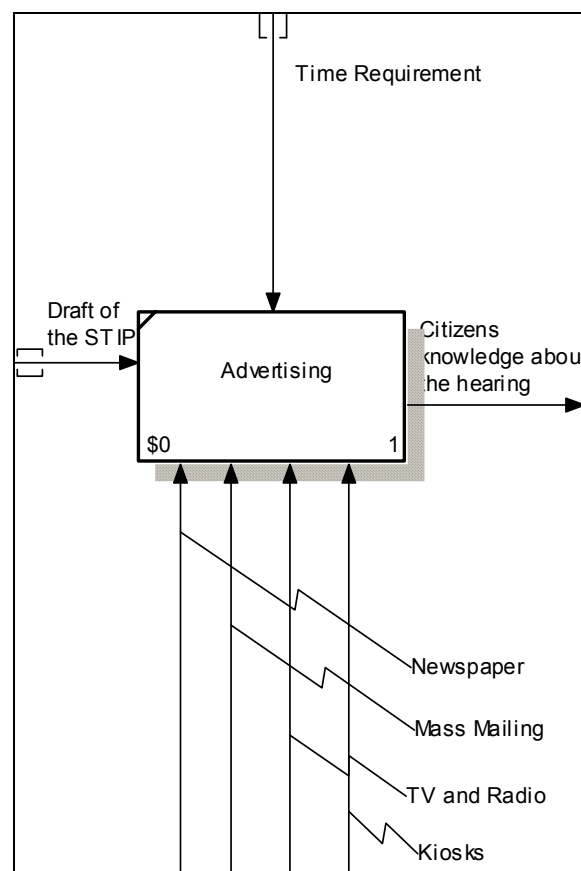
Figure H-1: IDEF0 Model of Advertising Activity.
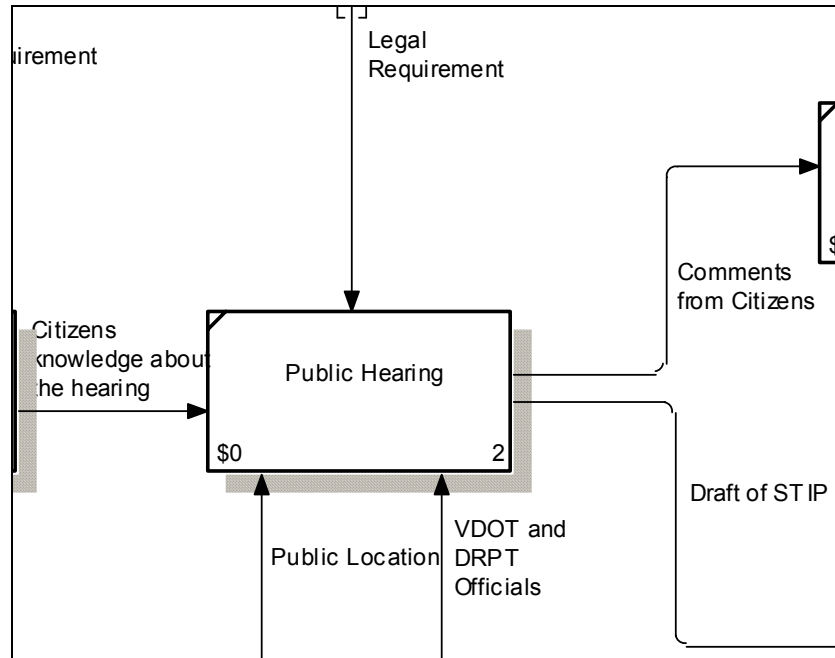
Figure H-2: IDEF0 Model of the Public Hearing Activity.
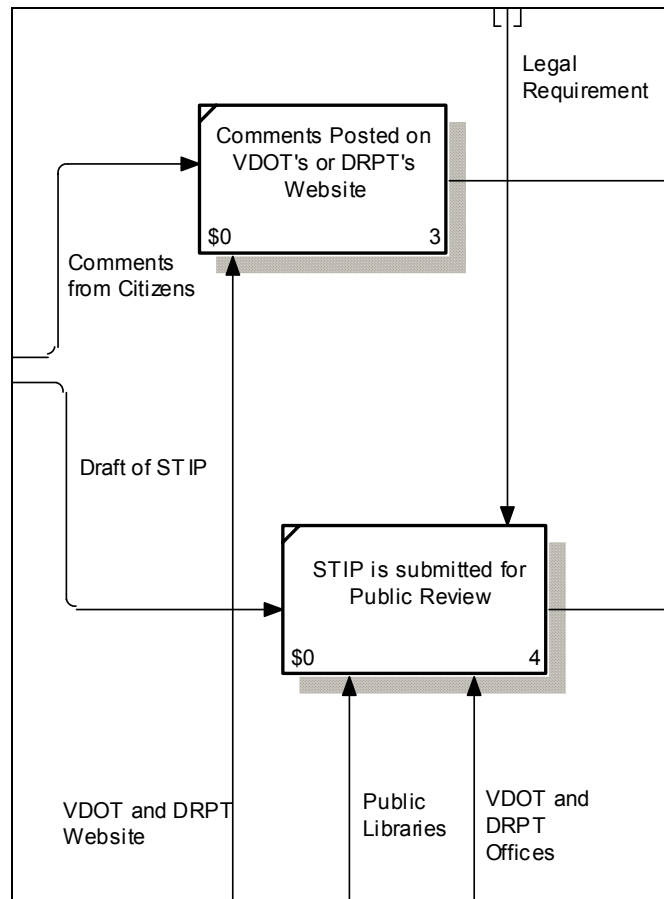
Figure H-3: IDEF0 Model of the Comment Posting and STIP Submission Activities.

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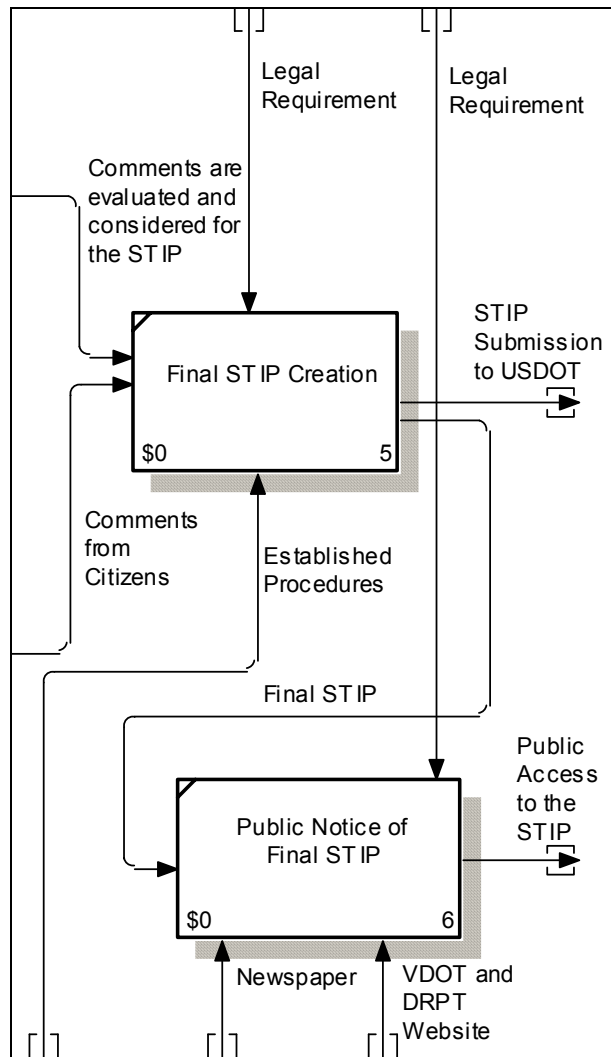
Figure H-4: IDEF0 Model of the Final STIP and Public Notice Activities.

Step 5:
Connect all of the separate IDEF0 models of the activities shown in Figures H-1-H-4. Frequently, the outputs of some activities are the inputs for others. Describe this in the IDEF0 model with connecting arrows that name each activity's outputs and inputs. Figure H-5 shows how every activity in the public involvement process relates to each other, depicting the workflow across the process.

| DE: | | TITLE: | VDOTs Public Involvement | | NUMBER: | |
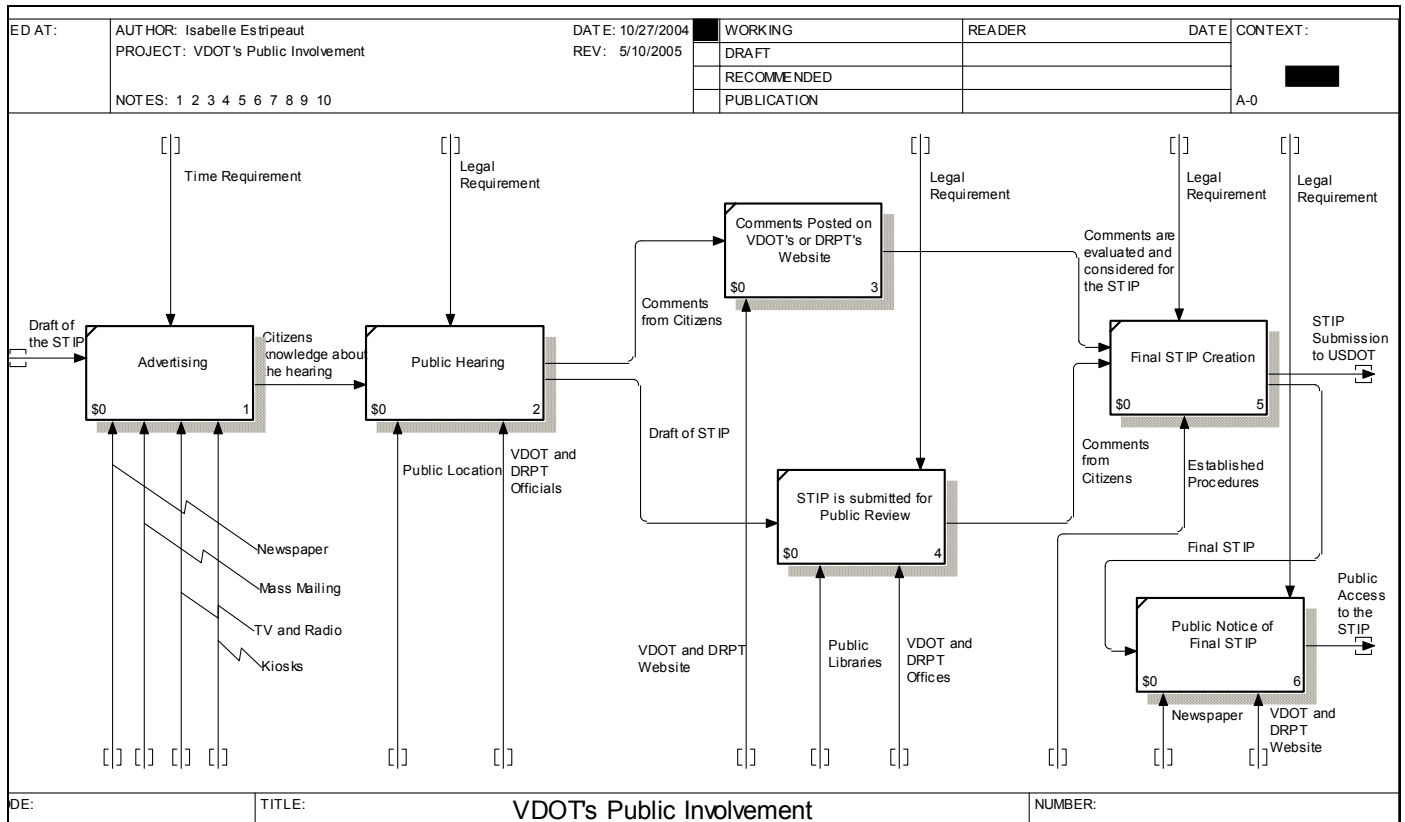
Figure H-5: IDEF0 Model of VDOT's Public Involvement Process.

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**APPENDIX I: LOCATING THE STATEWIDE TRANSPORTATION
IMPROVEMENT PROGRAM (STIP) AND THE
SIX-YEAR IMPROVEMENT PROGRAM (SYIP)
BUSINESS-PROCESS EFFORT
ON VDOT'S CENTRAL OFFICE WEBSITE (COWEB)**

Purpose and Overview

This appendix surveys the VDOT internal website and identifies where the STIP/SYIP-related business process models can be found in the central office website.

Approach

To better understand the SYIP/STIP business processes the VDOT internal website (CoWeb) was surveyed. Central office websites may be found on the lower left side of the main web page: COWEB http://coweb/main.html.

Results

The survey of COWEB found existing business models in the Environmental Division website <http://coweb/environmental>. Following are individual website addresses:
- Air Section Conformity Analysis Process
  <http://coweb/environmental/Airnoiseweb/air/Forms/conformity%20analysis%20process%20revised.pdf>
- Air Section Project Level Process
  <http://coweb/environmental/Airnoiseweb/air/Forms/project%20level%20process%20revised.pdf>
- Agricultural & Forestal District Conversion Process
  <http://coweb/environmental/District_Programs/Documents/AFD%20Flow%20Chart.pdf>
- Aquatic Ecology
  <http://coweb/environmental/Business%20Process%20Models/process%20models/aquatic%20ecology.htm>
- Noise
  <http://coweb/environmental/Airnoiseweb/noise/Noisechartandtext.htm>
- Erosion & Sedimentation Deficiency Advisory Process
  <http://coweb/environmental/Business%20Process%20Models/process%20models/E&S%20Deficiency%20Advisory%20Process.htm>
- Erosion & Sedimentation Control Recipient Process
  <http://coweb/environmental/Business%20Process%20Models/process%20models/ECR%20Recipient%20Process.htm>
- National Environmental Policy Act (NEPA) Documents
  <http://coweb/environmental/Business%20Process%20Models/process%20models/nepa.htm>
- State Environmental Review Process (SERP)
  http://coweb/environmental/Business%20Process%20Models/process%20models/SERP.htm
- Hazardous Materials Review
  <http://coweb/environmental/Business%20Process%20Models/process%20models/Hazmat%20Process%20final.htm>
- HAZMAT Lead and Asbestos
  <http://coweb/environmental/Business%20Process%20Models/process%20models/HazMat%20Lead%20and%20Asbestos.htm>

- Cultural Resources
  <http://coweb/environmental/Business%20Process%20Models/process%20models/cultur
  al%20resources%20final%20rev.htm>
- 4f<http://coweb/environmental/Business%20Process%20Models/process%20models/4f.htm>
- Partnering Processes Flow Chart
  <http://coweb/environmental/Business%20Process%20Models/process%20models/partne
  ring.htm>
- PS&E Re-Evaluation Flow Chart
  <http://coweb/environmental/District_Programs/Documents/PS&EFlow.doc>
- ROW Re-Evaluation Flow Chart
  <http://coweb/environmental/District_Programs/Documents/rwreeval2.ppt>

Several of the business process models and flow charts found in the environmental division website are given below. More of these can be found at the links given above. Figure I-1 shows the flow chart for the partnering processes and Figure I-2 is the flow chart for the hazardous materials review process.

Partnering Processes

Identify projects for which partnering is required. (EIS's or EA's w/ federal water quality permits

↓

Schedule meeting with FHWA, EPA and Corps of Engineers

↓

Prepare presentations, agenda, diagrams, etc.

↓

Conduct meeting.

↓

Prepare minutes, compile comments from agencies.

↓

Adjust project as necessary

↓

Is another meeting necessary?

YES → (back to Schedule meeting)

NO

↓

End

Note concerning partnering processes:

Partnering is "required" for projects involving an EIS, or if it req an EA and a d a federal water quality permit. There are typically three meetings, but the # of meetings varies by project. Partnering ends before the the Draft EIS is approved.

Legend

- ☐ Process
- ☐ Document
- ▱ Data
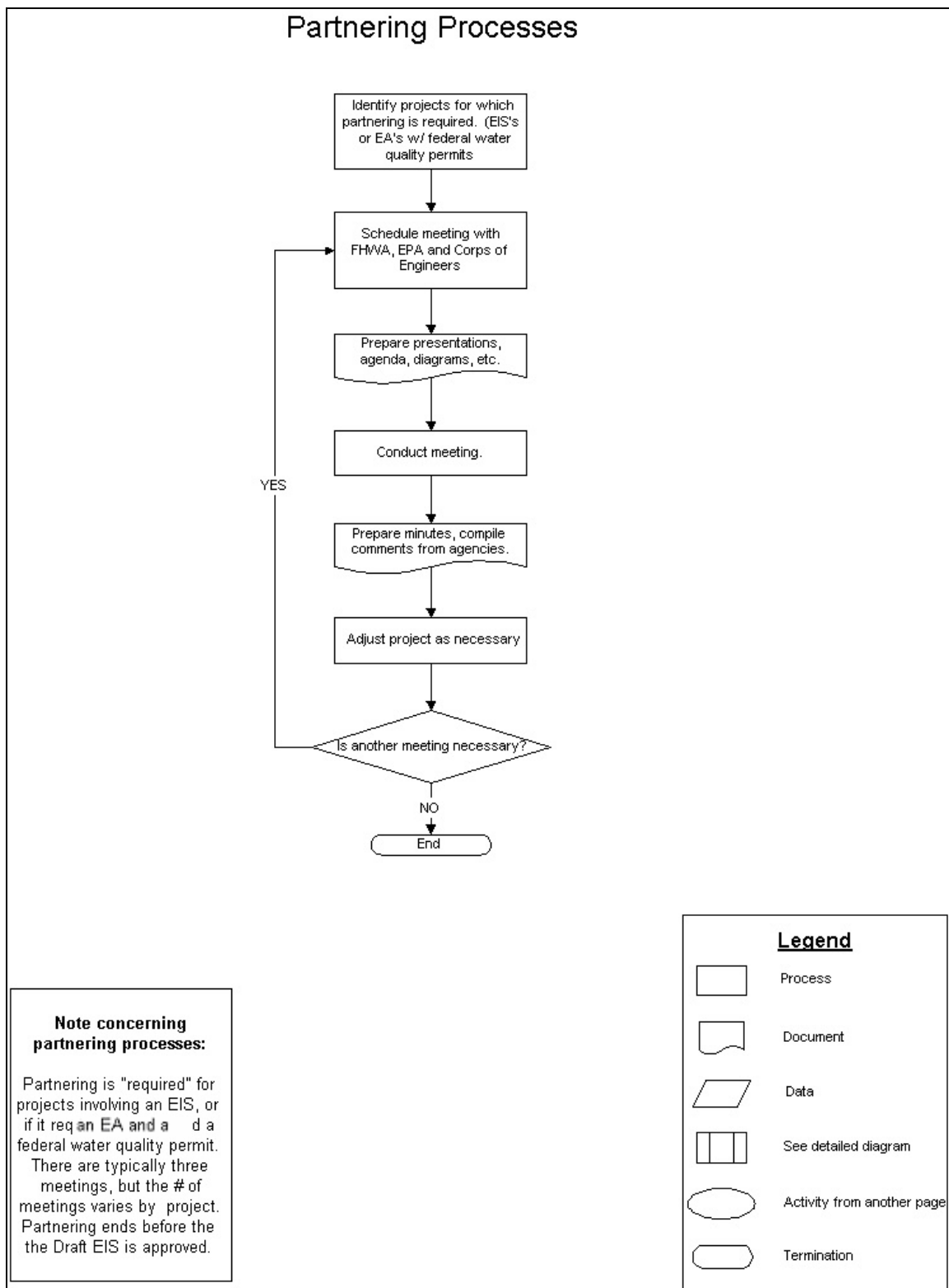- ☐ See detailed diagram
- ◯ Activity from another page
- ◯ Termination

Figure I-1: Work Flow Chart for Partnering Process.
<http://coweb/environmental/Business%20Process%20Models/process%20models/partnering.htm>

Hazardous Materials Review Process

Process Triggers

- Preliminary Field Inspection in SERP
- NEPA document scoping meeting
- Permit Determination
- Query of PPMS

Legend

Shape	Meaning
▭	Process
⬟	Document
▱	Data
⬭	Activity from another page
⬯	Termination

Process flow:

HazMat investigation triggered → Request / Review Plans → Plans indicate need for assessment?

- YES → Preliminary Assessment / Site Investigation (Assessment)
- NO → Field Review of Site or Corridor → Further Study needed?
  - YES → Preliminary Assessment / Site Investigation
  - NO → Clear Project → Recommend ROW Acquisition → End

If work done by a consultant, these phases may be distinct.

Relevant contamination found?
- NO → Clear Project
- YES → Prepare cost to cure estimates → Are there feasible avoidance / redesign / minimization alternatives?
  - YES → Coordinate with Design and ROW
  - NO → Owner cleanup option available?
    - YES → Owner performs cleanup → Is remediation still required?
      - NO → End
      - YES → Go to Page 2
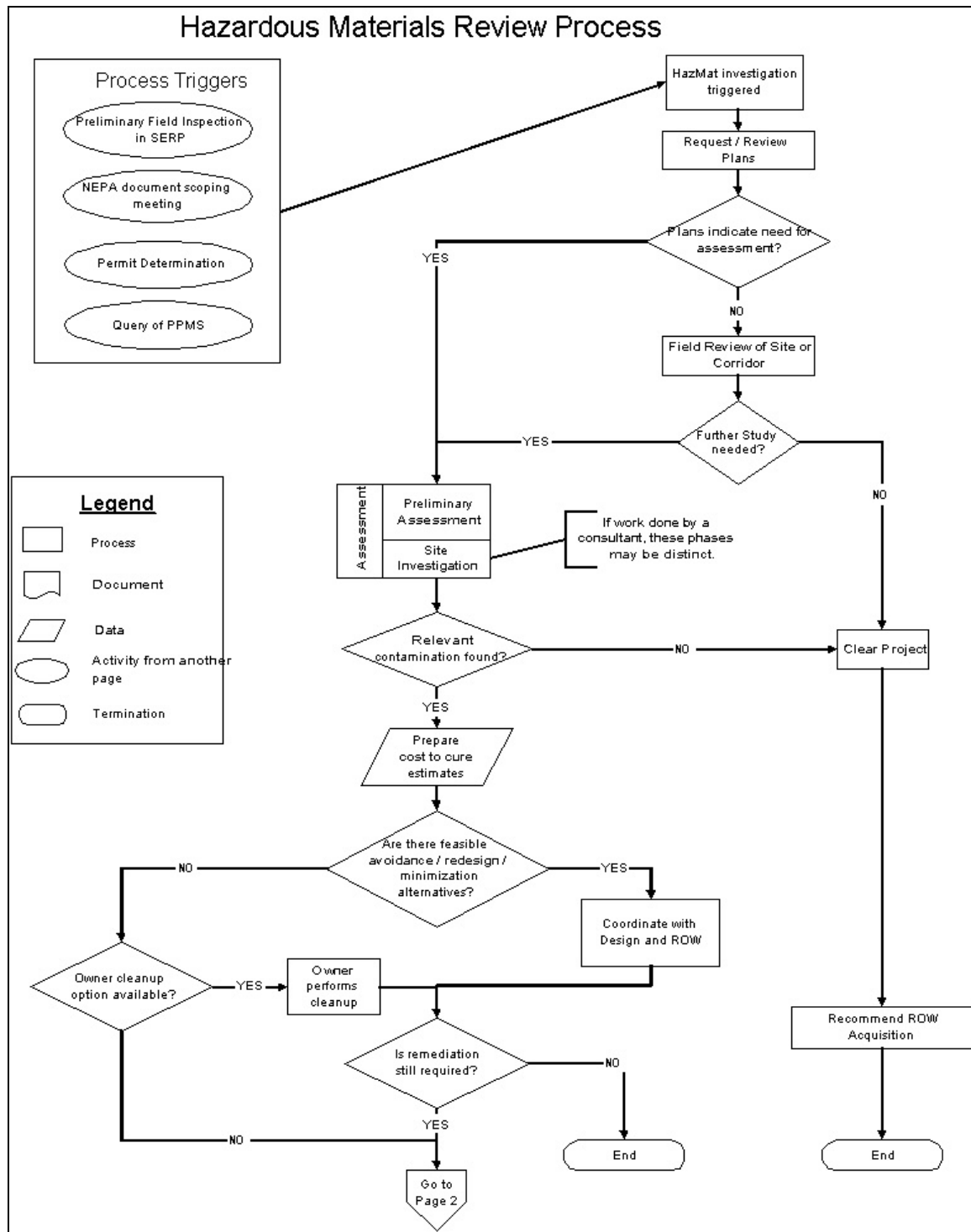   - NO → Go to Page 2

Figure I-2: The Work Flow Chart for the Hazardous Materials Review Process.

<http://coweb/environmental/Business%20Process%20Models/process%20models/Hazmat%20Process%20final.htm>

**APPENDIX J: SOFTWARE PACKAGES RELEVANT TO FUTURE AUTOMATION
OF STIP PROJECT MANAGEMENT**

Purpose and Overview

This appendix identifies software applications useful in replacing existing IDEF-described *mechanisms.*

Vendors

Hummingbird Ltd.

Hummingbird Ltd (www.hummingbird.com), a leading global provider of enterprise software solutions, provided software for the project. Enterprise content management (ECM) solutions allow customers to manage the entire lifecycle of enterprise content from creation to disposition.

Kofax

Kofax is the world's leading provider of information capture solutions (www.kofax.com). Their products accelerate business processes by collecting paper documents, forms, and e-documents, transforming them into accurate, retrievable information, and delivering it into your business applications and databases.

Adobe

Adobe helps people and businesses communicate better through its world-leading digital imaging, design, and document technology platforms for consumers, creative professionals, and enterprises (www.adobe.com).

FileNet

FileNet Corporation helps organizations make better decisions by managing the content and processes that drive the business (www.filenet.com).

Document Management Software

Hummingbird DOCS Open® (Document Management System)

The DOCS Open® software has the following features:
- It is a document management solution that enables organizations to effectively and efficiently manage the entire information chain.
- It allows users to control, organize, access, and share vital corporate information quickly, easily, and accurately.
- Word-processing documents, spreadsheets, presentations, forms, images, e-mail messages, and any other type of file that needs to be saved, secured, and archived are managed within the DOCS Open® document management environment.

The DOCS Open® document management software can be used to enhance transparency between different divisions within VDOT. It may be used to control, organize, access, and share the essential information.

Kofax Ascent Capture

The software Ascent Capture has the following features:
- It accelerates business processes by collecting paper documents, forms, and e-documents, transforming them into accurate, retrievable information, and delivering it all into business applications and databases.
- It allows remote offices to scan documents directly into the central Ascent Capture process for release into a back-end enterprise system.
- The software's powerful forms-processing modules can extract information from the most difficult documents, to postal mail scanning, to microfilm archiving for long-term records retention.
- The software delivers information into workflow and content management systems via releasing modules written in Visual Basic.

Kofax Ascent Capture is a very basic software, allowing users within VDOT to submit all hardcopy information into the database. Different districts have different documentation formats. This program would allow VDOT to transform the information into a unique format that can be viewed and accessed by any other division. The software would allow VDOT to deliver information into workflow and content management systems.

Adobe Acrobat Capture Cluster

Acrobat Capture Cluster software has the following features.
- It accurately performs optical character recognition (OCR).
- The software takes advantage of advanced page layout and content recognition.
- It cleans up your images before applying recognition.
- It chooses the output file format that best suits your requirements.
- The scalable architecture ensures productive document processing for low- or high-volume requirements.
- It can easily integrate with existing software.
- The software finds flexible scanning and files input options.

Adobe Acrobat Capture Cluster is very similar to the Kofax Ascent Capture software. It may be used by VDOT to submit all hardcopy information into the database and to format the data to suit the user's specifications.

Planning and Programming Software

Hummingbird Enterprise 2004 – Workflow software has the following features.
<u>*For End Users:*</u>
- It initiates processes from within the Enterprise WebTop.
- It can receive assigned tasks and related content in a choice of interfaces—via e-mail, browser, instant messaging alert, mobile device, or WebTop.
- The user can be alerted to overdue, incomplete, and escalated tasks and delegate in one click if permitted to do so as part of the job.

For Administrators:
- The software can easily define graphical workflows by means of dragging and dropping steps, setting conditional branching logic, escalations, and business rules.
- It can quickly simulate process successes and failures during the design stage.
- The user can monitor status at a glance directly from a Web browser with graphical snapshot views of all processes.
- The user can include partners, suppliers, and other external participants without need for training.
- The user can make rapid adjustments or enhancements to business processes as demanded.

For Organizations:
- Organizations can move content through creation, approval, and publishing lifecycle stages more quickly and consistently.
- All information, content, and metadata related to processes can be maintained in a secure repository.
- The users can react quickly to opportunities, customer requests, and changing market conditions.

The Hummingbird Enterprise 2004 Workflow software can be used by VDOT to coordinate planning and programming efforts. The software enables the user to view the workflow and be aware of all the tasks within different processes.

FileNet Compliance Framework software is designed to help manage critical document lifecycles, enforce and monitor processes for compliance, and respond to audits and inquiries. It has four components:
- *FileNet Business Process Manager* is designed to automate, integrate, and optimize business processes to ensure continuous regulatory compliance and maximum operational efficiency.
- *FileNet Content Manager* offers support for content critical to compliance initiatives through a single, integrated, scalable repository.
- *FileNet Records Manager* is designed to support the entire record lifecycle, enabling companies to organize, store securely, retrieve quickly, and dispose of records as required by legislation.
- *FileNet eForms* is designed to provide everything needed to easily design, deploy, and process electronic forms across the enterprise to speed business decisions, reduce costly errors, and streamline operations.

FileNet Compliance Framework has the following features. It:
- helps to reduce and manage risk to avoid shutdowns, penalties, and legal action,
- drives proactive and immediate response to material events,
- provides greater visibility and control of business processes and related information,
- improves the security and privacy of information,
- provides monitoring and reporting capabilities for auditing purposes, and
- delivers maximum flexibility and agility to better respond to the changing regulatory environment.

Business Process Manager

FileNet Business Process Manager is used to develop business process models. It increases process performance, reduces cycle times, and improves productivity. This software automates, streamlines, and optimizes complex processes by managing the flow of work throughout the enterprise. It has the following features:

- increases agility and accelerates responsiveness to business or transaction events,
- optimizes operational efficiency and resources utilization,
- enforces corporate standards and improves process consistency,
- shortens process cycle times while enabling better decisions, and
- reduces the complexity of integrating people, processes, and existing systems.