

A State Transition Model for Business Processes

Towards Object-oriented Business Process Automation

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Abstract: This paper develops a new model for business processes, called State Transition Model. According to this model, a business process instance starts in some state, then flows, not necessarily sequentially, through zero or more intermediate states, until it is terminated in one of the states. The State Transition Model isolates the workflow part of a process from the non-workflow parts. The State Transition Model facilitates object-oriented design of business processes. It results in a top-down approach to human-centric business process automation. This is in contrast to the popular BPMN model, which results in a bottom-up approach.

1 INTRODUCTION

Business process automation is the strategy an organization uses in order to reap one or more of the following benefits:-

- Improved operational efficiency
- Reduced turnaround times
- Consistency of business activities
- Reduced errors
- Reduced operating costs

Process automation methodologies should ideally enable integration of existing proven software applications, or third-party software, in order to avoid “re-inventing the wheel”, as well as to reduce the associated development costs.

Automation of a given business process typically begins with a process model (Havey, 2005; Aalst, 2009; Weske, 2007; Object Management Group, 2011). It is usually a BPMN model, which appears to be a defacto industry standard.

2 STATE TRANSITION MODEL

In this paper, we propose a State Transition Model for business processes. Our model is quite different from that proposed by Huang (Huang, 1998), in which a process is modelled as a collection of states, with each task, or activity, represented by one state, and several types of transitions between states.

According to our model, a business process starts in a state, called *StartState*, then flows, not necessarily sequentially, through zero or more *intermediate states*, until it is terminated in one of the states. In each state, a corresponding *role* performs one or more activities. (See Figure 1).

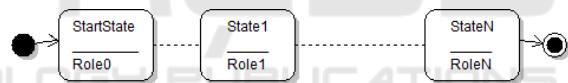


Figure 1: State Transition Model.

Note: A business process instance can simultaneously be in more than one state, pending activities to be performed by the corresponding role players (actors). This can happen due to parallel workflow. Shown in Figure 2 is a process that can simultaneously be in States y_1, \dots, y_n , since it flowed simultaneously, i.e., in parallel, from State x to States y_1, \dots, y_n .

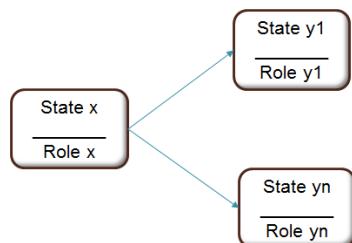


Figure 2: Parallel Workflow.

3 STATE TRANSITION MODEL DEVELOPMENT

Each state is represented by a rounded rectangle. (See Figure 3). The name of the state, and the name of the role, are shown within the rounded rectangle. Attached notes list out

1. The activities performed in the state, and
2. The state transitions from out of the state.

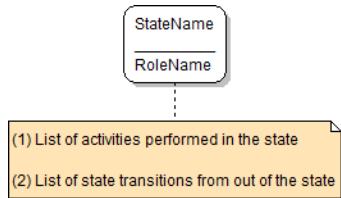


Figure 3: State Representation.

StartState is represented as shown in Figure 4.

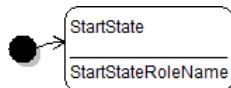


Figure 4: StartState Representation.

A state in which the process can be terminated is represented as shown in Figure 5.

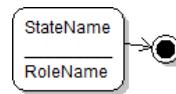


Figure 5: Process Termination.

An arrow from one state to another represents a *potential state transition* (See Figure 6).



Figure 6: Potential State Transition.

A flow chart for developing a State Transition Diagram is shown in Figure 7.

To create State Transition Diagrams, you can use any State Diagramming Tool, e.g., Violet UML Editor, a free download from <https://sourceforge.net/projects/violet/>.

4 EXAMPLE: LEAVE APPLICATION PROCESS

The employees of an organization (e.g., a corporation) can go on leave only after due approval. One of the employees plays the role of HRManager, who is the final authority to approve leave. Typically,

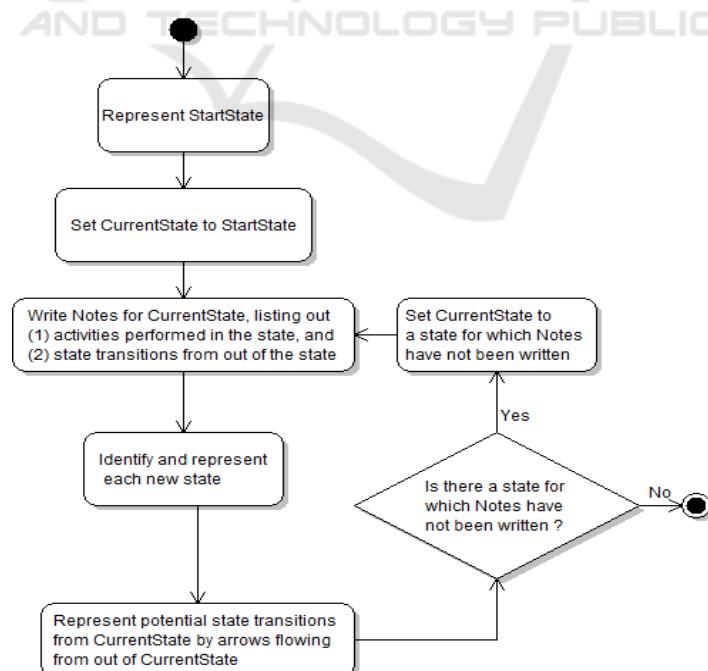


Figure 7: Flow Chart for Developing a State Transition Diagram.

every employee has a Supervisor; however, there are a few senior employees who do not have Supervisors. In case an employee has a Supervisor, the latter's approval is also required for going on leave.

Leave Application Process is as follows:-

- LeaveApplicant starts the process by inputting (i) Leave Start Date, and (ii) Number of Days of Leave Required. In case the LeaveApplicant has a Supervisor, the Leave Application goes to the Supervisor; otherwise, it goes straight to HRManager.
- Supervisor either approves, or disapproves, the Leave. If he / she approves, the Leave Application goes to the HRManager; otherwise, it returns to the LeaveApplicant.
- HRManager either approves, or disapproves, the Leave. In either case, the Leave Application returns to the LeaveApplicant.
- LeaveApplicant terminates the process.

Leave Application Process – StartState is shown in Figure 8.

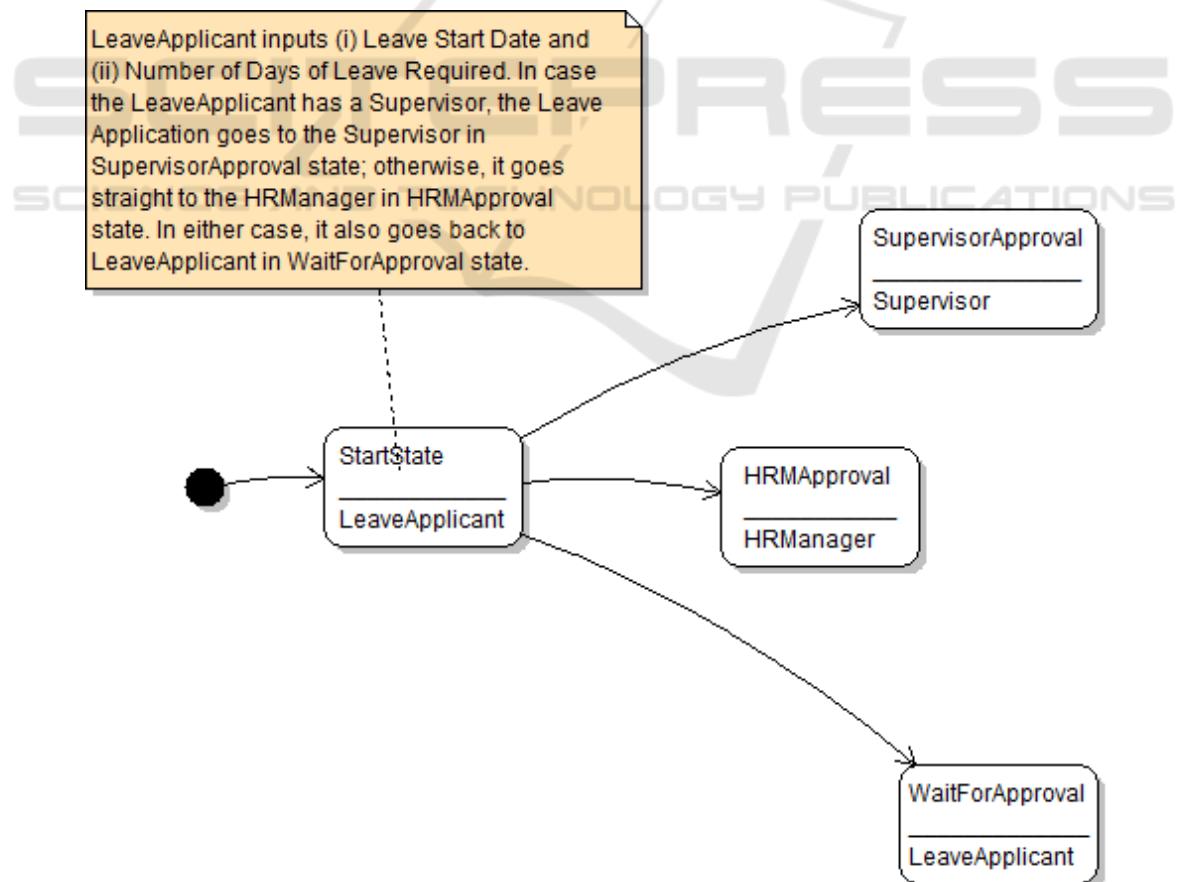


Figure 8: Leave Application Process - StartState.

5 DISCUSSION

The State Transition Model enables us to treat a business process instance as an object belonging to the business process instance class. The object *always* gets created in the StartState of the process under consideration. Thereafter, the object may make one or more state transitions. At some instance of time, the object can simultaneously be in more than one state. Finally, the object may get destroyed while in some state(s).

The State Transition Model does not model the activities performed in each state. These activities do not involve workflow; techniques for modeling such activities are by now well established, notably UML (Rumbaugh, 2004).

The State Transition Model also models only the *potential* state transitions. The conditions under which each state transition takes place are not modeled. This is because, typically, the conditions will involve values of data in a database; therefore,

Leave Application Process – SupervisorApproval state details are added on, and shown in Figure 9.

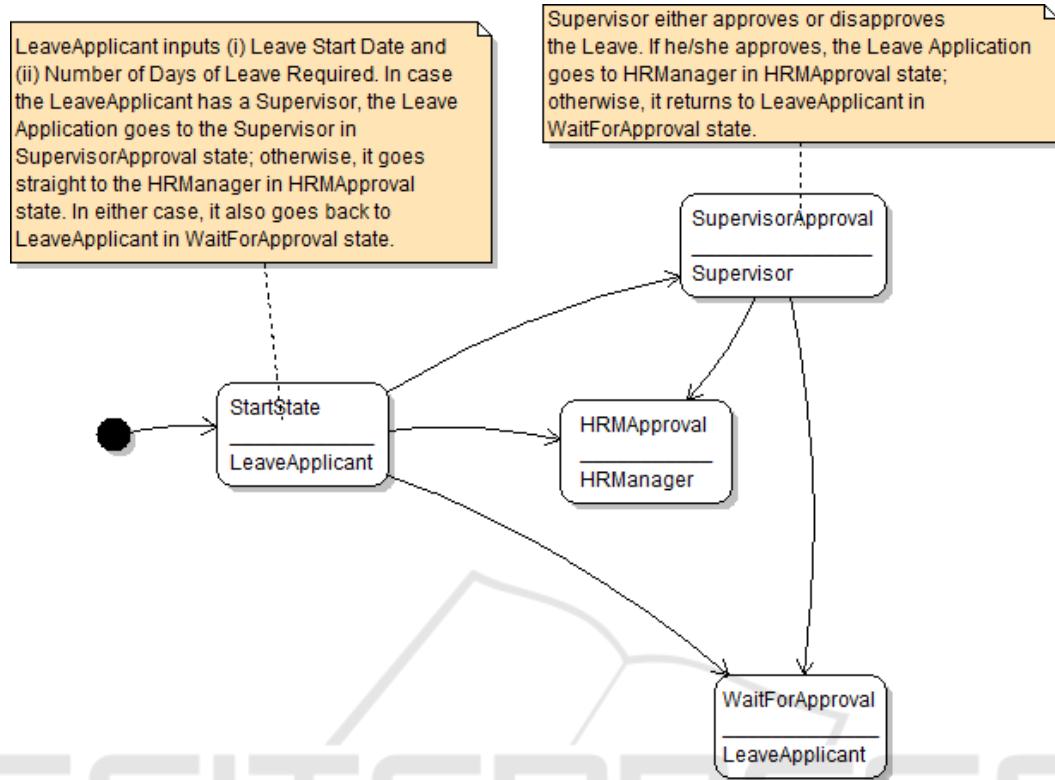


Figure 9: Leave Application Process - SupervisorApproval.

Leave Application Process – HRManagerApproval state details are added on, and shown in Figure 10.

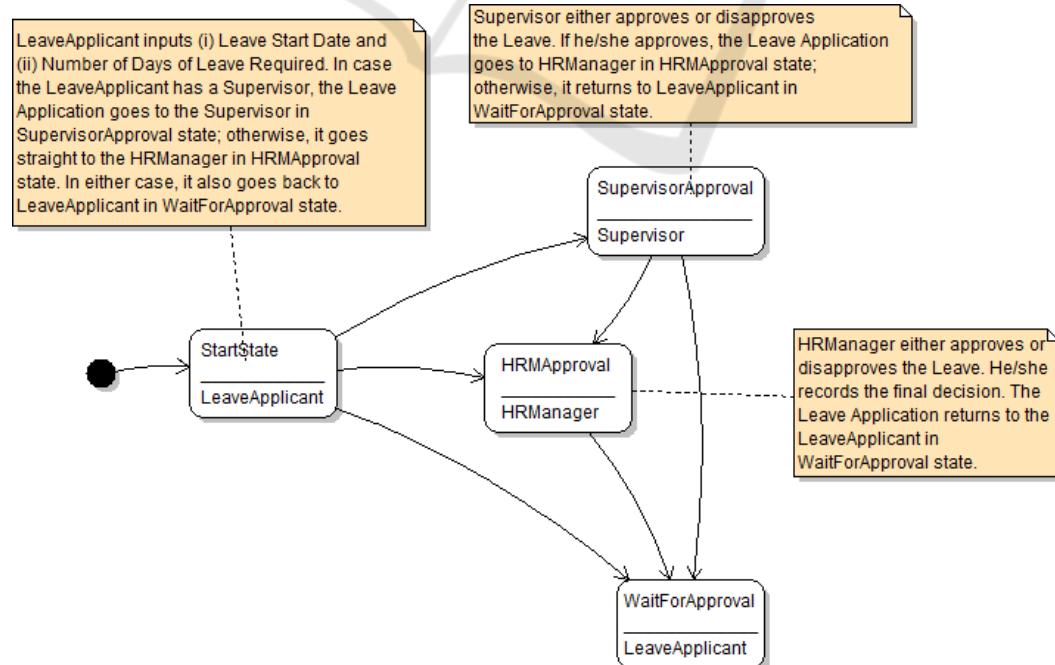


Figure 10: Leave Application Process - HRManagerApproval.

Leave Application Process – WaitForApproval state details are added on, and shown in Figure 11.

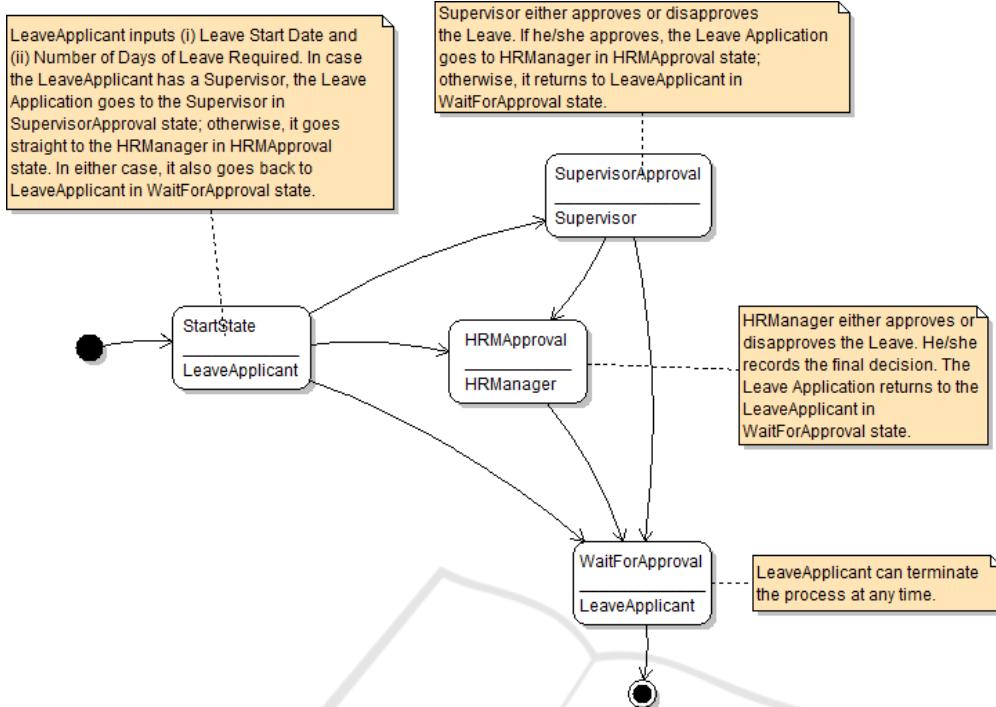


Figure 11: Leave Application Process - WaitForApproval.

The final Leave Application Process – State Transition Model is shown in Figure 12.

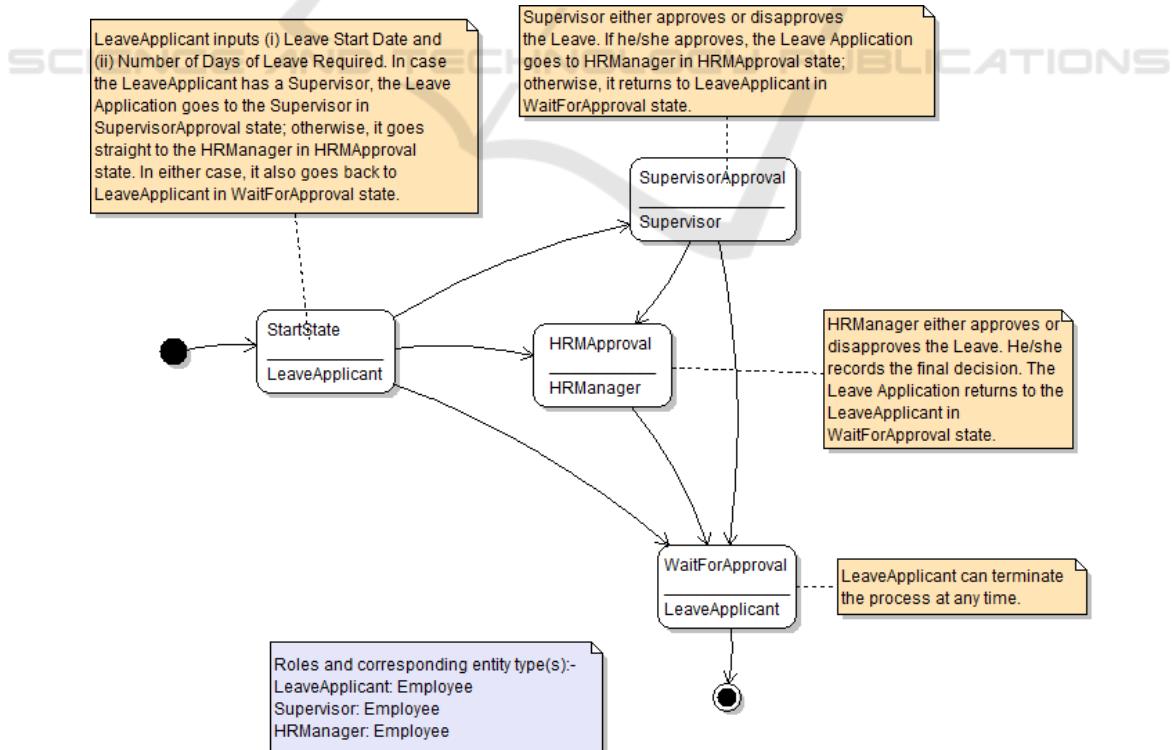


Figure 12: Leave Application Process – State Transition Model.

modeling these conditions is deferred to the coding phase.

6 FROM MODEL TO PROCESS AUTOMATION SOFTWARE

The author has developed a technique for developing the process automation software in the Java language, starting from the State Transition Model (Please see EnterpriseFlow User Guide – Part 7 in EnterpriseFlow_DBaaS_Kit.zip, downloadable from <http://www.enterpriseflow.com>). It is found that the states in the model directly map to key software artefacts, viz., one pre-defined, customizable, JSP template corresponding to each state. Developing non-workflow software corresponding to the activities performed in each state, and invoking the same from the corresponding state's JSP, or invoking third-party software from a state's JSP, are straightforward.

The procedure for developing the process automation software starting from a BPMN model can be found elsewhere. (Dumas, 2013). It will be seen that this is a bottom-up approach, since software development commences after detailed BPMN modelling. On the other hand, the State Transition Model approach turns out to be a top-down approach.

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