EXTENDING IP-MAPS: INCORPORATING THE EVENT-DRIVEN PROCESS CHAIN METHODOLOGY

(Research-in-Progress)

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Abstract: This paper takes the basic constructs of the IP-Map diagram and demonstrates how they can be rearranged into a family of diagrams based on the Event-Driven Process Chain Methodology. This family of diagrams can be used to fully describe the organizational, procedural, informational, and communication structure of a business process while at the same time highlighting the information products used by that business process. The paper concludes with a review of requirements for a software package that will allow analysts to model and explore their business processes with an emphasis on improving the quality of the organization's information products.

Key Words: Information Quality, IP-Maps, Event-Driven Process Chains

OVERVIEW OF IP-MAPS

An Information Production Map (IP-Map) is a graphical model designed to help people to comprehend, evaluate, and describe how an information product such as an invoice, customer order, or prescription is assembled. The IP-Map is aimed at creating a systematic representation for capturing the details associated with the manufacture of an information product [2]. The IP-Map is similar to a data flow diagram but contains additional constructs to more fully capture the creation of an information product.

To illustrate the use of IP-Maps, consider the case of a fictitious school called Big State University (BSU). To improve the quality of its information products, BSU has embarked on a data quality campaign. BSU begins its campaign by asking each university department to identify the information products that they use. One of these departments, the Office of Alumni Affairs, has identified mailing labels as an important information product. Incorrect or out-of-date mailing labels are a problem for Alumni Affairs. Undeliverable mail costs the school money in terms of unrecoverable printing and mailing costs, as well as potential lost donation revenue from missing or disgruntled alumni. To minimize the quantity of undeliverable mail going out to its alumni, BSU has decided to employ the IP-Map technique to assess and improve the quality of its alumni mailing labels. After thoroughly interviewing the Alumni Affairs' staff, BSU documents the process for the production of alumni mailing labels using an IP-Map and a set of metadata tables (See Figure 1 and Table 1).

After the end of each semester, data about graduating seniors are taken from the Big State University's active student database by the Registrar Office and transferred to Alumni Affairs so they can add this information to their Alumni database. Alumni are encouraged to send name/address corrections and other changes (marriages, divorces, births, phone number changes) to Alumni Affairs so that their information can be kept up to date. Alumni may choose to phone in the information, send email via the Big State University's alumni web site, stop by the Alumni Affairs Office, or send updates via regular mail. The secretary at Alumni Affairs records this information into the Alumni database on a weekly basis.

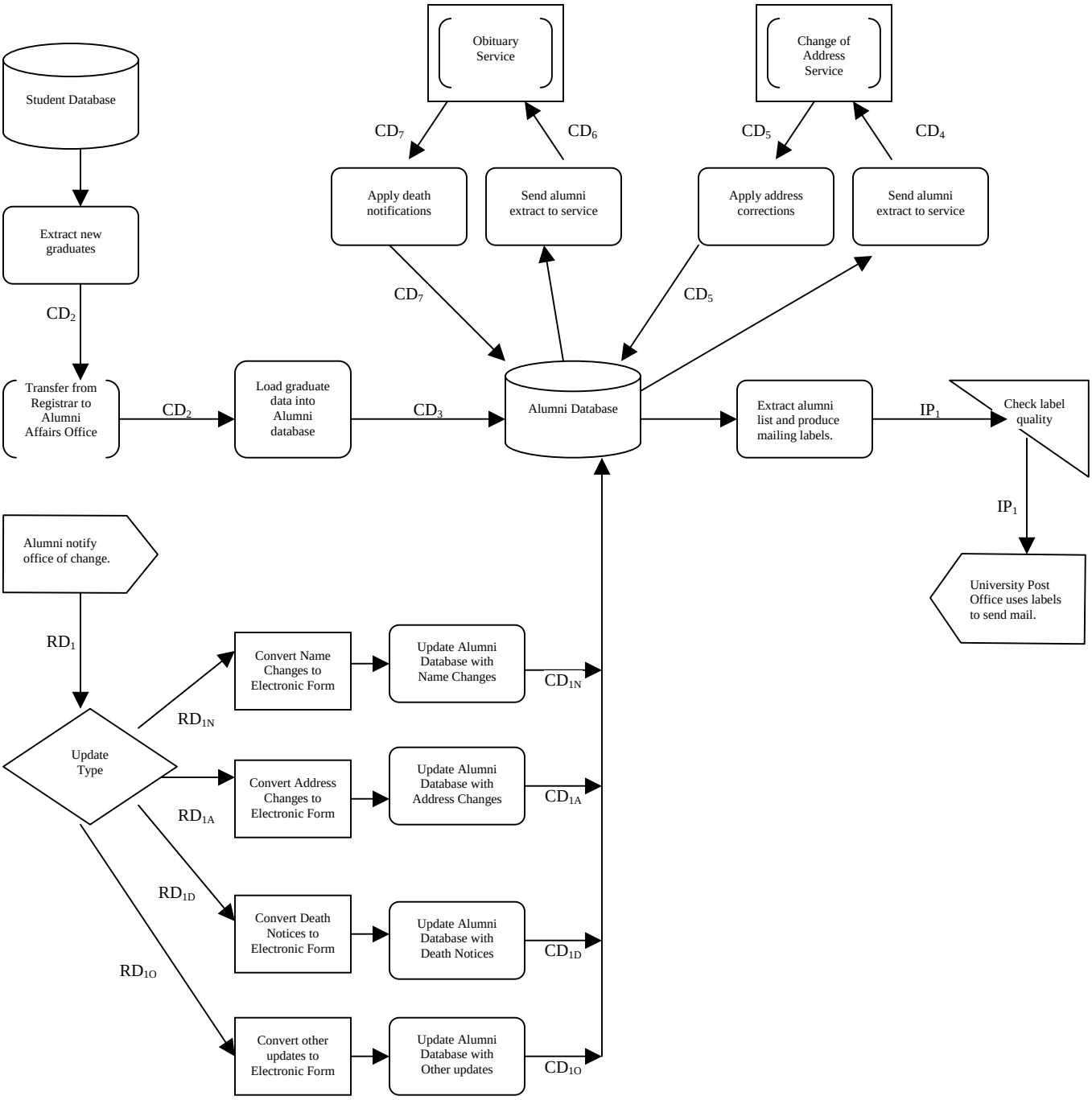


Figure 1. IP MAP for production of Alumni Mailing Labels.

Unfortunately, only about 1 in 10 alumni remember to inform Big State University of their name and address changes. To track down moving alumni, every quarter Alumni Affairs sends a list of its mailing labels to a Change of Address Service, which compares the address of alumni against its master list and identifies those addresses that have changed. This service has demonstrated it is able to detect and correct 95% of the changed addresses and can also identify misspelled addresses and names. In other words, 5% of the changed or incorrect addresses remain undetected by the Change of Address Service.

Besides the problem of incorrect or out-of-date addresses, there is also the problem of identifying deceased alumni. While relatives may contact Big State University about 20% of the time to stop the

mailings to deceased alumni, in many cases, there is no notification. To help it identify deceased alumni, once a year, Big State University sends its active mailing list to an Obituary Service, which compares the list to its master list and can identify about 80% of the alumni who are now dead.

When it is time for Big State University to send out an alumni publication, Alumni Affairs runs a program to create a list of mailing labels. The Alumni Affairs secretary checks the labels for format quality before pasting the labels onto the outgoing publication and sending them to the University Post Office for mailing.

Name/Type	Dept/Role	Location	Business Process	Composed Of	Base System	Quality Issues
Alumni (DS_1)	Former BSU students	Depends on the individual.	Alumni send in their data changes.	Name, Address, and other Status Changes in a free format.	Mail, phone, in-person or electronic correspondence.	Typos or misinformation sometimes occur.
University Post Office (CB_1)	BSU Post Office Personnel	111 Sullivan Hall	Mailing labels are used to address alumni publications.	Mailing Labels (IP_1)	Set of Paper Labels	
Student (STO_1)	BSU Register Office	222 Carpenter Hall	Registrar Office maintains data on active students	All university data collected on students. See data dictionary for a complete list of fields.	Oracle Database	
Alumni Data (STO_2)	BSU Alumni Affairs Staff	204 Breezedale Hall	Alumni Affairs maintains data on alumni.	Alumni Mailing Information, Other Alumni Data. See data dictionary for a complete list of fields.	Oracle Database	Data becomes obsolete as it sits in the database. See component description for obsolescence rates.
Update Type (D_1)	BSU Alumni Affairs Secretary	204 Breezedale Hall	Secretary reviews and sorts types of update requests into separate piles. (RD_{1N}, RD_{1A}, RD_{1D}, RD_{1O})	Input: RD_1 - Correspondence from alumni (either mail, email, phone, or in-person)	Paper-based system.	

Table 1. Sample Metadata. (Note: Full table's contents have been omitted for the sake of brevity.)

BSU can use the IP-Map to improve the quality of alumni mailing labels in several ways.

1. BSU can use the IP-Map to visualize the most important phases in the manufacture of the mailing labels and identify the critical phases that affect its quality.

2. BSU can use the IP-Map to pinpoint bottlenecks in the mailing label production process and estimate the time to deliver the information product.

3. BSU can use the IP-Map to identify ownership of the processes at each of the phases and to implement quality-at-source initiatives.

4. BSU can use the IP-Map to understand the organizational (business units) as well as in information system boundaries spanned by the different processes / stages in the IP-Map.

5. BSU can use the IP-Map in conjunction with other analytical tools to measure the quality of the information product at the different stages in the manufacturing process using appropriate quality dimensions.

Although IP-Maps are extremely useful for describing the manufacture of a given information product, it is difficult for any one diagram to fully capture all the various aspects of a business process. For example, IP-Maps do not easily convey the following information.

- How does an information product fit into the business processes of an organization in terms of when and where it is used in the sequence of tasks that make up those business processes?
- What is the communication structure between the data sources, data consumers, and various organizational groups involved in the manufacture of an information product?
- What is the hierarchy or relationship between the different organizational groups involved in the manufacture of an information product?
- What is the hierarchy or relationship between the different functions / tasks involved in the manufacture of an information product?
- What is the relationship between the different information products, data storages, and other data components used by an organization?

To resolve these difficulties, this paper proposes that what is needed is a family of diagrams based on the event-driven process model to fully describe the informational, organizational, procedural and interaction components of a business process. Each diagram highlights a different aspect of the business process. Taken together, the entire set of diagrams form a complete picture for describing and analyzing a business process along with its required set of information products.

BACKGROUND ON EVENT-DRIVEN PROCESS CHAIN METHODOLOGY

In today's competitive and cost-cutting environment, many organizations are looking at ways to make the way they do business more efficient and effective. To achieve this goal, companies in the 1990's began moving from a functional orientation to a process orientation. Under a functional orientation, the company organized itself into "vertical" units and sub-units, each with a defined set of resources for performing a defined set of tasks. The problem with this approach was that it often discouraged people belonging to one unit from communicating with other units. In addition, this approach often encouraged people to optimize their unit's performance at the expense of other units that in turn could lead to a reduction of the overall efficiency and effectiveness of an organization.

Process orientation tries to avoid the weaknesses of the functional approach by focusing attention on the key business processes and how they can be improved. Business processes are used to define the flow of work, typically across organizational boundaries, in order to add value for the customer and to meet business goals. Process orientation is horizontal in nature, meaning that people from various units work together as a team on a specific business process.

The improvement of key business processes is often referred to as business process re-engineering (BPR) (if changes to the business process are immediate and dramatic) or business process improvements (if changes to the business process are gradual and incremental). In any case, a wide range of techniques can be employed to assist organizations in analyzing and improving their business processes. These techniques include workflow analysis, simulation, value chain analysis, critical path analysis, and performance measurements as well as organizational change techniques such as team building, incentive compensation, and reducing resistance to change.

One common modeling technique used in the field of business process engineering is known as Event-Driven Process Chains (EPCs). For example, event-driven process chains are used extensively to model business processes in SAP R/3 (SAP AG) [1]. EPCs employ a set of geometric shapes to portray the interconnections between tasks, data, organization units and the logical time sequence involved in completing a business process. It is important for each EPC to begin with at least one event (the start event) and to end with at least one final event (the finish event). An event in turn triggers one or more

tasks. The organizational units (departments, people, etc.) responsible for doing the task and the resources (information, raw materials, etc.) needed to complete the task are added to the chain to show a complete picture of how tasks are performed for a given business process. EPCs then supplements its business process map with a set of diagrams which model other viewpoints of the business process such as how information is exchanged, what information is needed, how the company is structured, and an overview of the main functions of an organization.

To combine Event-Driven Process Chains with the IP-Map methodology requires the additional of a few extra constructs to the original IP-Map set. These changes along with the list of other IP-Map constructs are detailed in the following table.

Construct Description	Type of Construct	Construct Icon
Event - Events describe the occurrence of a status that in turns acts as a trigger for a business process, i.e. When should something be done? Example: Order is received.	EPC Construct	E_i
Organization - Organization units describe the outline structure of an enterprise, i.e. Who should do it? Example: Sales department, plant, secretary.	EPC Construct	O_i
Information, material, or resource object - Business object entities, i.e. What is needed to complete the task? Example: physical material, order inquiry, raw data, component data, information product.	EPC Construct	RD_i, CD_i, IP_i
Logical Operators - Connectors that describe the logical relationship between events, functions, processes, i.e. And, Or, Exclusive Or.	EPC Construct	A O X
Control Flow - Arrows that describe the chronological and logical interdependencies of events and functions or processes.	EPC Construct	
Resource / Organization Unit Assignment - Lines that describe which unit (employee) or resource is associated with a function or process.	EPC Construct	
Information / Material Flow - Arrows that define whether a function reads or changes an information product.	EPC / IP-Map Construct	
Function or Process Block - Task that describes any transformations, manipulations, or calculations performed, i.e. What should be done? Example: Create purchase order, Update database.	EPC / IP-Map Construct	P_i
Source (raw input data) block - This block is used to represent the source of each raw (input) data that must be available in order to produce the information product expected by the consumer.	IP-Map Construct	DS_i
Customer (output) block - This block is used to represent the consumer of the information product. The consumer specifies in this block the data elements that constitute the "finished" information product.	IP-Map Construct	CB_i
Data Quality block - This block is used to represent the checks for data quality on those data items that are essential in producing a "defect-free" information product. Therefore, associated with this block is a list of the data quality checks that are being performed on the specified component data items.	IP-Map Construct	QB_i

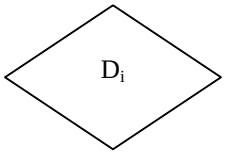
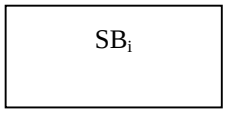
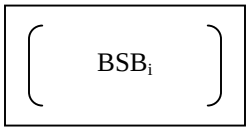
Construct Description	Type of Construct	Construct Icon
Data Storage block - This block is used to represent the capture of data items in storage files or databases so that they can be available for further processing.	IP-Map Construct	
Decision block - In some complex information manufacturing systems, depending on the value of some particular data items(s), it may be necessary to direct the data items to a different set of blocks downstream for further processing. In such cases, a decision block is used to capture the different conditions to be evaluated and the corresponding procedures for handling the incoming data items based on the evaluation.	IP-Map Construct	
Business Boundary block: The business boundary block is used to specify the movement of the information product (or raw / component data) across departmental or organizational boundaries. The role of the business boundary block in the IP-Map is to highlight the data quality problems that might arise when crossing business unit boundaries and therefore assign accountability to the appropriate business unit.	IP-Map Construct	
Information System Boundary block: This block is used to reflect the changes to the raw input data items or component data items as they move from one information system to another type of information system (Example: Paper to Electronic). These system changes could be intra or inter-business units.	IP-Map Construct	
There are circumstances where the raw input data items or component data items go through both a business boundary and a system boundary change. The combined business-information system boundary block is defined for this purpose.	IP-Map Construct	

Table 2. Constructs used in IP-Maps and EPC's diagrams.

FAMILY OF DIAGRAMS

The next section illustrates a set of diagrams based on extending the basic IP-Map presented earlier in the paper with the additional business process viewpoints offered by the EPC methodology.

Event Process Chain (EPC) Diagram - Business Process Overview

The EPC diagram is the central view of a business process, which then incorporates the other diagrams into its structure. The EPC models the interconnections between tasks, data, and organization units, and the logical time sequence involved. The EPC diagram helps to answer the question of how an information product fits into the business processes of an organization in terms of when and where it is used. The EPC diagram is very flexible and can model any business process regardless of whether it involves the creation or use of an information product. Figures 2 to 6 contain a sample EPC diagram that models a business process that uses mailing labels as well as several EPC diagrams that break down the IP-Map (Figure 1) into several business processes conducted by the Office of Alumni Affairs for managing alumni data.

The EPC diagrams in this paper have been augmented from the traditional EPC diagrams to include several constructs from IP-Maps. Data sources can be associated with a particular raw data component while customers can be associated with a particular information product. Data storages can be represented along with other information, material, or resource objects to highlight which databases are being used in a business process. In addition, these EPC diagrams can incorporate the IP-Map constructs for representing data quality checks, system or organization boundary transfers in addition to the process/function construct to more aptly categorize the type of task taking place.

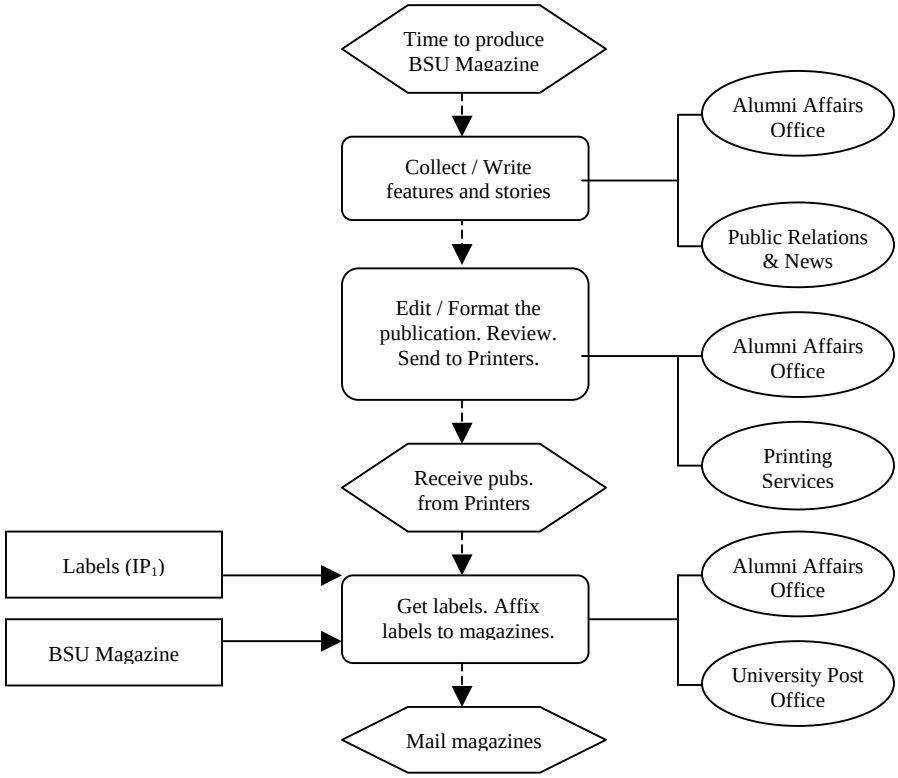


Figure 2. EPC - BSU magazine publication process.

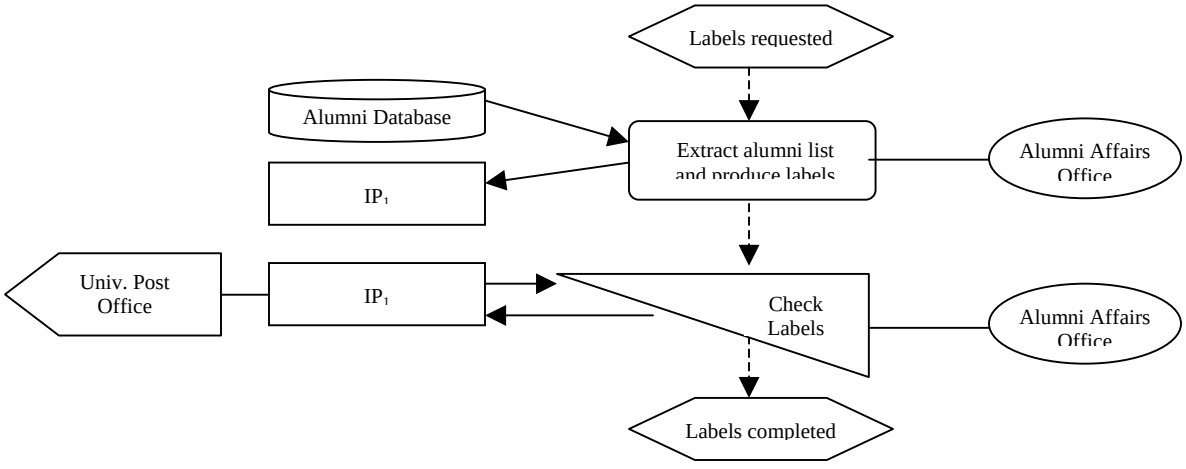


Figure 3. EPC - Create mailing labels.

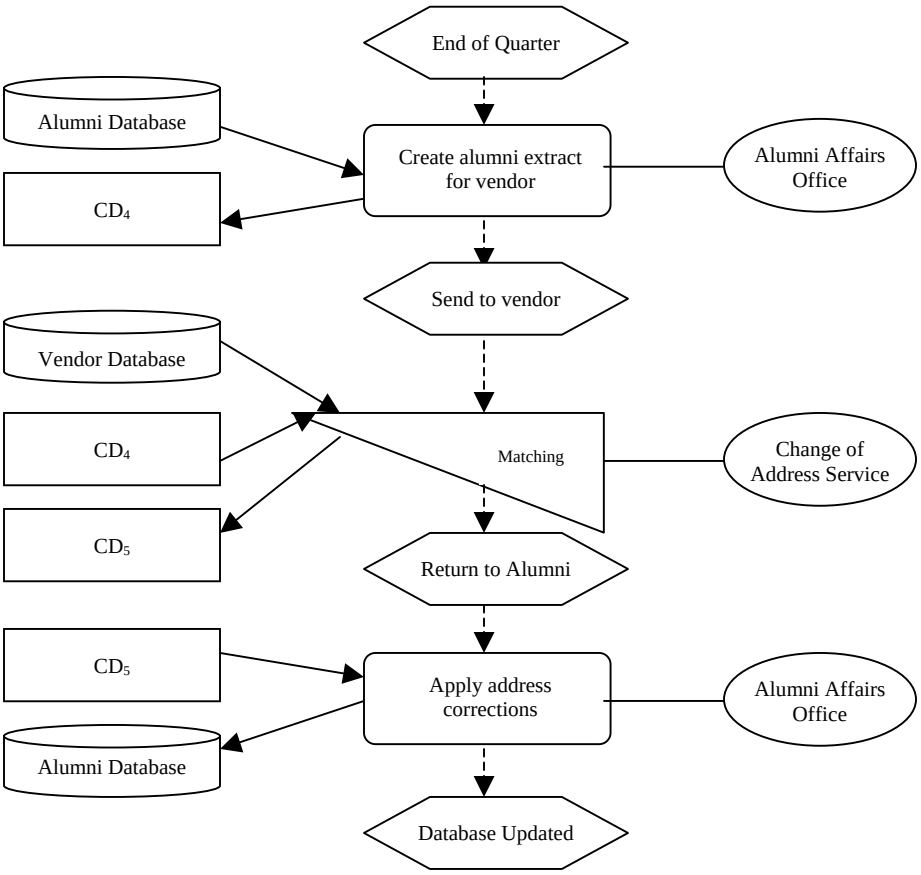


Figure 4. EPC - Check for addresses changes. (Note: The process for checking for alumni deaths would look very similar to this diagram except the vendor performing the matching operation would be the Obituary Service.)

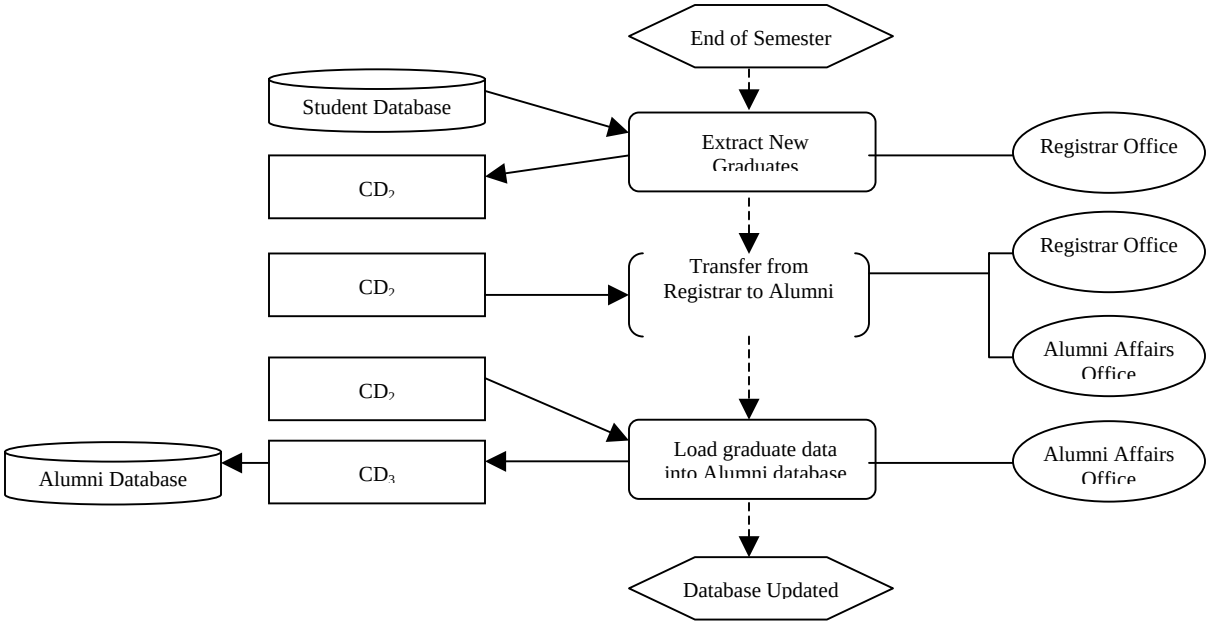


Figure 5. EPC - Update the alumni database with new alumni.

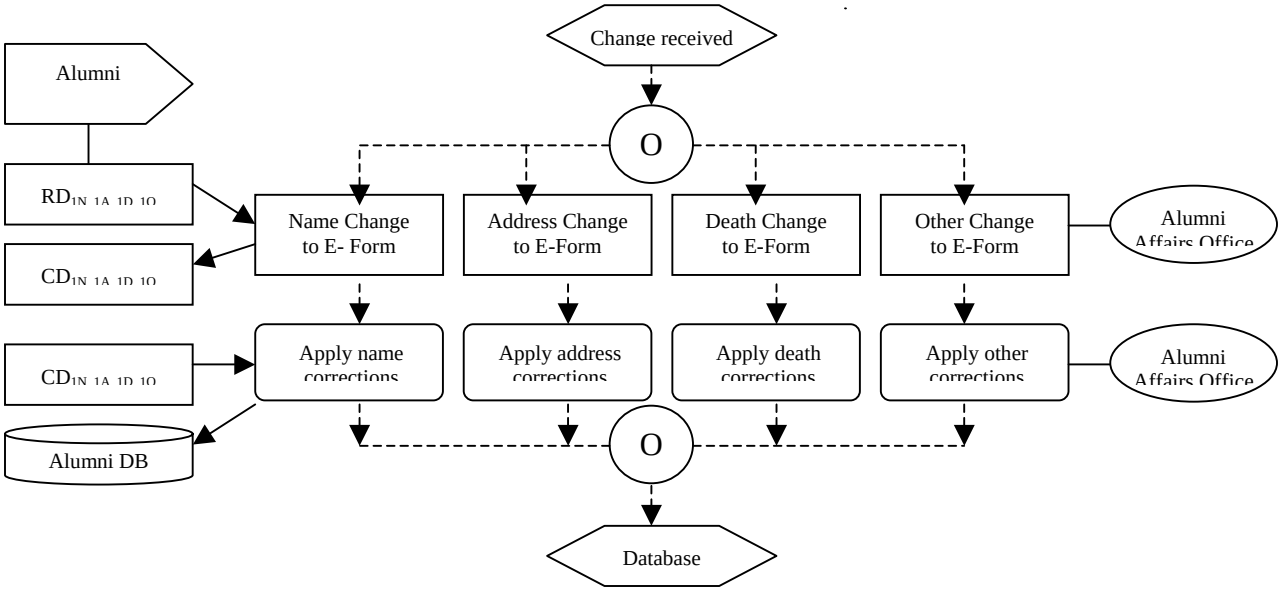


Figure 6. EPC - Handle change requests from alumni.

The Interaction Model - How Do Company Units Interact?

The interaction model allows companies to analyze the way information flows between the different organization units, data sources, and data consumers for a given business process. It highlights the information flows between senders and receivers without going into great detail why or when the information flows occurs. The direction of the arrows indicates whether the communication is one-way or two-way. This type of diagram may be useful in understanding why communications succeed or sometimes fail during the execution of a business process. For example, the diagram may reveal that a department does not have interaction with another group, which may explain why improper decisions are being made during a business process. The diagram below illustrates an Interaction Model for the production of alumni mailing labels.

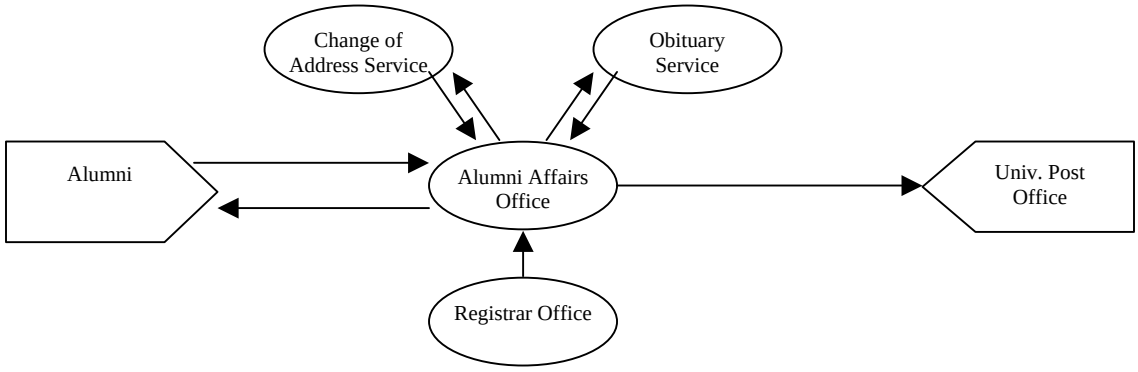


Figure 7. Interaction model for maintaining alumni mailing data.

The Organizational Model - Who Does What?

The organizational viewpoint is basically a traditional organization chart that shows the hierarchy or relationship between the different organizational groups. This chart allows people to see the overall structure of the organization and to explore the relationships between the organization structure and the distribution of business processes, functions, and information products. This chart can be organized into several levels of detail depending on the complexity of the organization's structure. In addition, color can be used to highlight those units participating in a particular business process. For example, the organization units highlighted in Figure 8 represent those units directly involved in the production of alumni mailing labels. This type of diagram can be useful when analyzing a business process to determine how closely related the groups involved in the business process are in terms of their positions in the organization's overall structure.

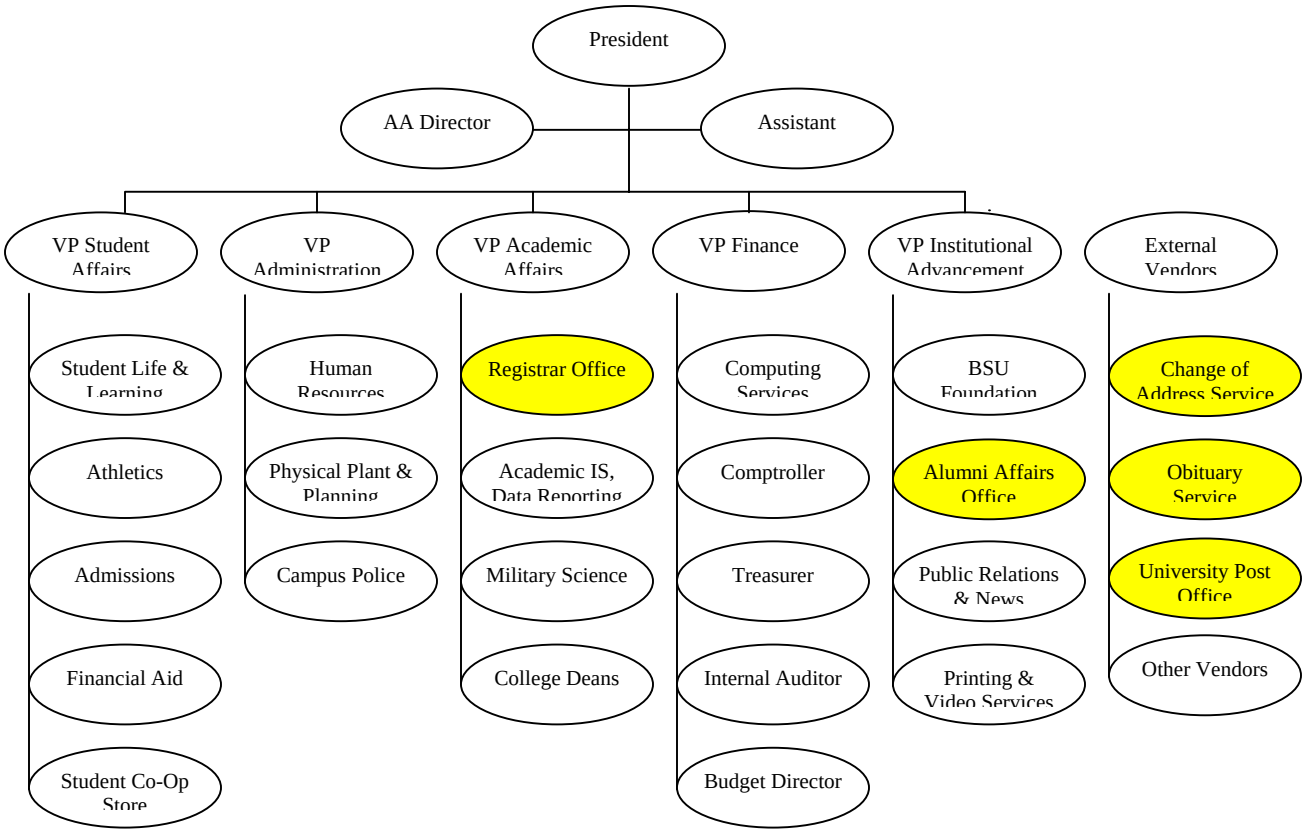


Figure 8. BSU Organization Diagram.

The Component Model - What Happens?

The component model uses a function tree to show what the main business processes are. It does not describe the order of those processes or who carries them out. The component model represents the different business process functions and how they relate to each other. It shows how functions or tasks activate one another and which functions are subordinate to another. Functions can be broken down into several levels, each level representing units at varying degrees of detail and precision. In addition, for this family of diagrams, the component model can be augmented with some of the specialized task constructs from the IP-Map, namely the verification block, IS boundary block, and business boundary block.

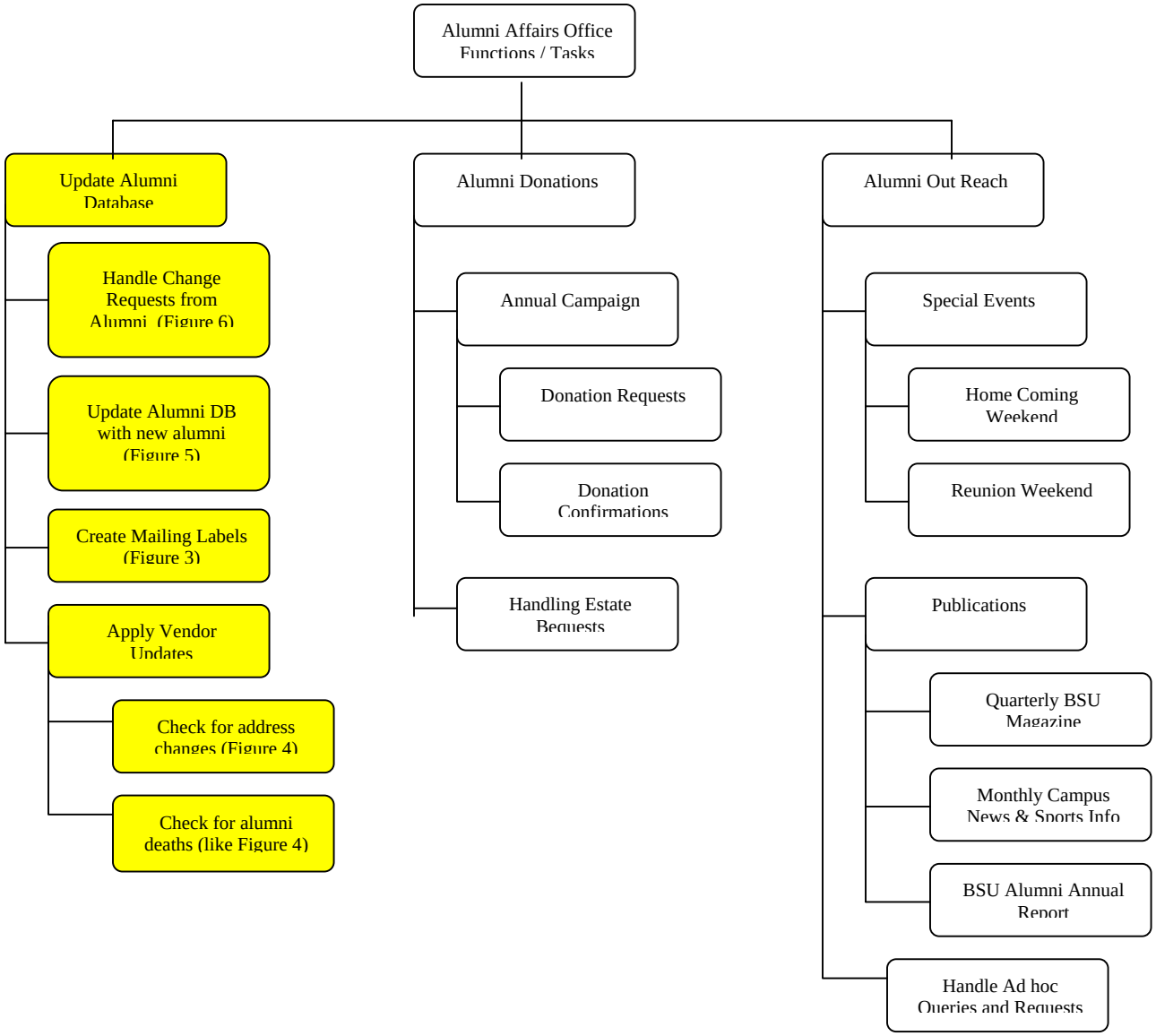


Figure 9. Alumni Affairs Office represented as a component model. (Note: Highlighted blocks represent tasks or functions associated with the production of alumni mailing labels. Blocks such as the "Handle Change Requests from Alumni" could be expanded into greater detail to coincide with the tasks listed in the EPC diagrams. The remaining blocks represent other tasks or functions associated with the Office of Alumni Affairs.)

The Data Model - What Is Needed?

The data model depicts the relationship between the different information objects used by an organization. For this family of diagrams, the data model has been altered from its original EPC model conception to include the IP-Map constructs describing the data storages, data consumers and sources, information products, and raw and component data.

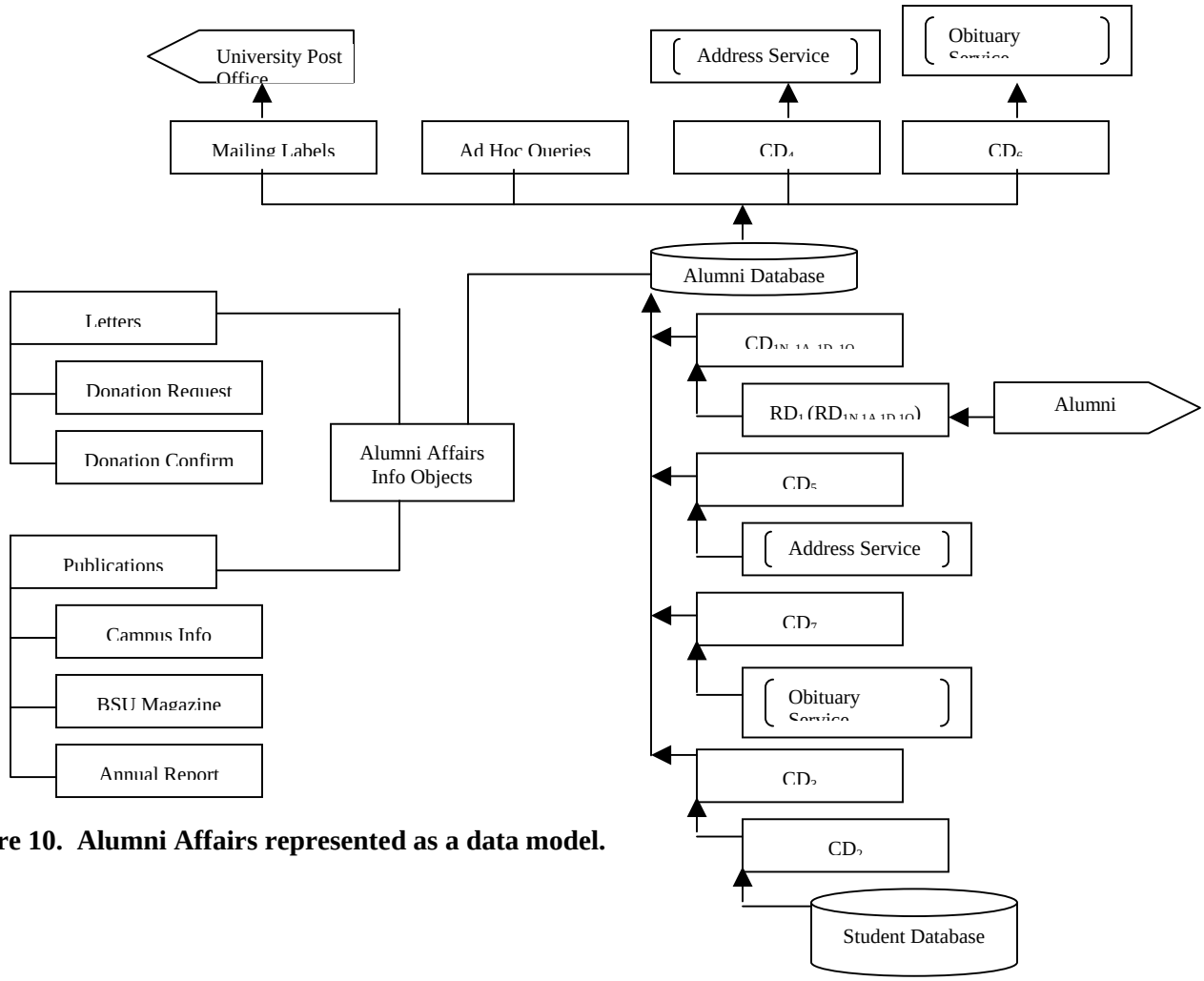


Figure 10. Alumni Affairs represented as a data model.

PROPOSAL FOR FUTURE WORK

Although EPC and IP-Map diagrams are useful for modeling and analyzing a business process and its information needs, the construction and manipulation of these models is a long and tedious process if done by hand. In order for analysts to take full advantage of their business process and information product models, they need a software product that will integrate a variety of important features.

1. Organizations need the ability to generate, view, modify, delete, customize, save, and distribute their business process and information product diagrams. Individuals need to have the ability to zoom in and out of the diagrams as well as being able to drill up or down in the diagram's hierarchy in order to see the business process at various levels of detail. Micrografx EnterpriseCharter (a plug-in module for Micrografx FlowCharter) and Microsoft's Visio 2000 are two examples of software products that provide this type of functionality for constructing diagrams.

2. This tool should also incorporate a metadata repository so that every business object in a diagram links to a set of descriptive characteristics about that object. Many vendors offer database products either as stand-alone products or as part of another package such as a BPR or case tool that could be used to organize a set of metadata tables.

3. Organizations need to be able to interface their business process and information product diagrams with other types of software such as Enterprise Resource Planning (ERP) systems or case tools for

system development so that these diagrams can easily be translated into the code requirements for rapid system development. Groups like the Workflow Management Coalition are working on standards that they hope vendors will incorporate to permit "flow to code" capabilities or at least the ability to check that the code covers all aspects of the business process flow chart.

4. Organizations need the ability to integrate their business process diagrams with a new class of generic software called Workflow Management Systems (WFMS). WFMS has its roots in products like image processing, document management tools, groupware, and project support software. Today's WFMS software products offers organizations assistance in doing the following:
    a. Provide computer-based support for making the business process logic explicit so that a business can both enforce and document the business rules it uses.
    b. Provide organizations with a means to create, collect, and evaluate metrics relating to the time, cost, or quality of performing a process and its constituent tasks
    c. Provide run time control functions for managing the process in an operational environment as well as assistance in sequencing the various activities to be handled as part of each process.
    d. Provide the capability to match the tasks that need to be done with the people needed to perform them and the information resources needed to perform them.

5. Organizations need the ability to perform what-if analysis so that the impact of a proposed change to a business process can be evaluated. It would be very useful if an analyst could change a business process diagram on-line and then run a simulation feature to get an assessment of how that change would affect specified time, cost, or quality metrics for that business process. Several high-end BPR packages exist today that allow people to do modeling, analysis, simulation and animation with their business process models.

6. Organizations need the ability to mine their database of business objects to seek out patterns among business processes and to ask questions such as "How many business processes use a particular information product?" or "How many organizations are involved in the production of this information product?" The Repository Information System available in the SAP R/3 software package is a good example of a module that allows business and IS people to query a database of business objects to find out where they are used. In addition, link analysis and visualization tools may also provide a means to assist people in mining their business diagrams to uncover areas of redundancy or inefficiency.

Although a software package that incorporates all these features does not yet exist, there are vendor specific software products and analytical techniques that accomplish some of these features. The challenge will be to encourage vendors to incorporate an information product methodology as they expand the features and functionality of their software products to encompass advanced modeling and analytical capabilities so that business analysts can fully explore complex sets of business processes and information needs across an entire organization.

REFERENCES

[1] Curran, T.A. and A. Ladd, SAP R/3 Business Blueprint: Understanding Enterprise Supply Chain Management, 2nd Edition. Prentice Hall PTR, Upper Saddle River: N.J., 2000.

[2] Shankaranarayan, G., R. Y. Wang and M. Ziad. Modeling the Manufacture of an Information Product with IP-MAP. *Proceedings of Conference on Information Quality*. Massachusetts Institute of Technology: pp. 1-16, 2000.