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## Workflow Modeling based on State Chart

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## II. Related Study 2.1 Workflow

- Workflow is a business process executed and managed by a computer
- Workflow Management System
  - Software which defines, executes and manages workflow
  - Plays a main role executing and managing a process based on several information system which supports a business process
- Development of workflow
  - Workflow integrates business process and application for business executed individually
  - Workflow contributes to automate business and exchange information efficiently
  - Recently, there is an attempt that make it easy to manage cooperation and exchange business quickly for integration between enterprises

## I. Introduction

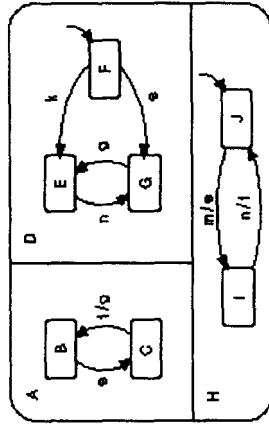
- Many specification languages has been developed for workflow modeling, but their emphasis on the process semantics make it difficult for use on the business process modeling.
- Also their lack of understanding of global view of business process adds another problem to model workflow in a seamless and accurate and timely fashion.
- In this paper, we propose a semi-formal visual approach in building a workflow model based on Structured State Chart.
- A transition from informal descriptions to concrete descriptions can be done easily and seamlessly.
- It enables to model and automate sophisticated business processes in a structured way.
- Graphical characteristics of the proposed system can easily include customers, producers, and other prospectives in the system.
- We will show how to build a simple B2B transaction into state chart based work flow model and also will show it's XML model conforming to BPEL4WS.

## II. Related Study 2.2 State Chart

- Structured State Chart
  - Proposed by David Harel
  - A visual fixed method in order to detail response system(2)(3)
  - An expansion of existing State Transition Diagram(4)
    - Adding concept of hierarchy, concurrency and broadcast communication
  - A fixed method which cluster or concretize state and transition

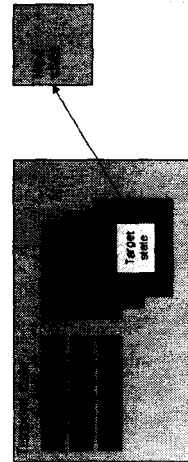
## II. Related Study 2.2 State Chart

### □ Example of State Chart



## II. Related Study 2.2 State Chart

- In this paper, we propose advanced State Chart Concept in order to describe dynamic action of system
  - In each state, trigger(or event, condition) is defined
    - Define target state and action when trigger is activated
  - Define activity(actions) which is executed in temporal state
    - entry action : action which is activated when just entered
    - do action : action which is performed in state
    - exit action : action which is activated when just exit
  - This is a figure that describe advanced State Chart



## II. Related Study 2.3 BPEL4WS

- Business Process Execution Language for Web Services
  - Developed for describing execution of business process
  - Specification that BEA Systems, IBM and Microsoft established in order to activate Web Services
  - Process in BPEL4WS executes function through Web Services Interface
  - Provides protocol that combines distributed Web Services and manage transaction with WS-Coordination and WS-Transaction

### III. Workflow modeling 3.1 Workflow scenario

□ **Analyst' virtual scenario(s)**

Customer, Producer, Supplier\_1 and Supplier\_2 are participant of B2B electronic commerce.

1. Customer sends an order to Producer for purchasing Product A.
2. Producer orders Product B to Supplier\_1 and Product C to Supplier\_2.
3. Supplier\_1 and Supplier\_2 makes Product B and C. When Product B and C are delivered, Producer assembles material and make Product A, and then delivers Product A to Customer
4. Customer receive Product A and pays a charge to Producer.

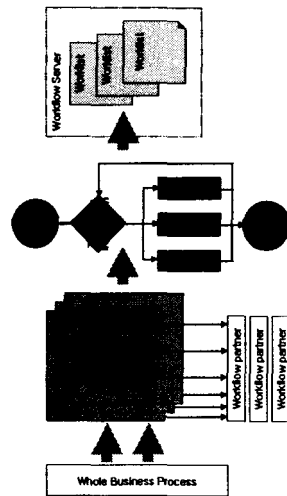
### III. Workflow modeling 3.2 Workflow modeling using State Chart

□ **State Chart as a Modeling Tool**

- o Very difficult to model a whole business into individual states as a flat design
  - o Hierarchy may be a key word in analyzing a big and complicated business process
- **Modeling procedure**
- o Divide whole business into individual unit states which has start and final end points
    - Each unit state consists of sub states
  - o Model workflow perceive that participate at unit state or sub state
  - o Model transition trigger and action/event, do and exit
  - o Finally, develop a work list after an analysis of transition trigger, activity and partner in a server

### III. Workflow modeling 3.2 Workflow modeling using State Chart

□ **Procedure of Workflow Modeling**



### III. Workflow modeling 3.2 Workflow modeling using State Chart

□ **Analysis of Producer's business in B2B workflow**

1. wait\_order state that is waiting for ordering
  1. When Customer orders Product A, receive\_order\_a event is generated.
  2. Temporal state is converted into wait\_delivery\_ab state
2. In entering wait\_delivery\_ab state, entry actions is executed that one is send\_order\_b event of and another is send\_order\_c of Supplier\_2 and the other is notify event of Customer
3. In wait\_delivery\_ab state, Customer system check delivery of product A and product B by executing check\_delivery\_bc method
  1. In this state, because Product B and C is delivered concurrently by Supplier\_1 and Supplier\_2, sub states are activated
  2. In sub state of wait\_delivery\_bc, check\_delivery\_b and check\_delivery\_c are executed
  3. When delivery is complete, receive\_delivery\_bc event generated
  4. When receive\_delivery\_bc event activated, temporal state is converted into wait\_payment state

### III. Workflow modeling 3.2 Workflow modeling using State Chart

#### □ Analysis of Producer's business in B2B workflow(continued)

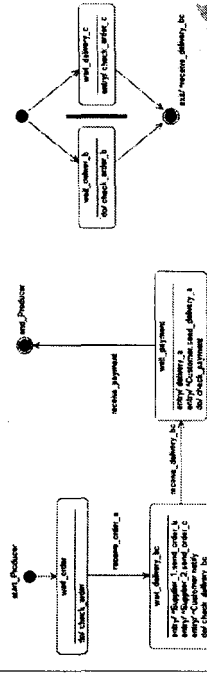
4. In wait\_payment state
  1. Entry action that deliver\_a which deliver Product A is executed and send\_delivery\_a event activated
  2. Do action check\_payment executed
  3. When payment is completed, whole business process is completed
  4. Process end

### III. Workflow modeling 3.2 Workflow modeling using State Chart

#### □ UML expression of State Chart

- o This is the UML expression of Supplier's business process

#### □ Producer's State Chart Diagram



### III. Workflow modeling 3.3 XML Expression of State Information

#### □ BPEL4WS Language for State Chart-to-XML Expression

#### □ Mapping Schema

State Chart	BPEL4WS		Note
	Element	Attributes	
unit state	<process>	name	
partnes	<partner> <partner>	Name ServiceLinkType myRole, partnerRole	
Transition	<sequence> <flow>, <switch> <parallel>		Trigger information
entry, do, exit action	<receive>, <invoke> <reply>	partner, portType, operation, inputContainer outputContainer	

Listing 1. State Chart-to-BPEL4WS Mapping Schema

### III. Workflow modeling 3.3 XML Expression of State Information

```

<?xml version="1.0" encoding="UTF-8" ?>
<process name="Producer" xmlns:bpe4ws="http://schemas.xmlsoap.org/ws/2003/05/bpel/instance#" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://schemas.xmlsoap.org/ws/2003/05/bpel/instance# http://schemas.xmlsoap.org/ws/2003/05/bpel/instance.xsd">
  <sequence>
    <receive name="receive_order_a" partner="myRole" portType="myRole" operation="receive_order_a" outputContainer="" />
    <do name="deliver_a" partner="" portType="" operation="deliver_a" outputContainer="" />
    <switch name="switch_payment" partner="" portType="" operation="switch_payment" outputContainer="" />
    <do name="check_payment" partner="" portType="" operation="check_payment" outputContainer="" />
    <do name="deliver_a" partner="" portType="" operation="deliver_a" outputContainer="" />
    <do name="deliver_a" partner="" portType="" operation="deliver_a" outputContainer="" />
    <do name="deliver_a" partner="" portType="" operation="deliver_a" outputContainer="" />
    <do name="deliver_a" partner="" portType="" operation="deliver_a" outputContainer="" />
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  </sequence>
</process>

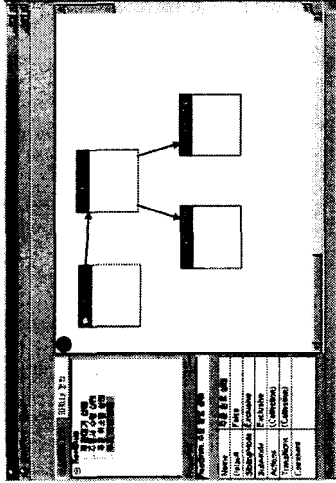
```

## IV. Implementation

- Implementation environment
  - OS : Windows 2000 Server
  - Implementation Tool : Microsoft Visual Studio .Net 2002
  - Database : MS SQL Server 2000

## IV. Implementation

### □ Visual tool interface



## V. Conclusion and future study

- Summary
  - The State chart supports hierarchy, concurrency and broad communication
  - Analyze workflow based on State Chart
  - Create State Chart Diagram according to results of analysis
  - Create BPEL4WS's XAL document using proposed visual tool
- Benefits using State Chart
  - A transition from informal descriptions to concrete descriptions can be done easily and seamlessly
  - Make it easy to model workflow using hierarchy, concurrency and broad communication of State Chart
- Future Study
  - Validation workflow language based on Workflow Management System

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