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# Role-driven Business Process Models

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## Abstract

The responsibility and capacity of participants are given more attention in role-driven process models, which consist of roles and their relationships. In this paper, role-driven process modelling is firstly reviewed. Then role identification is discussed in the role-driven process models and a concurrent logical programming language ConGolog is used as a role-driven formal process model. Based on agent design platform JADE, role-driven process running is also simulated with an example illustrated.

**Key words:** Role-driven, business Process, formal model

## 1、 Introduction

Flow charts are very useful in information system analysis and design. At present, there are many process modeling methods, which describe a process from different perspectives. Among them, activity-based process modelling is prevalent. Business logic and dependency relationship between activities of process actors are mostly emphasized with little attention paid to the organization of people and their roles. Process modelling has come to be associated with the dynamic behavior of businesses more generally but the responsibilities and commitments among actors (humans or information systems that fill roles, perform tasks and interact during workflow execution) are hard to be grasped for complex processes, resulting in the difficulty in confirming the abilities of participants. Processes, in essence, consist of roles and their interaction. It is a customer-performer chain whose spots are roles and linked by communications between them. Activities and their logic relationships are only exterior of business

processes. In so doing, role-driven process modelling accentuates the way different roles cooperate instead of the decomposition of functions in achieving goals. Conceptually, role is a hierarchical concept, which encapsulates process participants' attributes and behaviors such as goals, abilities, responsibilities, restrictions and protocols. It is a module played by actors in different organization hierarchies – team members, functional departments or work teams etc.

Unlike organization structure, process models also include operations of organizations, which may activity-based or role-driven.. In order to overcome the disadvantages of the activity-based process modelling, the organizational factors are emphasized in role-driven process modelling, which enables the customer-oriented strategy in the information age. The customer may be people within a single organization, as well as across organizational boundaries.

In this paper the current research situation of role-driven process modelling is firstly reviewed, and then role identification is analyzed based on the discussion above, which is vital and difficult in the decomposition of business processes. In process formal description, ConGolog, a synchronous logic programming language is used, and role-driven process model is simulated on multi-agent platform JADE.

## 2、 Related work of process role modeling

Role concept has been used as researches on the auto-generated tools of management information systems [1], in which a role is a basic unit but it is usually used in the access control of information systems [2]. Only during recent years did few foreign scholars started to make research on the role-driven process modelling with few references. Moreover, several role-driven

process-modelling methods have been proposed that mostly are adapted from the activity-based process modelling, focusing on the interaction among roles. These methods can generally be divided into two categories: non-formal graphic models and formalized script language. As for the former, several graphical maps of the process have been discussed. For example, communication-based workflow modelling [3] stems from work on the Conversation with Action model preparation in which the technique reduces every activity in a workflow to four phases based on the communication between a customer and a performer: preparation, negotiation, performance and acceptance. The relationship between neighboring roles is considered as customer-performer built upon the central idea of customer satisfaction. The whole process looks like the set of interactive loops made up of the four steps. Essentially, communication-based workflow modelling embodies the content of the corresponding activity with the interaction between the neighboring two roles, too detailed to describe more complex processes. In the UML (unified modeling Language), how a group of cooperative roles take responsibility of a process fulfilling the required goal, and exchange messages can be modeled by cooperative graph [4]. Organization operation charts also describe how organization units including process workers, departments, work teams and organization related entities etc. coordinate in particular business environments, which makes it easy to identify the role each unit plays and analyze organization business keystones and future development chances. It appears to be an integration of a traditional organization structure chart and an activity-based process model to describe the organization operation in detail. Consisting of entities and their business relationships, organization operation charts concentrate more on how business process proceeds than the management chain. Generally, the function of the analysis and simulation of most process modelling systems is weak. The problem has been given attention. An individual or group in the organization carries out their activities spread over the

whole activity-based process model. In order to make it clearer that what activities they must take part in and how it interact with other participants, role activity diagrams (RADs) are introduced [5]. The basis of RADs is that activities that constitute the process may be grouped into roles, that is, we can cluster the activities an individual or group execute into roles so that their responsibility or set of responsibilities can be identified. Then attention can be on the interaction between roles. From the point of view, RADs can be derived from the activity-based process models, which also include other elements such as state that may be viewed as a point that depicts the thread of control of the role besides activities. Compared to activity-based process models, this complicates process modelling unsuitable for large-scaled processes. Some scholars also refer to Petri nets for RADs. On the other hand, RADs can be transformed into role activity diagrams, which can instead be mapped to simulation models to improve the analysis of business processes. In addition, the role-based executable model (RoEnact) can also be used for executable specification allowing errors to be spotted earlier [6]. RoEnact is a process modeling language that can generate synchronous process instances that can be executed. RoEnact models can be made up of the following behavior: action, interaction, selection and creation. The action of each role instance may change its own state and other roles involving the interaction move from one state to another. RoEnact is based on condition-action paradigm that the object-oriented technique often uses, but short of concurrent support within high-level roles and role identification. As for formalized process modelling notation, some process modelling languages provide a role-based perspective upon business process, such as BPML (business process modelling language) defined by BPMI.org and WPD (workflow process description language) by WFMC (workflow management coalition).

To conclude, role-based perspectives seem to have been paid the attention, but limit to the simple extension of activity-based technique and cannot provide

satisfactory process simulations. Prototype systems for the donation and analysis of role-based process models have not been reported.

## 2、 Role capturing and description

Roles can be seen the abstraction of hierarchical organization entities. To describe the role-driven business processes, roles and their interaction must be firstly identified. But how to compartmentalize roles from business processes are hard, which results in the interaction between roles. In the following discussion, we will solve the problem. A formalized role-driven process model in terms of ConGolog is also given based on the solution discussed above. And process simulation is conducted using multi-agent platform JADE.

### 3.1 identifying Role

High-level goals of organizations such as business strategy are difficult to be formalized, but they can be divided into several sub-goals that are more detailed and easier to be embodied. Processes are the way to achieve goals of the organization and their decomposition accords to that of the organization goals. Different organization entities take on different responsibilities. Sometimes a role is seen as a set of ordered activities that are taken part in by some specified actors, including individuals, function departments, inter-department work groups or even inter-organization confederation. The complex high-level processes that gain goals with more contents usually involve virtual roles that cross several functional departments.

The responsibilities of roles correspond to the sub-goals of an organization. Usually, two ways can be used to identify a role. One is from top to bottom that is suitable for process design. The other suitable for process analysis is from bottom to top. The first one is described as follows [7]:

Make clear goals of the organization, usually described in the natural language. It can be done by communicating with stakeholders, investigating organization strategies

or other organizations in the industry.

Decomposing goal. Specific sub-goals can be obtained by analyzing how goal goes deep into sub-levels to solve complex tasks. As a result, the “and/or” chart can be used to represent the decomposition of goals. The conflict and influences between the goals should be paid more attention to because they are related.

Identifying roles and their obligation, which synchronizes with breaking up goals. As for a certain goal, the role that is able to accomplish it may be confirmed, or further refining should be made. Different level roles are responsible for different goals on different levels

Detail how each role act and the interaction with other roles. Organization entities are allotted a sequence of activities to add value to business processes as their responsibilities. The responsibilities are consistent with the essence of role concept. Bottom to top role identification such as RADs mentioned above can be extended from activity-based process models. Roles encapsulate how anticipant behavior of individual groups by grouping activities that are taken charge of by the same entity. Comparably, bottom to top role identification seems more intuitive and makes it easy to translate from activity-based process models. Moreover, the method need not have a good grasp of the origination in detail beforehand. The top to bottom idea seems to be easier. However, role must be drawn out directly according to the degree of relevance between activities and roles, which seems to be too subjective and hard to provide the adaptable granularity of a role. As for some more complex processes, the method will consume much time. Here the idea in reference 8 can be introduced to solve the problem, which proposes that the role-relevant process view can be got by means of the degree of relevance between roles and activities. In the method, process operations and access control policies are utilized to define the degrees of relevance between organizational roles and tasks. A process is partitioned into several role-relevant views by threshold (a virtual activity which satisfies the property of order-preserving).

Then the number of roles and the activities they do can be approximately figured out by the process views.

### 3.2 Formalization of role-driven process

Processes consist of internal activities presided over by roles and bidirectional interactions between neighboring roles. In role-centered process modelling, the interactions are especially emphasized. Herein, Congolog will be used to discuss the process formalization and agent platform JADE will be used to do simulations. Congolog is a concurrent logical programming language that supports the cooperation between multi-agents [9]. In the role-based formal process models, a process is defined as a set of roles that commit to each other because performer-customer relationship exists between neighboring roles. Each role takes on the responsibility of sharing process goals, internal activities and interactions with other roles. Interactions are included in activity functions of roles. Fig. 1 illustrates the RAD of the loan examining and approving process.

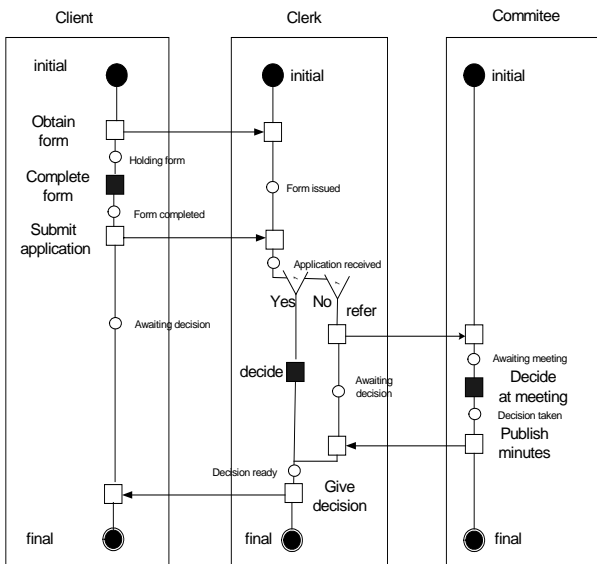


Fig. 1 The RAD of the example process

The following is the script of role Clerk in the language Congolog :

```

role Clerk
responsibility ...

```

```

Action Decide ...
endAction
Action refer (b, c, app) ...
endAction
Action SenseMessage ...
endAction
action GiveDecision (b,app) ...
endAction
proc Evaluate (self,app)
if WithinGuideline (app) then
Decide
else for c: Actor (c) ^ PlayRole (c, Committee) do
Refer (self, c, app)
endFor
endProc
proc main
( a: Submit (a) ^ Received (a, self) → Evaluate
(self,app)
>>

```

```

while true do
SenseMessage
if ! Empty (MessageQue (self) ) then
GiveDecision (self,app)
endWhile
endproc
endRole
Role committee:
omitted...

```

Some problems still exist in the formal model discussion above. For example, it takes much time for the modeling personnel to be familiar with the situation calculus and the language Congolog. Moreover, when processes change, it is difficult to maintain the model. Some modeling tools, therefore, are needed.

### 3.3 Simulation based on JADE

Agent is an intelligent entity with self-governance, sociality, reactivity and initiative etc. It has been widely used in many fields. In view of having some common characteristics of roles such as knowledge, faith, obligation, intension and so on, in our discussion

multi-agent is used to simulate the coordination process of multi-roles. Each agent corresponds to a role in RADs. Activities and interactive rules are stored in knowledge base of the agent, which can be referred from the ConGolog process model. The instances of a role (a role may have many instances) can take concurrent actions, which fits in with the actual running of processes. Simulation platform is based on Java JDK environment and JADE (Java Agent Develop Framework) provides a frame that can be used to construct the expected agent system. Some common properties of agents are stored in the role class while individuation knowledge is stored in activity rules of roles. The reasoning machine of agents is implemented by embedding JESS (Java Expert System Shell), an expert system programmed by Java, which provides a script language to edit activity rules of the role. In addition, the agent that stays in the container as a manager, which coordinates other agents. Part of the simulation interfaces is shown in fig.2. From the simulation result, interaction procedure and internal activities of each role can be observed clearly so that the process logic can be well verified.

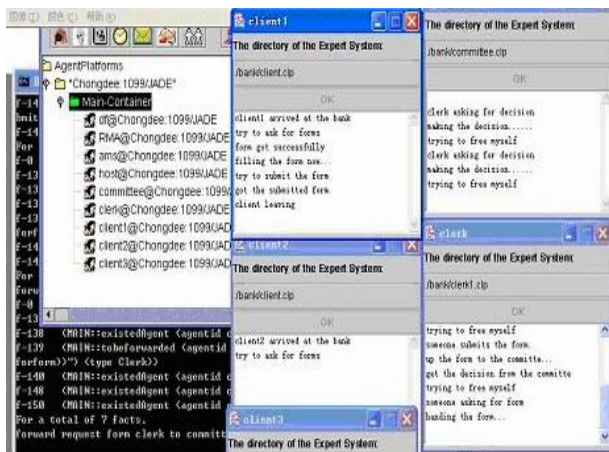


Fig.2 Simulating process using JADE

### 3、 Conclusion

Instead of control relationship, cooperation is emphasized in role-driven process models. Actually the role-driven models are a customer-performer chain that

is role-centered and consists of multi-roles, which makes it easier to carry out the customer-oriented strategy. On the other hand, the role-driven process models do not exclude the activity-based ones, but to seek for the combination of the two. Generally, the granularity of role-driven process models is larger, which should be detailed using activity-based process modelling when needed.

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