ABSTRACT

State transportation agencies depend on advancements in information technology to help manage the billions of dollars spent on thousands of construction projects every year. As transportation planning and programming become increasingly complex, communication among different divisions of the agencies is becoming even more important. This paper describes an effort to apply business process modeling to aid the integration of planning and programming of construction projects for a state transportation agency, metropolitan planning organizations, and related agencies. Business process models are developed according to the IDEF modeling standard that is used in Computer Associates AllFusion Process Modeler. IDEF modeling provides structured documentation about the processes of the agency while improving the transparency and validity of agency activities. Furthermore, IDEF modeling helps to determine bottlenecks in the current processes and supports the prioritization of investments in reengineering and associated information technologies. IDEF modeling enables employees at different levels of the agency to understand the business processes of their professional colleagues. Several lessons of the effort are as follows. (i) IDEF modeling can be translated efficiently to simulation models that provided increased detail of critical activities. (ii) The use of information technology is recommended to provide for real-time monitoring of selected planning and programming activities. (iii) Sources of risk to various agency activities need to be modeled explicitly by theoretical extension of the current IDEF methodology. Numerous examples and case studies are provided in the paper. This effort was supported in part by the Virginia Department of Transportation and the Virginia Transportation Research Council.

1 INTRODUCTION

In the automation of many business processes, the information technology divisions of transportation agencies are facing the development and maintenance of information technology applications that are in need of priority setting and resource allocation. Development of business process models can support the agencies in making decisions about what systems have the greatest impact relative to their required investments of resources.

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

This paper contains the following sections: Background, Methodology, and Demonstrations on metropolitan planning organizations (MPOs), urban programs, and secondary roads. The next section is an overview of the technical extensions of business process modeling for simulations and commercial off the shelf software. The final section provides a conclusion and outlines future work recommendations.
2 BACKGROUND

This section contains a background of IDEF, MPOs, VDOT, STIP/SYIP, and previous efforts with business process modeling for VDOT.

VDOT is currently responsible for transportation planning, managing finances, conducting research and development, improving systems operations, examining environmental impacts, and implementing projects. VDOT also interacts with the federal government, the Virginia state legislature, third-party organizations, external contractors, and the public. These complexities pose a major problem for both employees within VDOT and the general public who use traffic systems.

There are two programs within VDOT that serve as big contributing factors to the complexities in the proposal process: the Six-year Improvement Program and the State Transportation Improvement Program. SYIP is an annually-updated state program that determines how funds will be allocated in the next six fiscal years, while STIP is an annually-updated program that the federal government maintains in Virginia. Funds for a given project can come from either the federal government or the state government, so it is important for VDOT to keep track of all transportation projects (SYIP 2004).

MPOs are defined as organizations that have been entrusted by law to take the lead responsibility for developing urbanized areas with populations of 50,000 or more people (Transportation Equity Act for the 21st Century). An MPO is involved in processes such as 1) creating the planning documents for various transportation projects in a given locality, 2) allocating funds received directly from the federal government, and 3) interacting with local governments and the general public to address specific needs in the immediate areas. In the state of Virginia, there are 11 MPOs that represent the most populated areas (Hampton Roads Planning District Commission 2003, Deloitte & Touche 2004).

Although there have been several attempts to create a standard for developing business process models, the most successful one thus far is the integrated definition (IDEF) standard. Most of the recent development of IDEF has been by commercial companies such as Knowledge Based Systems and Computer Associates (DeWitte et al. 1992). Since the introduction of IDEF, a variety of different types of modeling methodologies have been created as extensions from the original standard to describe different aspects of business processes. This effort specifically used the IDEF0 methodology with the AllFusion software suite from Computer Associates to create the business process models.

IDEF has a long history that originated with the U.S. Air Force in the 1970s. One division in the U.S. Air Force, the Integrated Computer-Aided Manufacturing (ICAM) program, sought to increase manufacturing productivity through systematic application of computer technology. The ICAM program identified the need for better analysis and communication techniques for those involved in the industry (IDEF0 Report, 1993).

As a result, ICAM developed IDEF, which came in three different types: IDEF0 as a functional model, IDEF1 as an information model, and IDEF2 as a dynamics model. In 1983, the U.S. Air Force Integrated Information Support System program enhanced IDEF1 by creating IDEF1X, which allowed for more sophisticated data modeling. Currently, IDEF0 and IDEF1X techniques are the most commonly used techniques for supporting modeling efforts in the government and commercial sectors (IDEF0 Report 1993, Transportation Equity Act 1998).

There are two major growth areas for the future of IDEF. The first area deals with incorporating IDEF technology with other emerging Internet technologies, while the second area deals with incorporating simulation technologies. It is important to investigate growth areas because they help lay the framework for seeing why IDEF modeling will benefit VDOT.

To examine the reason to incorporate IDEF with Internet technologies, it is important to investigate how IDEF originally started. IDEF was developed for creating general systems that could be understood by multiple parties such as the U.S Air Force, the Department of Defense, and defense contractors (DeWitte et al. 1992). IDEF is now shifting towards utilizing process modeling techniques that incorporate Java and Open Database Connectivity. This shift allows the IDEF standard to be versatile across various computing environments, which helps IDEF continue achieving the goal of creating general systems that can be easily understood by multiple parties.

The second major growth area is to incorporate elements of simulation into business process modeling. There is a need to build web-based simulation systems that allow ad-hoc process models to be built and simulated (Ding et al. 2003). Further, simulation provides an efficient methodology for finding bottlenecks in business processes and provides potential for cost savings, since various process changes can be examined without having to actually implement each change (Peters et al. 1997).

The Department of Systems and Information Engineering (SIE) at the University of Virginia charged a Capstone group in 2003 to address the issue of creating more efficient processes of a transportation agency of planning and programming. The group started examining the business processes by interacting with agency managers involved in process reengineering and by evaluating commercial software that builds business process models (Jennings 2004, Issadore et al. 2004). Most recently, the 2004-2005 SIE Capstone group interacted in greater depth with agency managers to explore additional business processes and used the software to build the appropriate process models. The additional business processes examined...
were those involved in planning and programming with secondary roads, urban programs, and MPOs.

3 METHODOLOGY

This section describes the methodology used to create business processing models for the business processes of the SYIP/STIP.

The business process modeling methodology formulated in this paper encompasses gathering and organizing information about the business process of a transportation agency, creating an IDEF0 model based on the information, demonstrating the application of creating an IDEF0 model of the business process to other business processes of the SYIP/STIP, and publishing the findings and methodology.

A general approach to gather necessary information and mapping that information into IDEF0 that can be applied to a business process of a transportation agency is as follows:

1) Prepare a set of questions that will answer objectives described by the IDEF0 model
2) Schedule an appointment for a phone or personal interview with an upper level employee of a business process
3) Conduct the interview at the scheduled time
4) Combine interview notes with other outside information to compile a comprehensive collection of relevant information
5) Organize information into activities and respective elements described by the IDEF0 standard
6) Apply the information to the elements and create an IDEF0 model

The first step is to prepare a set of questions that will answer objectives described by the IDEF0 model. If proper preparation is taken into consideration, large amounts of time will be saved in the long run. Considering the final objectives of the IDEF0 model before preparing questions will help the interviewer form questions that merit responses for the IDEF0 model. A good approach is to look at the IDEF0 model first and then formulate questions with end result in mind. For example, the interviewer asks questions about inputs, controls, mechanisms, and outputs for specific business process activities.

The second step in the methodology is to schedule an appointment for a phone or personal interview with an upper level employee of a business process. For example, an interviewer would contact a Program Manager for a specific district.

Once a name and phone number or email address have been found, the individual conducting research must make contact with the found upper level employee. More than one call or email will most likely be made until you get a response, so persistence is crucial.

The third step is to conduct the interview at the scheduled time. The interviewee, a high level employee within the business process, has a busy schedule and will not wait to talk to someone soliciting information. Conversely, contacting the interviewee earlier than the scheduled time may interfere with the full schedule of the interviewee.

During the interview, a continuous dialogue is essential. The longer an interviewee is talking, the larger the amount of information available. Conducting successful interviews to elicit essential information requires practice.

The fourth step is to combine interview notes with other outside information to compile a comprehensive collection of relevant information. A compilation of gathered information will improve the completeness of steps involved in the business process. In addition, the information gathered in the interview can be cross referenced with outside information to confirm its validity and clear up any misunderstandings or missing parts.

The fifth step is to organize the collected information into activities with respective elements described by the IDEF0 standard. Preparing questions for the interview with activities and elements of the IDEF0 model in mind provides for a systematic organization of information. Ideally, the responses to the questions should directly map into IDEF0. However, information gathered from the interview or from outside sources may have an unclear destination in the IDEF0 model. Therefore, this information should be organized with similar existing information that has already classified. In either case, the information should be sorted into specific activities.

When organizing information into IDEF activities and the respective elements, an understanding of IDEF0 functionality must be established. As an overview of IDEF0 functionality, the elements of an activity within a business process include inputs, controls, mechanisms, and outputs. Inputs are items that are consumed or modified in the activity, such as traffic analysis, soil investigation, and information meetings. Controls are defined as constraints on the activity, such as funding, requirements, and legislation. Mechanisms are items that are used to perform the business process, but are not themselves consumed, such as files or external contractors. Outputs are results from the activity, such as the result of the finished construction project or having a path for construction clear of all utilities and private land owners. The elements of an activity in a business process detailed in an IDEF0 model are graphically represented in the following figure.
With the elements of an IDEF0 activity in mind, the gathered information from interviews and outside resources can be systematically organized. One of the most effective ways to manage large amounts of information is to organize it into a table. Table 1 shows a portion of the IDEF0 worksheet used to organize relevant information on a business process. The activities are labeled in the leftmost column, while the respective inputs, controls, mechanisms, and outputs are shown in the row of that activity.

Table 1. IDEF0 Worksheet for business process of a transportation agency

<table>
<thead>
<tr>
<th>Activity</th>
<th>Inputs</th>
<th>Controls</th>
<th>Mechanisms</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity 1</td>
<td>traffic analysis</td>
<td>budget</td>
<td>engineers</td>
<td>draft of program resolution</td>
</tr>
<tr>
<td></td>
<td>draft of program resolution</td>
<td>legislation</td>
<td>data from FHWA</td>
<td>right-of-way</td>
</tr>
<tr>
<td>Activity n</td>
<td>right-of-way</td>
<td>budget</td>
<td>external bidders</td>
<td>awarded contract</td>
</tr>
</tbody>
</table>

The sixth step is to apply the information to the elements and create an IDEF model using BPWin from Computer Associates. BPWin uses the IDEF0 standard as a specific business process modeling standard. To map the information into the IDEF0 standard, the information needs to be organized into activities, or specific tasks, and their corresponding inputs, controls, mechanisms, and outputs, as described above.

4 Demonstration

The following sections describe the results of the three demonstrations using the IDEF0 modeling methodology.

In order to better examine how business process modeling using IDEF can improve the transportation programs of VDOT, the following three demonstrations were conducted: Metropolitan Planning Organizations, Urban Programs, and Secondary Roads.

4.1 Metropolitan Planning Organizations

This section applies business process modeling to the planning and programming activities involving metropolitan planning organizations (MPOs).

Before going into the details of the Transportation Improvement Program (TIP) Planning Document process, there needs to be a brief discussion on the background of a TIP. As mentioned earlier, there is the SYIP under the state of Virginia and the STIP under the federal government. Oftentimes, these two programs are very similar to each other. To better manage all of the transportation projects in Virginia, a Transportation Improvement Program (TIP) is created for each region, which is represented by an MPO. The TIP planning document is the intermediary document used when converting projects from the SYIP to the STIP. The MPOs are responsible for the successful creation of the TIP planning documents and for the outcomes of the TIP.

The TIP planning document for each respective MPO has to be submitted every year for the state of Virginia, and each document has to follow strict requirements on what is included and the formatting of the document. In creating or modifying the document, each MPO uses existing research, accident records, and other observable factors to describe the projects. Once the TIP document is created, it is sent to the planning division of VDOT for review. Figure 2 shows the IDEF0 model for the TIP planning document process.

The MPOs bear the responsibility for determining how the TIPS are to be funded. Most of the funding for TIPS comes from federal funds allocated to Virginia through the Transportation Equity Act. In addition, funds also come from the State of Virginia, local counties, municipalities, private developers, and toll authorities. Figure 3 shows the IDEF0 model for the funding allocation process.

Lastly, the MPOs are required to involve the public by following certain procedures before submitting a TIP planning document. Since the public is ultimately funding the projects, it has a right to voice its opinions to the MPOs. Specifically, the MPOs are required to carry out hearings in public locations, advertise the hearings in local newspapers, and submit drafts of the TIP planning documents to public libraries. After the hearing on the TIP, the public has an opportunity to make comments, which are embedded into the planning document and sent along to state authorities.
4.2 Urban Programs

4.2.1 IDEF0 Model for Urban Programs

This section describes applying the business process modeling methodology to the planning and programming activities involving Urban Programs.

After applying the business process modeling methodology to the case study of Urban Programs, a comprehensive IDEF0 model was constructed. 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. Figure 5 shows that each activity has respective inputs, controls, mechanisms, and outputs, denoted by the arrows.

An important attribute of the IDEF0 model for Urban Programs 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 important attribute of the IDEF0 model for Urban Programs 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.

4.2.2 Preliminary Engineering Activity for Urban Programs

Preliminary engineering is the first activity in the business process of Urban Programs. Before breaking ground on a construction project in an urban area, preliminary engineering must take place. During preliminary engineering, a programming resolution entailing the construction project specifications is developed. The left-most activity in Figure 5 shows a view of the elements of preliminary engi-
neering that are involved in developing a draft of the programming resolution.

The inputs for preliminary engineering activity are traffic analysis, soil investigation and alternative analysis. The inputs for preliminary engineering are used to gather information on the area surrounding the proposed construction area. Consider the example of expanding a road in an urban area. Traffic analysis would need to be conducted to gather information on the number of cars and trucks that use the road in the peak hour, as well as the accident rates and daily flow rates. Soil analysis must be conducted to ensure compliance with environmental regulations. Alternative analysis is necessary to fully explore any and all other possible options of ending with the same result of the proposed project, but executed by different means.

The controls of the preliminary engineering activity are the budget and other requirements set forth by the state and federal levels. When managing the preliminary engineering activity and the involved processes, the budget must be considered. VDOT allocates a certain amount of funding to carry out the activity. The cash flow directly controls the flexibility of the preliminary engineering. Additionally, while carrying out this activity, VDOT must abide by the laws set forth by state and federal government to ensure a smooth preliminary engineering process.

The mechanisms of the preliminary engineering activity include survey crews, aerial photographers, external contractors and engineers. The mechanisms are essential to the preliminary engineering activity and are comprised of groups of people and engineers who physically collect information about the traffic, environmental and alternative analysis. Many times, the work is done in-house by VDOT employees, but hiring external contractors is not an uncommon practice.

The final result, or the output, of the preliminary engineering activity is the draft of the programming resolution. The draft of the programming resolution is made after the inputs, controls and mechanisms are assessed. After all factors are considered, the proposed construction project detailing the preliminary engineering activity is drafted and then sent to enter the right-of-way activity.

4.2.3 Right-of-Way Activity for Urban Programs

The second activity in the business process of Urban Programs is the right-of-way activity. The right-of-way activity involves the acquisition of utilities and property from private land owners that could impede the construction process. Examples of utilities and property might include telephone poles and single family homes, respectively. The acquisition process typically involves one of two things: the assessment of the fair market value for the utility or property and a settlement with the owner outside of court; or the condemnation of the property or utility via means of a lawsuit with suitable compensation represented by the fair market value. Although acquisition of property and utilities is the strong-hand method to obtain the right-of-way, VDOT employs this method only if alternative construction options are not feasible.

The center activity in Figure 5 displays a view of the right-of-way activity for urban programs. The IDEF0 model shows that the input for the right-of-way activity is the draft of the programming resolution developed in the previous activity, preliminary engineering.

The controls for the right-of-way activity are SYIP/STIP restrictions, budget and other constraints. The SYIP/STIP outlines very specific restrictions on utility and property acquisition in addition to funding allocation detailed in the budget. Additional controls on the right-of-way activity would include the local legal restrictions for utility and property acquisition.

The mechanism for the right-of-way activity is the data from the Federal Highway Administration (FHWA). The data from the FHWA could be extremely comprehensive in nature. Information on laws, restrictions, statistics, policy and other related information could be obtained from the FHWA data (United States).

Finally, when the right-of-way activity is accomplished, the outputs are an approved programming resolution and an authorized right-of-way. Once all utilities and property impeding the construction process has been acquired, the plans for the construction project can begin the next phase. With all obstructions removed, the construction project has an authorized right-of-way.

4.2.4 Contract for Construction Activity for Urban Programs

The contract for construction is the third activity in the business process of Urban Programs. Both the preliminary engineering and the right-of-way activity must be completed before the contract for construction may begin. During the contract for construction activity, the approved programming resolution for a construction project is placed on the open market to be sold to the most competitive bidder.

The right most activity in Figure 5 displays a view of the contract for construction activity and the respective elements of Urban Programs. The inputs are an approved programming resolution and an authorized right-of-way. In addition, the contract for construction must be authorized by on the federal and state levels before the activity may begin. To fully approve the contract for construction, the state and federal levels must consider the controls for the activity, which include the restrictions established by the SYIP/STIP and the monetary constraints in the budget.

External bidders also influence the contract for construction as the mechanisms for the activity. When a contract for construction is revealed to the public, external contractors will compete with each other and place bids for
the contract. Ultimately, the output of the contract for construction activity is the awarded contract for construction to the bidder who proposes to complete the project in the shortest amount of time and for the least amount of money. After the last activity in the business process of Urban Programs is completed, the construction process may begin.

4.3 Secondary Roads

This section describes the results from applying the methodology to the planning and programming activities involving secondary roads. Using the information obtained during the execution of the methodology, an IDEF0 model was created. This model consists of five levels: the top level, the secondary road process level, the board of supervisors work session level, the public hearing level and the approval level.

The secondary road six year program is created through a culmination of over 80 locally created six year programs. This model describes the process in which each of these programs is developed.

The top level of this model describes the constraints on the entire process. As seen in Figure 6, there are specific code of Virginia sections that constrain the creation of this program.

The next level of the model contains the three main activities for the secondary road six year program. These levels are the board of supervisors work session, public hearing, and approval of STIP recommendations. Each of these activities can be seen in Figure 7 and will be explained further in the following sections.

Each of the three activities contains a level of sub activities. The board of supervisors work session is the activity that gets the process moving. This activity must take place before anything else and contains the sub activities: gather requests, evaluate requests, and draft the six year plan. Each of the activities is constrained by time, money, code of Virginia regulations. The elements of the model can be seen in Figure 8.

The next level of the model is contained under the public hearing main activity. This level contains one sub activity titled “public input.” The purpose of this activity is to allow for public input on the six year plan and to attached the comments to the report for evaluation by the board of supervisors.

The final set of activities are the “Approve STIP recommendations.” This set of activities contain three different sub activities. These activities are “Sign Approved Plan”, “Send copy to district and secondary roads division” and to e-mail the secondary roads division of submission. These activities outline the controls and deliverables for the interactions between the transportation department and the localities. The three sub activities can be seen in Figure 9. Each of the activities is restricted by different controls and must be completed using different mechanisms.

Figure 6. First Level of IDEF0 Model. This is the top figure in the model

Figure 7. Second Level of IDEF0 Model. This is the second level in the IDEF model, each activity in this level has one sub level figure in the model

Figure 8. Sub Level of Board of Supervisors Work Session from Figure 7. This is the sub level of the “Board of Supervisors Work Session”.

Figure 9. Sub Level of Public Input from Figure 8. This is the sub level of the “Public Input”.
The output from this level is the final approved STIP or SYIP document that is submitted to the state.

5 TECHNICAL EXTENSIONS

This section describes technical several extensions of business process modeling. The two sub-sections provide detail on the use of software simulation in business process analysis and the incorporation of commercial off the shelf software with business process modeling.

5.1 Simulation of a business process model for a transportation agency

Computer 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. AllFusion is capable of creating models of three different types, the business process (IDEF0), process flow (IDEF3) and data flow (DFD) diagrams. The IDEF3 process flow model captures precedence and causality between activities. These models provide 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 Arena for further analysis.

An example of exporting to the simulation program has been prepared based on the Virginia Department of Transportation 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. Information from the flowchart from the VDOT memorandum, the “How a Road Gets Built Fact Sheet” from the VDOT website and an interview with a VDOT official on project development were synthesized to create an IDEF3 model.

To successfully export a model to the simulation program, the time it takes for each activity to be completed has to be entered into the IDEF3 model. User defined properties (UDPs) have to be created before translation into the simulation program. Afterwards, selecting File → Export → Arena in the AllFusion application menu quickly translates the model into the simulation program.

The compatibility of AllFusion with a powerful simulation program like Arena can facilitate the analysis of models through simulation. Computer simulation 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. The Virginia Department of Transportation can then use this information to speed up or improve its SYP and STIP development.

5.2 Implications of BPM for acquisition of COTS for transportation agencies

This section describes the implications of business process modeling for acquisition of COTS for transportation agencies.

The commercial off-the-shelf (COTS) products, Hummingbird Ltd., Adobe, Kofax and FileNet were recommended to be considered for support of the planning and programming activities of VDOT.

Hummingbird Ltd. is a leading global provider of enterprise software solutions. They help customers manage the lifecycle of enterprise content from creation to settlement. With Hummingbird DOCS Open organizations can efficiently manage the whole information chain. The software manages any word processing document, spreadsheet, presentation, form, image, e-mail message, and any other type of file that must be saved and stored. It can be used to enhance transparency between different divisions within VDOT. The software may be used to control, organize, access and share the essential corporate information.

Kofax products are used to accelerate business processes by collecting paper documents, forms, and e-documents, transforming them into retrievable information and delivering it to business applications and databases. It would allow users in VDOT to submit all hardcopy information into the database. Different districts have different formats of documentation. Kofax can help VDOT transform information into a unique format that can be viewed and accessed by any other division. The software can help VDOT to deliver information into the workflow creating an organized management structure.

Adobe Acrobat Capture Cluster is a document management software. It takes advantage of advanced page-layout and content recognition. It cleans up images before applying recognition. The program chooses the best output
file that suit users requirements. Adobe can be integrated with existing software therefore future improvement will not be a problem. It may be used by VDOT to submit all hardcopy information into the database formatting the data to suit the user’s specifications.

Hummingbird Enterprise 2004 – Workflow is a planning and programming software. It can receive assigned tasks and related content in a choice of interfaces such as e-mail, browser, instant messaging alert, or mobile device. The user can be alerted to overdue and incomplete tasks and hand over in one click. The software can be used to easily define graphical workflows by dragging and dropping steps, and business rules. The software can quickly show process success and failures during design stage. Rapid adjustment or modifications to business processes can be done as needed. The software permits the user to move content through creation, approval and publishing lifecycle. 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 products help organizations make better decisions by managing the content and processes that drive their business. With FileNet Compliance Framework users can manage document lifecycles, implement and monitor business processes, and respond to inquiries. FileNet Compliance Framework provides greater visibility and control of business processes. It has an improved security and privacy of information. It provides monitoring and reporting capabilities for reviewing purposes. FileNet Business Process Manager increases process performance, reduces cycle times, and improves productivity by automating, and optimizing complex processes by managing workflow throughout the enterprise.

6 CONCLUSION

6.1 Summary

This research effort demonstrated the use of business process models to understand and support reengineering of the STIP/SYIP development processes at VDOT.

The effort found that process modeling can support aid priority-setting and resource allocation for the automation of business processes using information technologies.

The effort found that previous efforts to model the STIP and SYIP were less complete and less formal.

The effort found that business process modeling is an effective method for describing who does what, how, and why in major business processes for highway agencies.

The effort found that there are potential uses of business process modeling for other complex processes of the transportation agency.

6.2 Recommendations

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

The agency should consider the use of IDEF methodology, and the AllFusion software or its equivalent, to document a variety of business processes.

The agency should consider to train selected personnel to develop and interpret IDEF models.

The agency should consider implementing software for streamlining the collection of information for IDEF models. An interface software application would allows the user to bypass the task of transcribing interviews, entering that information into the developed Excel worksheet, and then transferring that same information into the AllFusion software.

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