Construction of BPMN-based Business Process Model Base

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Abstract
On the purpose of managing process models to make them more practical and effective in enterprises, a construction of BPMN-based Business Process Model Base is proposed. Considering Business Process Modeling Notation (BPMN) is used as a standard of process modeling, based on BPMN, the process model transformation is given, and business blueprint modularization management methodology is used for process management. Therefore, BPMN-based Business Process Model Base provides a solution of business process modeling standardization, management and execution so as to enhance the business process reuse.

Keywords: Business Process Modeling, BPMN, Business Process Management

1. Introduction
With the development of process modeling technology and process execution language, business process management becomes more and more important when enterprises implementing information system. The key point is the standardization of business process description and the modeling flexibility, as well as the management of business process model to make them more practical and effective [1].

At present, related works about business process description and execution are developed from different kinds of aspects. For process modeling, there are different kinds of process modeling methods, such as UML activity diagram, EPC, Petri Net and so on. All of these technologies have their own advantages and functions [2]. The Object Management Group (OMG) has developed Business Process Modeling Notation (BPMN). The primary goal of BPMN is to provide a notation that is readily understandable by all business users, from the business analysts to the technical developers. Thus, BPMN creates a standardized bridge for the gap between the business process design and process implementation [3]. Follow-up researches will be focus on mapping and transformation from other modeling language to BPMN. For business process execution, there’re two main technical standards: XPDL and BPEL. Business Process Execution Language (BPEL) is a standard executable language for specifying interactions with Web Service; it is an orchestration language that specifies a protocol for peer-to-peer interactions. At present, BPEL is well developed, as a mature technology it has an edge in business process execution area [4]. Based on these technologies, Business Process Management System (BPMS) as a hotspot, usually focus on the integration of data or the integration of different systems. But the management methodology is not well performed in BPMS.

According to related researches and technologies mentioned above, with the study of the process model transformation to BPMN and business blueprint modularization management methodology, this passage provides a BPMN-based Business Process Model Base to improve business process management in information system.

2. Framework
The construction of BPMN-based Model Base can be separated to three parts: modeling, management and execution. They respectively correspond to the data layer, the module layer and the application layer in system. For the modeling of business process, it uses BPMN as modeling method to realize the standardization of business process description. Then the system optimizes these process models and classifies them to different modules, and establishes the Model Base. Finally, with the help of mapping BPMN model to BPEL, the system uses the BPMN and BPEL execution engine to execute
these business processes. Figure 1 shows the framework of BPMN-based Business Process Model Base.

![Diagram of BPMN-based Business Process Model Base](image)

**Figure 1. Framework of BPMN-based Business Process Model Base**

1. **Data Layer**
   The Data Layer signifies the data sources of Model Base. It mainly contains the initial processes that have not been standardized and optimized. As the import of system, Data Layer provides two options: New (to model a new process) and Import (to transform an exist process). For new process modeling, the system provides a BPMN modeler engine to users. At the same time, Model Base supports the model import from other systems. For business process diagrams described by different modeling methods, such as EPC and so on, the system establishes mapping rules to transform them to BPMN. At last, through the standard modeling and transformation in Data Layer, all of the business processes will be described in BPMN.

2. **Module Layer**
   The Module Layer is the main part of Business Process Model Base. According to business requirement and the actual condition of business operation, the Model Base has been separated to six modules. Business process is classified and saved in its matching module. The physical structure is tree structure. The system hierarchy is divided from module to business unit and then to sub-process. The logical structure contains nested structure, source and target. The Module Layer provides searching, invoking and updating functions so that the system could realize the reuse of business process model.

3. **Application Layer**
   The Application Layer of system provides user the visual interface and the execution engine interface. The main functions of Application Layer are export and transformation from business process model to BPEL. The Application Layer provides the export of standard BPMN model, which can be implemented by BPMN execution engine. Besides, it provides the transformation interface from BPMN to BPEL, so that business process models can be exported and saved as BPEL document and then implemented by BPEL execution engine.

### 3. Model Base

#### 3.1. Business process modeling and transformation

BPMN creates a standardized bridge for the gap between the business process design and process implementation. The primary goal of BPMN is to provide a notation that is readily understandable by all business users, from the business analyst that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes. As a hotspot in
modeling area, more and more supporting tools are developed for BPMN modeling. For the initial process modeling in the system Data Layer, the Model Base use Eclipse SOA Tools Platform (STP) as modeling engine. Eclipse SOA Tools Platform (STP) is developed based on Eclipse and Service Oriented Architecture, it contains BPMN Modeler tool for business process modeling. The export of BPMN Modeler is BPMN process diagram and its XML description.

Event-Driven Process Chain (EPC) is also widely used in information system. It is a type of flowchart, and developed within the framework of ARIS. The EPC modeling method emphasizes the order and statement of a process, but not the data transmission and organizational cooperation. Comparatively, BPMN has advantages in the description of business process. With the help of EPML, EPC can be transformed to BPMN. EPML is short for EPC Markup Language; it is the system interchange format of EPC. The following table shows the core element of EPC mapping to BPMN.

<table>
<thead>
<tr>
<th>EPC</th>
<th>EPML</th>
<th>BPMN tag : xml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;event&gt;(Entry event)</td>
<td>&lt;Activity&gt; “activityType=EventStart”</td>
</tr>
<tr>
<td></td>
<td>&lt;event&gt;</td>
<td>&lt;Activity&gt; “activityType=EventIntermediary”</td>
</tr>
<tr>
<td></td>
<td>&lt;event&gt; (End event)</td>
<td>&lt;Activity&gt; “activityType=EventEnd”</td>
</tr>
<tr>
<td></td>
<td>&lt;function&gt;</td>
<td>&lt;Activity&gt; “activityType=Task”</td>
</tr>
<tr>
<td></td>
<td>&lt;arc&gt;</td>
<td>&lt;SequenceEdge&gt;</td>
</tr>
<tr>
<td></td>
<td>&lt;xor&gt;</td>
<td>&lt;Activity&gt; “activityType=GatewayExclusive”</td>
</tr>
<tr>
<td></td>
<td>&lt;or&gt;</td>
<td>&lt;Activity&gt; “activityType=GatewayInclusive”</td>
</tr>
<tr>
<td></td>
<td>&lt;and&gt;</td>
<td>&lt;Activity&gt; “activityType=GatewayParallel”</td>
</tr>
</tbody>
</table>

Besides of these core elements mapping, there’re some constraint conditions for the transformation.

- The entry and end of EPC are all event. But for BPMN, it is classified as “Start Event” and “End Event”.
- The “Intermediate Event” in BPMN should be transformed according to the specific situation of each event in EPC. The EPC modeling rules has formatted that each “Function” must connect to an “Event”. Some events only describe the statement of each function, but have no meaning for the description and execution of process. Other events, which are the constraint condition for the next function, can be transformed to BPMN “Intermediate Events” as the trigger of activity.
- Some “Relations” in EPC process are important; it can be expressed as “Association” in BPMN diagram. For example:
  EPC Data --- BPMN <artifacts xmi: type="bpmn: DataObject”>
- The “Pool” and “Lane” in BPMN correspond to the “Role” element in EPC.
- Some extended EPC elements like “Process Interface”, which directs to a sub process, can be expressed as “Sub- Process” in BPMN.

According to these mapping rules, system can generate a XML description to BPMN process. The modeling engine Eclipse STP BPMN modeler can analyze XML description, and then generate the corresponding BPMN process model. For these generated models, please notice that they cannot reach the optimal condition in one step. There may have some logical defect or description redundancy. Further standardizing and optimizing are still needed as appropriate.

### 3.2. Business process optimizing and management

Business process optimizing is a kind of strategy, which makes enterprises hold their advantages.
For process modeling in information system, the optimization of business process has to consider business operating efficiency, as well as the performance in system. Process optimizing means carding, formulating and improving a process, it combined with the idea of business operating and IT implementation. With the aim of improving efficiency, it penetrates in the whole process of Model Base designing and implementing.

(1) Module design

The Business Process Model Base is the main part of the framework in this passage. It can be realized by the modularization management methodology [5]. According to business requirement and function department, combined with the actual business operating situation, the optimized business processes are classified to six modules. They are Material Management Module, Sales Management Module, Financial Management Module, Production Planning Module, Human Resources Module and Customer Relation Management Module. It can be recognized that, the classification of business process module is not only according to business function but also reflecting the departmental structure of enterprises.

The departmental system of management is an obstacle to the accuracy and integrity of business process modeling. Usually, a process is described from the whole business operating aspect, and it may be involved in several departments. However, business personnel only operate and are familiar with the business of their own department. They sometimes only need a feedback from other department, but rarely participate in the business operating. Take sales order handling as an example, for sales department, checking inventory or delivery is only a simple activity which they won’t take part in. But for the material management department, a whole process is needed to describe this business behavior. For this kind of trans-department synergic process, the modeling need to use BPMN “Sub-Process” element and should be based on the physical and logical structure.

(2) Module layer

The relation between business layer and system layer is shown in figure 2:

- Level 0: Organization. The highest level of business layer. An organization is a specific entity when interacting with external customers or suppliers.
- Level 1: Department. It represents the classification of different business function. Each department corresponds to a module in system. The classification of function shows the main business responsibility in different department. For example, sales order handling is the responsibility of sales department. Accordingly, all of the sales order handling processes will be saved in Sales Management Module in system.
- Level 2: Business Scenario. According to business operation process, business process in department can be sorted to details as different kinds of business scenario. For example, sales order handling can be classified to standard order processing, rush order processing and so on. Each business scenario corresponds to a Business Unit in system.
- Level 3: Business Process. Each business scenario can be described as a business process independently. Take the whole processing of standard order as an example, this process can be...
generated from a sales activity to customer inquiry processing and quotation processing, then delivery and billing. The whole process needs to be entirely modeled in the purpose of describing a business scenario clearly.

- Level 4: Business Behavior. A business process can be considered as an ordered set of business behavior series. In the Model Base, business behavior is described by Sub-Process. Because some similar business processes may be composed of the same business behaviors, by invoking these Sub-Processes, the system realized the reusability of process.
- Activity. Activity is the basic element in business process. Each business behavior is described by a series of business activities. This is corresponding to the Task element in BPMN.

3. Module structure

According to the module layers mentioned above, the physical relation of Model Base is shown as Tree Structure. The Model Base is classified to Modules, and then divided from the Business Unit which described different business scenario to different Business Processes, and finally ended by Sub-Processes as the leaf node of system. Business process execution logic is based on Source and Target relation in BPMN modeling. At the same time, according to the nested structure, disrupt sub-processes are integrated. By extending a sub-process, the description can be shown to the very detail of every activity. The module structure is shown in figure 3.

3.3. Business process execution and application

At present, the execution of business processes can be achieved in two ways. One way is to use BPMN execution engine. The system supports the export of standard BPMN diagram. Through the relevant technology of BPMN execution engine, such as JBPM, the execution of business process can be achieved. Another way is to generate the arrangement of execution model according to the business process model. The system generates a specific BPEL process and then uses the existing BPEL execution engine. But there may be inconsistencies between the business model and the execution model. It is because of the incompatibility between the Graphs oriented BPMN model and the Block oriented BPEL process. This may lead to conversion function loss in BPMN models, cyclic structure and parallel language processing difficulties and other issues [6]. Related research model and algorithm are developed in many ways. The upcoming BPMN 2.0 version will make more improvements and supports to the process execution, in particular conversion to BPEL. This passage will not go into the technical details here.

4. Case Study

This paper takes an order processing business process as an example. It displays the whole process from business process modeling to optimizing, then to management and implementation in the research of BPMN based Business Process Model Base.

(1) Business process description

Order stands for the customer demand for products; sales department is the main responsible part for order processing. Customer orders start from the customer inquiry, sales department needs to edit the quotation according to customer requests. After customer accepting the item and price, the order will be generated. For order processing, the process includes records of customer needs and develop production or procurement requirements according to it, then submit to materials management department for further processing. At this point, the determination of the expected delivery date and transportation type is needed. Then return the feedback to the customer. And next step is the billing and invoice processing.

(2) Preliminary modeling

To the process description mentioned above, corresponding EPC flow chart is shown on the right (Figure 4).

According to the mapping rules described in this passage, this EPC flow chart can be automatically transformed to BPMN business process diagram. The following figure shows the preliminary transformed BPMN model (Figure 5).
As the above model displayed, the first Event in EPC is transformed to “Start Event”, analogously, the last Event in EPC model is transformed to “End Event” in BPMN model. All of the other Events are omitted from the EPC flow chart when transforming. Obviously, for this business process modeling, the transformed BPMN diagram is simpler than the EPC flow chart. After the transformation, further optimizing is needed.

![Figure 4. EPC flow chart](image)

![Figure 5. Preliminary transformed BPMN model](image)

### (3) Model optimization

According to the BPMN model shown in figure 5, each “Task” can be corresponded to the complete process templates in Model Base. For example, “Customer Quotation Processing” is a Sub-Process in Model Base. It can be extended to the business process diagram template shown in the following figure:

![Figure 6. Customer Quotation Processing BPMN model](image)

Customer quotation processing is located in Sales Management Module. It exists in the business scenario of standard order processing, rush order processing, as well as third-party order processing and contract processing. The following optimization steps are similar to the first Task. All activities in BPMN can be found and located in Model Base, and then the corresponding Sub-Process can be invoked directly. Because the fully detailed flow chart is very complicated, with the help of Sub-Process element in BPMN, the nested structure can simplify business process diagram. At the same time, when extending the Sub-Process, it will refine to detail tasks in order to achieve the integrity of the process. According to this, the process model will be completed and clear.

### 5. Conclusion

This passage provides a framework of BPMN based Business Process Model Base. The Model Base integrates business modeling, process management and system execution. For the standardization of business process modeling, system uses BPMN as the modeling method to describe business process,
and formulate transformation method mapping EPC flow chart to BPMN model. With the study of business blueprint and modularization management methodology, the optimized business process model will be managed according to their own business classification. According to the corresponding relation between business layer and system layer, business process models are displayed as tree structure in system. At last, with BPMN and BPEL execution engine, business process will be executed effectively and normatively. With the aim of strengthening the functions of Business Process Model Base, following research should be focus on the execution of business process and the corresponding conversion rules.

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7. References