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**State Flow as a Way of Analyzing Business  
Processes – Case Studies**

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# State Flow Technique for Business Processes Analysis - Case Studies

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**Abstract:** The exponential growth of the Internet and information technology in general leads to the increased volumes of customer requests and often brings about the situation when a small staff has to cope with a large number of business processes. To achieve an effective management under the circumstances one needs a computer system able to support these business processes. Such a system cannot be developed without first modeling business processes. To model business processes relevant for a particular domain analysts need to acquire a great deal of "in-house" information from the people who participate in business processes – the information on routines, rules, etc. In general, it is not enough to get the process participants to describe their actions, they should first achieve a deeper understanding of the processes in which they participate (in terms of goals, activities, etc). A special technique called State Flow (SF) has been developed to give the process participants the idea of in which processes they participate. The paper gives an overview of application of the SF technique to building models of two business processes: a decision-making process and a process of recruiting new members (for a nonprofit association).

**Keywords:** business process modeling, process management, business analysis, conceptual modeling

## 1. Introduction

Modern information technology, and especially the Internet, drastically changes the ways in which private and public companies and organizations communicate with their customers – people or other organizations. More efficient communication channels make it possible to increase the volumes of products sold and services provided. As a result, the companies are faced with the problem of coping with much larger numbers of customer requests without increasing the number of employees. This is true for both, the public sector which usually does not have enough resources to spend on employing more people, and private

companies which face a growing competition for educated personnel. A possible solution to the problem is to find the ways of increasing the effectiveness of internal business processes.

A business process can be viewed as a framework for activities that lead to a well-defined objective (Hammer and Champy, 1994; Kueng and Kawalek, 1997). Examples of objectives in various domains are:

- closing a sale,
- receiving payment for an order,
- discharging a patient from a hospital,
- building a software system according to specifications.

There are several important factors that should be taken into consideration when devising routines for business processes management.

- A business process may stretch over a long period of time; some processes may take years to complete. In the meantime the business environment may change so drastically that the process's objectives as well as the tactics used to achieve them may need to be modified. Consider, for example, changes in software system specifications, migration of the personnel, changes in the organizational structure.
- A business process may involve many people who belong to different units in the organizational structure.
- The same person may be involved in many business processes simultaneously.

These properties make an effective control of business processes an extremely difficult task. This is especially true in a business environment where a small staff has to cope with a large number of processes, and there is no possibility to assign a manager to supervise the execution of each process separately. The solution is to transfer some of the controlling and coordinating functions to a software support system. The system should take over the supervising function when a process follows a standard pattern (autopilot), while allowing manual control when a process deviates from the standard.

The prerequisite for developing a support system for management of business processes is the creation of a model of the processes in question. There exist a number of formal techniques for modeling business processes, Role Activity Diagrams (RAD), IDEF, Petri-nets, Use-Cases to name but a few of them. Those formalisms can be used to properly structure the software of a process support system. However, to achieve the proper functioning of a support system in a particular domain, a formal model should be filled with a specific content, i.e. description of the actual business processes.

To produce a comprehensive description of a business process is far from easy as operational procedures involved are very seldom documented, and if they are, their descriptions often lack essential details. The only way to cope with the task is to interview the personnel involved in business processes to be modeled, the persons who will obviously be the ones to use the process support system when it is ready. The personnel would, naturally, know their jobs, but they, most probably, would know nothing about formal models of business processes. Moreover, they are hardly aware of the business processes in which they themselves are involved, which is often the case in functionally organized companies. A business analyst should be equipped with a tool which would help him/her to get the necessary information from the personnel without teaching them all about formal models.

The situation in which an analyst finds him/herself reminds of the one of a field linguist who studies languages that exists only in the spoken form. Linguists have special methods permitting them to get the necessary information from the native speakers without teaching them any linguistic notions. Moreover, it is considered a wrong practice to teach them linguistics, as it may influence the native speaker in a wrong way. The formal diagrammatic methods like RAD, Petri-nets, State-Transition diagrams, etc. are no more appropriate for people involved in a business process than linguistic models for native speakers.

A new approach has been developed to help a process analyst to get the relevant information from the personnel. This approach, which we call State Flow (SF), is based on a business process modeling technique suggested in (Bider and Khomyakov, 1998). Briefly, the SF approach consists in showing the personnel which changes occur in a process's state during its life cycle. In the paper, the SF approach is explained while discussing its application to two different business processes. The first process is a decision-making process in one of the Swedish municipalities. The decisions are of political nature, and they require coordination with various external and internal interested parties. The second process concerns recruiting new members to a large nonprofit association.

The paper has the following structure. In section 2 we informally describe the business processes, which were investigated. In section 3, we give a short overview of the modeling technique we used when analyzing the business processes involved. In section 4 we discuss the SF approach to presenting the decision-making and recruiting processes for the personnel. Section 5 discusses those parts of the processes' descriptions that are more difficult to visualize. In Section 6, we describe the way we worked with the personnel. In section 7, we present some conclusions derived from our experience.

## **2. Description of business processes**

### **2.1 The decision-making process**

A decision-making process starts when a resolution is to be adopted by a particular decision-making body. A resolution may vary from allowing public access to certain information to approving the next year budget. However, the routines for preparing and making a decision are much the same for different types of decisions made.

A decision-making process usually originates by some document. It can be an external document, e.g., a motion from a political party, information on a new regulation passed by a parliament, etc., or an internal document, e.g., a record from the previous meeting, etc. Before a decision-making body can pass a resolution, all relevant information should be gathered, summarized and a proposal for a resolution should be prepared.

The basis for decision making usually consists of a number of documents, e.g., documents containing external or internal opinions on the matter, laws and other regulations which should be taken into consideration, etc. At the start of the process, some of these basic documents exist e.g., laws and regulations, others, e.g., internal or external reviews, are compiled during the process.

Various groups of people are involved in the compilation of basic documents and the proposal for a resolution. Some people belong to the organization which is responsible for the decision making process. We call this organization an *owner* (of the process). People who work for an owner are called *staff*. A member of the staff is not always employed by the owner; he/she may have another type of relationship with the owner, e.g. be a politician.

Other human participants of the process may belong to external organizations which may be responsible for external reviews, for implementation of resolutions, etc. We will refer to such people as contact persons, or just *contacts*.

The decision-making process is driven through executing activities like: *prepare proposal*, *request review*, etc. Normally, activities are first planned and then executed. The staff is the driving force of the process. The staff is responsible for planning and executing activities. The contacts serve only as counterparts in communication activities, e.g. send a letter to X, phone Y where X and Y are contacts. Even when a counterpart is expected to act in some way, e.g. send a review, or call back, it is a member of the staff who is responsible for the activity. He/she must send a reminder, or ring himself/herself if the contact does not reply in time.

## **2.2. Recruiting new members**

This process is typical for any association which needs to recruit new members and sends out recruiters to prospective members. The association in our case was a tenants association which takes part in rent negotiations with property owners on behalf of its members. The key notion in the recruiting process is a house entrance. In Sweden, each house entrance constitutes a separate address, and different entrances of the same building may belong to different property owners.

A recruiter starts with printing a list of the persons who lived at a given address at the moment of the previous recruiting tour. Besides the tenants names, the list includes some information gathered during the previous recruiting tour, e.g. which tenants do not want to be bothered, names of the tenants who are already members of the association, etc.

Each recruiter works with several entrance lists simultaneously for some time. The entrances are in the same geographical district, but they do not necessarily belong to the same property owner. The recruiting conversation concerns both situations in the given geographical district, and behaviour of a particular property owner. Thus, a recruiter needs to have some information on the district he/she is going to tour, and the property owners who rent apartments in this district.

The recruiter starts his/her tour with updating the entrance list. He/she does it by comparing the tentative list he/she has with the list of tenants placed at the entrance. Then a recruiter knocks on all the doors where non-members live, excluding those whose names are marked “don’t bother” on the list. If the door is

opened, a conversation follows which may or may not result in recruiting a new member.

One entrance is normally visited two or more times during a recruiting tour. It is up to the recruiter to decide if there is any idea to continue visiting a particular entrance. Two visits may be required, e.g. because some old people would not dare to open a door to a stranger. A written message or phone call before the next visit could help in this case.

After the tour of a specific entrance has been finished, there still may be a number of non-members who were not contacted during the tour. If the recruiter considers that there are good chances to reach these people over the phone, the recruiting process for this entrance may continue via phone.

### 3. Modeling technique

We start with giving an overview of the main ideas of the *ObjectDriver* approach to modeling business processes, see (Bider and Khomyakov, 1998, 2000) for details. This approach has been used in our case studies as a kind of meta-model.

Quite often, a particular approach to business process modeling is focused on some practical problem. BPR (business process reengineering) technique (Hammer and Champy, 1994) is focused on the improvement of business processes. Workflow technique (Workflow Management Coalition, 1995) is aimed at achieving effective coordination between people (and other resources) who participate in the same processes. Our approach is aimed at providing effective control over the processes. That means we are focused on devising means of ensuring that each process is run according to some predefined rules (however good or bad they may be).

In our approach, we take into consideration that processes exist not only in business, but in the physical world as well. The theory of physical processes control has quite a long history, and many useful concepts were worked out in its frame, especially in the field of hybrid dynamical systems (Schaft and Schumacher, 2000). We believe that at least some of these concepts can be successfully used for elaborating the tools for controlling business processes.

One of the main concepts of the process control theory is a process's *state*. This notion is the core of the *ObjectDriver* approach. A process's state is aimed to show how much has been done to achieve the objective of a process and how much is

still to be done. A state of a process is represented by a complex structure which includes attributes, and references to various human and non-human participants of the business process, such as process's owner, documents, etc. (see examples in the next section). A state of a process does not show what activities have been executed to reach it; it only shows the results achieved so far.

The process is driven forward through a set of stipulated states until its objective has been reached, e.g., a delivery has been paid for. The objective can be defined as a set of conditions which have to be fulfilled before a process can be considered as finished. A state which satisfies these conditions is called a *final state* of the process.

The process is driven forward through *activities* which are executed either automatically or with a human assistance. Activities can be planned first and executed later. A *planned activity* records such information as type of action (goods shipment, compiling a program, sending a letter), planned date and time, deadline, name of a person responsible for an action, etc.

The process's state is used as a primary tool in deciding on what should be done to reach the process's objective from the current state. All activities planned and executed in the frame of the process should be aimed to minimize the difference between the current state and the projected final one. However, in some cases, a *history* of the process's evolution in time is important when deciding on actions. The history is defined as a time-ordered sequence of all previous states.

Let's include in the process's state all activities currently planned for this process. As a result, the process's state beside its *passive part* (attributes and references mentioned above) will get an *active part*. The active part, i.e. the process's plan, will be responsible for moving the process forward. Making the plan an integral part of the state allows us to define the notion of valid state that can be applied not only to the final states of the process, but also to any intermediate state. For example, the process that is not in the final state, but has no activities planned for moving it to the next stipulated state is often considered to be in an invalid state. Formal rules can be defined to specify what planned activities could/should be added to an invalid state to make it valid. The use of these rules can be combined with manual planning.

When an activity is executed, a process changes its state. Changes concern both the passive and active parts of the state. The active part, i.e. plan, changes due to the executed activity disappears from the process plan and some new activities are

planned instead of it. Changes in the state constitute an internal time axis of the process. To link this axis to the real time, event registration is performed each time an activity is executed. A *registered event* is a record that links the change in the state of a process to the reality outside the process. For example, it can record the date-time when the event happened and/or was registered, name the responsible for the event, register comments on the event at the moment of registration (or even later), etc. A list of all events that happened within the frame of a given process constitutes the *chronicle* of the process, i.e. its written history.

Note that many notions that we use here to describe the *ObjectDriver* approach coincide with those used in descriptions of other techniques for business process modeling. What distinguishes, however, our approach from others is its focus on flexible control at all stages which is of primary importance for office processes. More on the distinguishing characteristics of the *ObjectDriver* approach see in (Bider and Khomyakov, 2000).

## 4. Visualization

The most obvious way of visualizing the *ObjectDriver* model is through using a state flow. A state flow (SF) is an ordered sequence of triples, each of which visualizes the process at a particular time, and includes:

- an image of the passive part of the state of the process,
- an image of the active part of the state of the process (plan),
- the chronicle of the process from the beginning up to the given point of time.

Moving through the sequence forward and backward gives an impression of a live process where activities executed result in state changes, new activities being planned, and the chronicle filled with new events. Examples of such images are presented in the next subsections.

### 4.1. Decision-making process

The main issue when using the *Object Driver* approach is designing a structure to represent the state of a process. As was mentioned in the previous section, the state structure should provide an overview of what has been achieved in the frame of the process up to the given point of time. Naturally, this structure depends on the

type of a process in question. A structure used in modeling the decision-making process is given in Figure 1. It includes the following components:

	Type	Requested	Received	Satus	Document	Author
1	Review		Yes	Evaluated	98/KK0190 Review 1	Union of Retired
2	Review	Yes	Partly		98/KK0190 Review 2	Department of Cult
3	Review	Yes	No			Department of Eld
4	Review		Yes		98/KK0190 Review 3	Department of Plar
5	Opinion			Final	98/KK0190 Opinion 1	Municipality lawyer

Figure 1. State of the decision-making process.

- *Formal parameters*, e.g.: reference number, title, start date.
- *Decision-maker*, i.e. a committee, or any other decision-making body.
- *Status* shows the overall stage of the process, e.g.: *initial*, *ongoing*, *decision made*, *resolution expedited*, *archived*.
- *Origin* shows the instigation of a decision-making process and consists of three components: *document*, *initiator*, and *contact*. *Document* describes the matter on which a decision should be passed. *Initiator* refers to an organization (committee, department, etc.) that recommended (or demanded) that the matter described in the document be considered. *Contact* refers to a person who can be contacted in case there are any questions on origin.
- *Resolution*, a document (or a set of documents) which contains a proposal or already authorized decision. The *status* of a resolution signals the stage of processing, namely: *reviewing the grounds*, *preparing a proposal*, *awaiting decision*, *decision made*, *decision valid*. *Meeting* refers to the meeting of a decision-making body during which a proposal is to be discussed, or a resolution was made.

- *Grounds* lists documents on the basis of which a decision is going to be made or had been made. A row in the *grounds*, besides referring to a document and its author, embraces the following:
  - *Type* of a document, e.g.: *review* (submitted by external organization), internal *opinion*, existing *contract*, *contract proposal*, existing *law* or other kind of regulations, etc.
  - *Stage* of processing is expressed by three attributes: *requested*, *received*, and *status*. *Status* can be *preliminary*, *final*, and *evaluated*.

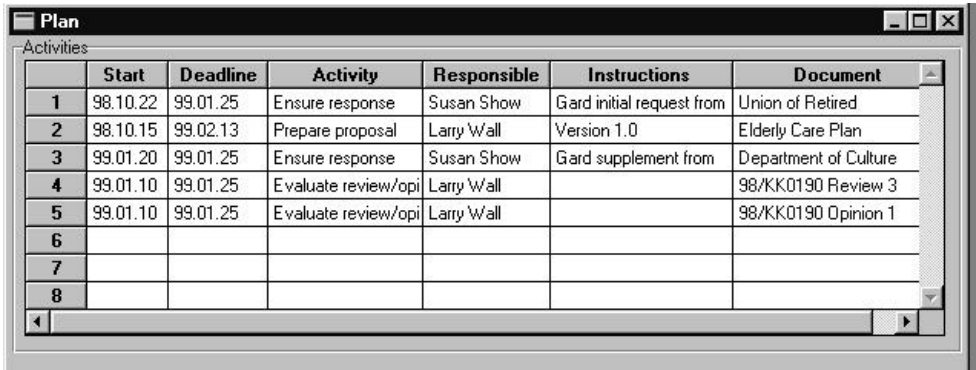
The state of the decision-making process having been defined as above, the *objective* of the process can be expressed as the following set of conditions:

- each component of *grounds* has its *status* set to *evaluated*,
- the *status of a resolution* is set to *valid*,
- the *status of a process* is set to *archived*.

The process presented in Figure 1 cannot be said to have reached its objective as the above listed conditions have not been satisfied. This fact is reflected in the plan of the process which is shown in Figure 2. The plan consists of the list of activities currently planned for the process. The main components of each planned activity are as follows:

- *Name* of activity, e.g.: define grounds, request review, prepare opinion, etc.
- *Execution conditions* which, in most cases, can be defined with the help of two date-time points: start and deadline.
- *Responsible* (actor) defines who is to perform the action.
- *Instructions* (in the text form) contain additional information on what should be done in complement to what is determined by the activity name and other parameters.
- *Document* points to a relevant document for those activities that deal with documents, e.g., *send letter*, *evaluate review*, etc.

- *Counterpart* refers to an external person (contact), or organization in case of a communication activity, e.g. send/receive letter.



	Start	Deadline	Activity	Responsible	Instructions	Document
1	98.10.22	99.01.25	Ensure response	Susan Show	Gard initial request from	Union of Retired
2	98.10.15	99.02.13	Prepare proposal	Larry Wall	Version 1.0	Elderly Care Plan
3	99.01.20	99.01.25	Ensure response	Susan Show	Gard supplement from	Department of Culture
4	99.01.10	99.01.25	Evaluate review/opi	Larry Wall		98/KK0190 Review 3
5	99.01.10	99.01.25	Evaluate review/opi	Larry Wall		98/KK0190 Opinion 1
6						
7						
8						

Figure 2. Process's plan.

Note that an activity can be executed without preliminary planning. However conceptually, this case may be considered as planning and executing in one step with *execution conditions* set to “now”. This view forces unplanned execution to be subjected to the normal rules of planning discussed later.

When an activity is executed in the frame of the process, it becomes an event, e.g., *request sent*. The event name corresponds to the activity name, but it is written in the past tense. A list of events happened in the frame of the process so far, i.e. the process's chronicle, is shown on Figure 3. The chronicle serves as a table of contents for the process as it allows going from the event to the state of the process before or after this event.

A set of state-plan-event pictures taken after each event (be it planned, or happened arbitrary) constitutes a lifeline of the process. Studying various examples of such lifelines gives a good understanding of the process behavior.

Chronicle					
Events					
	When	Event	Responsible	Comments	Document
1	98.09.17	Initiated	Susan Show		Request for elderly care plan
2	98.09.18	Grounds defined	Steve Smith		
3	98.09.22	Request sent	Susan Show		Request to Department of Culture
4	98.09.22	Request sent	Susan Show		Request to Department of Elderly
5	98.09.22	Request sent	Susan Show		Request to Union of Retired
6	98.09.22	Request sent	Susan Show		Request to Department of Planning
7	98.10.15	Opinion written	Jim Smith		98/KK0190 Opinion 1
8	98.12.20	Review recieved	Susan Show		98/KK0190 Review 1
9	98.12.21	Review recieved	Susan Show		98/KK0190 Review 2
10	99.01.15	Review evaluated	Larry Wall		98/KK0190 Review 1
11	99.01.05	Review evaluated	Larry Wall		98/KK0190 Review 2
12	99.01.10	Request sent	Susan Show		Request to Department of Culture
13	99.01.10	Review recieved	Susan Show		98/KK0190 Review 3
14	99.01.11	Meeting set	Susan Smith		

Figure 3. Chronicle.

## 4.2 Recruiting process visualized

The state of the recruiting process is shown on Figure 4. It includes the following components:

Recruiting Process										
Recruiter	DVE BENGTTSSON		Status	VISITING		Start	980222		End	
Entrance			Recruiting Information			Document				
Street	SPARVGATAN		Pr. Owner	EKTRÄDET AB		EVALUATION 199802				
Nr	9		Local org.	166						
Zip	41667	Code	3056							
City	GÖTEBORG		Address Info							
General Info										
Recruiting table										
Floor	#	Tenant	Phone #	Status	Visit	Ring	Info	Form	Comm	
2	21	LINDSTRÖM	031-7027305	No	C					
2	22	SCHEELE	031-7028302	Yes	C			541010-2402		
2	23	NORDENMARK	031-7029350		NO					
1	11	LUNDBLAD	031-7024830	NB						
Feedback		Stairs were very dirty during the visit. Many compalins from the tenants				Stairs were very dirty during the visit. Many compalins from the tenants				

Figure 4. State of the recruiting process.

- *General data: Recruiter, Start and End dates and Status*, where *Status* shows the overall stage of the recruiting process like: *initial, visiting, phone, mail, finished*.
- *Information* on the entrance to be visited: address, port code, etc.
- *Recruiting information*, i.e. information to be used during recruiting conversations. The following types of information are used:
  - information connected to the property owner, e.g., cases of its improper behavior against which the association is fighting,
  - information about a local branch of the association, e.g., address, telephone, a list of current activities, etc.,
  - information concerning the whole district, e.g., plans of building a new motorway to which association oppose,
  - information on the activities of the whole association, e.g., cases of successful negotiations, etc.

Each type of information is presented in a special document. The documents are linked to the process state when the process is initiated (if they exist at that time). Alternatively, they may be created and linked at the later stages of the process based on the information gathered by the recruiter (see below).

- *Recruiting table* shows the stage of processing for each apartment that belongs to the given entrance. The stage is described by the following columns:
  - *Floor* – floor number: Ground, 1, 2, etc.
  - *#* - apartment number (were appropriate).
  - *Tenant* - name of tenant, or blank if the apartment is empty for the moment.
  - *Phone #* - phone number to the apartment obtained if a phone contact is necessary or appropriate.
  - *Status*:
    - *M* – already a member of the association
    - *empty* – no contact yet
    - *Yes* – the tenant has been recruited during the process
    - *No* – the tenant could not be recruited during the process
    - *NB* – the tenant doesn't want to be bothered again.
  - *Visit* – status of visiting the apartment:
    - *empty* – have not tried (yet)

- *NH* (not at home) – nobody answered the call
  - *NO* (might be at home) – nobody answered the call but it looks like somebody was at home (and was afraid to open to a stranger)
  - *C (contact)* – the recruiting conversation has taken place
  - *R* (repeat) – the tenant wished to have a conversation at another time.
  - *Ring* – status of recruiting by phone:
    - *empty* – have not tried (yet)
    - *N* – nobody answers
    - *C (contact)* – a recruiting conversation has taken place
    - *R* (repeat) – the tenant wished to have a conversation at another time.
  - *Info* – status of the tenant’s request for printed materials:
    - *empty* – the tenant has not requested the printed info
    - *R* – the tenant requested the printed info
    - *S* – the printed info has been sent to the tenant.
  - *Form* – link (reference) to the application form filled by the tenant in case he/she has been recruited during the given process.
  - *Comment* – any comments the recruiter considered to be of importance.
- *Feedback* – describes any matter that the recruiter wants the association to deal with, for example, a complaint. This information is to be submitted to a manager who can start a process of solving the problems discovered by the recruiter. This process may result in preparing a new recruiting document containing a new example of the problem solved with the help of the association. If the document is ready before the given process is finished, it is linked to the process so that the recruiter can use a fresh example during his next visit to the given entrance.

In case of a recruiting process, it is difficult to formulate the objective based only on the process’s state. Obviously, the state is final if for each row in the recruiting table *Status* is set to the following values: *M* (member), *NB* (don’t bother), *Yes* (has been recruited) or *No* (has not been recruited). This state can only be reached if all tenants have been contacted in person, or via the phone, which is difficult to achieve in practice. It is up to a recruiter to decide when to finish the process. The rule of thumb is "at least half of the non-member tenants have been contacted" or "the number of visits is not less than two".

The state of the process in Figure 4 is not final and the process’s plan should be provided to make this state valid. The plan is visualised in the same way as in Figure 2.

## 5. Describing activities

To complete the description of a business process, we need to specify what activities can be executed within its frame and describe what these activities are supposed to do and how they are planned. So far this task cannot be fully visualized in SF, and it is done in the text form. The latter can be translated into some formal language to be understood by the computer.

Each activity determines an external and/or internal action. The external action describes what should happen in the outside world (the world outside a process), e.g., a review request is sent by mail to an external organization. The internal action defines how the process's state has to be changed, e.g., a review is marked as requested (see Figure 1).

If a process is not in a final state, some activities should be planned to move it forward. Without planned activities, the process hangs, which should not be allowed. The rules of adding new activities based on the current state are called planning rules. The planning rules can be divided in three categories (Kueng and Kawalek, 1997):

1. *what* (is to be planned),
2. *when* (the planned activity should be executed),
3. *who* (is to be made responsible for executing an activity).

These three categories are discussed in more detail in the following subsections. Note that our treatment of rules from categories 2 and 3 does not differ much from what the workflow standard suggest (Workflow Management Coalition, 1995). We discuss these rules here just to make the picture full.

### 5.1 What

The state of the process and sometimes its history determine which activities are needed to move the process forward. Let us assume the *grounds* of the decision-making process from Figure 1 include an external review. If the review is neither marked *requested*, nor *received*, an activity to *send a review request* should be planned. When the review is marked as *requested*, but not *received*, activity *ensure response* should be included in the plan.

It's impossible to foresee all possible ways a process can develop in time. That's why the planning rules should not be rigid, they should allow a responsible person a freedom to manually adjust the plan to be able to cope with unexpected events. The *what rules* embrace the following three types:

1. *Obligations* define mandatory activities, e.g., *send a request* in the example above.
2. *Prohibitions* define which activities cannot be planned in the current state. For example, an *ensure response* activity should disappear from the plan as soon as the decision is made that the review in question is not needed for decision making.
3. *Recommendations*. Anything that does not belong to obligations, and is not forbidden by prohibitions is permitted to plan. However, some standard actions can be recommended even if a responsible person can reject them, substitute or complement with other activities. For example, after an external review has been received, a confirmation should normally be planned. However, this activity can be left out, e.g., when the letter has been received with return receipt.

Note that three types of *what rules* defined above implicitly introduce the idea of policies in the domain of business processes. More on policies, see (ISO/IEC, 1995; Lupu and Sloman, 1997).

## 5.2 When

Planning the time limits for an activity, (*start* and *deadline*) requires taking into consideration the following factors:

- A natural gap to be expected between two consecutive interrelated events. For example, it is not feasible to expect an external review to arrive immediately after a request has been sent. The length of the interval is defined by some regulations or/and the amount of work that should be done to prepare a review.
- Availability of resources (people) needed for the completion of an activity.
- Priority of a particular activity if there are other activities that require the same resource, e.g., a particular person. Two types of priorities can be considered, the priority of the activity itself, and the priority of the process in which plan it is included.

### 5.3 Who

Activities may require human resources for their execution. We consider a *human resource* or *resource pool* as a list of people that:

- are able,
- have rights, and
- have obligations

to perform a certain activity within the frame of a business process in question. To have the rights and obligations, those people should belong to the staff of the organization that owns the process. Thus, a resource pool may be defined as a group of staff members. The definition of resources may not reflect the organizational structure of the process owner. It defines a “virtual organizational structure”.

The notion of resource pool is used to specify *who* can or must do *which activities*. This is done by assigning a list of activities to each resource pool. When a resource pool contains more than one individual, and there are no formal rules of assigning individuals to particular tasks (activities), a resource manager has to be appointed. The *resource manager* is a member of staff who is responsible for distribution of a particular resource pool. When an activity is planned that is mapped to his/her resource, the resource manager is obliged to assign a member of his/her pool to execute this activity. Consequently, activity planning might require two steps. First, an activity is planned without any resources assigned. Secondly, a resource manager assigns a particular member of his/her resource pool to complete the activity. Note that a resource manager need not to be a manager, this task can be done, e.g. by a secretary.

Note that the notions of resource pool and resource manager serve the same goal as the notion of role in other approaches, e.g., RAD (Ould, 1995).

## 6. How we worked

Groups of experts with whom we worked included people who occupied various positions in the municipality, and the tenants association. For example, the municipality included a manager for the administrative office, a secretary, a registrar, and a lawyer. In the beginning, the experts had no knowledge of business

process modeling, and the authors had a very vague idea of the processes going on in these organizations. Our knowledge was based on the documents we had received from the customers. They described the operational routines in a professional jargon which left outsiders no possibility to get insight into the business processes before meeting the experts.

The analysis was done in four steps, each of which included a meeting held with the group to discuss the progress.

1. The analysts describe their ideas of what business processes in general are and how they can be managed. The presentation was illustrated by examples from other business domains. The experts and the analysts try to identify the processes going on in the organization in question. The customers submit a description of current computer systems used.
2. The analysts draft state-plan-event pictures. An example of the process flow is created. For the municipality, it was done in the form of a simple WEB-based movie allowing the experts to browse through the process lifeline. For the association, the analysts elaborated a special tool that facilitates creation of the movie. An example of the process flow is discussed during the second meeting, and it is corrected after the meeting.
3. A conceptual model for the customer's business domain is built. Beside the description of the processes, it includes so-called static concepts, like *organization*, *individual*, *staff*, *contact*, *document*, *resource*, etc. The model consists of a list of terms, each term supplied with a definition/explanation. The conceptual model is discussed at the third meeting, and modified after the meeting.
4. During the fourth meeting, the activities needed to drive the business process forward are discussed in more details. The results of the discussion were presented in a document containing a table in which basic properties of each activity are defined. These properties include: how the activity change the state of the process, who can plan/execute it, what other activities should/can be planned after completion of the given one.

The conceptual model, the state flow examples, and the description of activities formed a basis for writing recommendations on tools for an effective management of the business processes analyzed.

## **7. Conclusion**

### **7.1 What followed**

The results of the analysis of the decision making process were used for writing requirements for a computer system to support this process. The municipality is currently looking for a system that satisfies these requirements. Most of the serious system vendors that answered the bid honored the clarity of the system requirements. While visiting the sites with reference installations of the offered systems, the experts from the analysis group have discovered that they have much better understanding of business processes than the people who already have installed so called processed-oriented systems.

Based on the results of the analysis of the recruiting process, a first version of support system has been developed, and it is about to be introduced in the business practice. The analysis of other business process in the tenants association continues. Some processes have been already analyzed, e.g., rent negotiation. Others are under investigation, e.g., lobbying (influencing political decision on a national or local level).

### **7.2 Lessons learned**

Our experience with two cases described above has proved that State Flow is quite an effective method of business process analysis. It allows to combine the knowledge and experience of experts in the field on one hand with that of business analysts on the other hand in order to obtain results in the timely fashion. Usually, 4 one-day meetings is enough to analyze one process.

The SF method is most appropriate for the loosely-structured processes for which it is not possible to obtain a sequence of activities performed even to a first approximation. To start with drafting a state structure is much easier than with inventing a sequence of activities that should lead to a not yet very well defined objective. A typical example of a loosely-structured process is lobbying (influencing political decisions) which we currently analyze.

Analysis of business processes with SF method has a value other than just being a foundation for a process support system. The experts consider that discussions of state pictures help them to structure their minds. Many ideas of how the process in question can be improved originated from these discussions. For example, when discussing the recruiting process, it was discovered that the number of members

recruited each year is approximately the same as the number of members that leave the association. It was decided that the recruiters must have "a sales" conversation not only with the nonmembers but with the existing members as well.

### 7.3 What is missing

To make the task of process analysis easier some means for visualizing activities description and rules of planning are required. Partly, this can be done with the help of diagrams. In appendix 1, we present a state-transition diagram that was used to explain connections between activities in the decision-making process. However, the known diagrammatic notations are not quite suitable for representing rules of planning. More research in this field is required.

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## Appendix 1. Diagrammatic presentation

It's difficult (if ever possible) to represent the whole decision-making process in a diagrammatic form. However, some details can be represented in this way. On Figure 5, a fragment of the decision-making process that concerns one external review is illustrated. Illustration is done in the form of a state-transition diagram where circles represent different states of the process, while arcs name the activities that move the process from one state to another. The diagram simplifies the actual picture, as it doesn't show global activities that can result in deleting the actual review from the *grounds*. It also doesn't show what activities could/should be planned in each state.

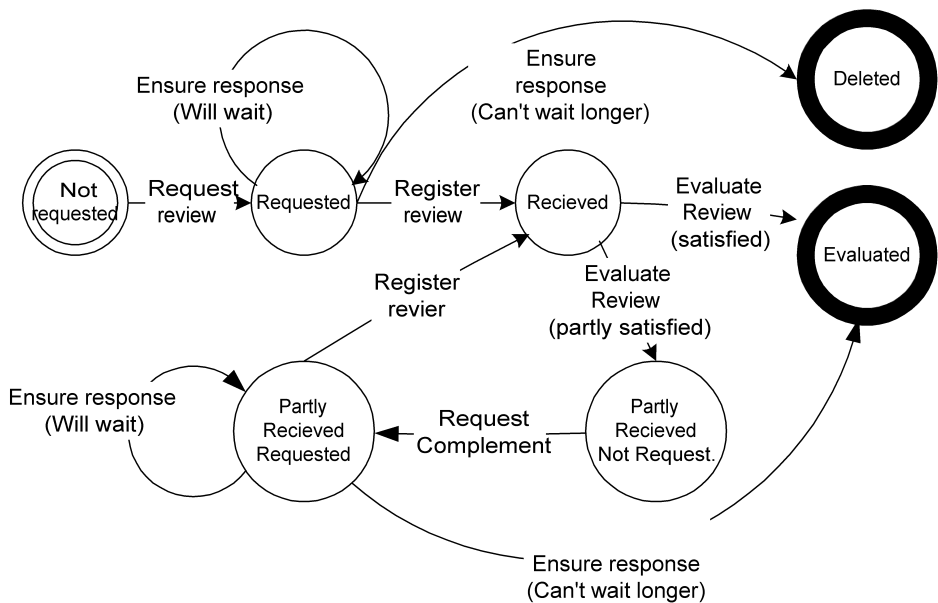


Figure. 5. State transition diagram for sub-process "Obtain external review".