Research on Service-Oriented Workflow and Performance Evaluation

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Abstract
The advent of SOA and Grid technology has brought new challenges to workflow operation and performance evaluation. In this paper, the characteristics of service-oriented workflow are presented, based on which the service-oriented workflow performance evaluation model is described and the performance analysis methods are depicted. Finally the design and implementation of our prototype system are introduced briefly.

1. Introduction
The evolution of Service-Oriented and Grid technologies has brought to the world a loosely coupled environment that enables flexible integration among heterogeneous systems. Service and workflow are close related, so it appears a new tendency that combines web service and workflow technology together. Because of the loosely coupled, autonomous and dynamic characteristics of service, the operation and performance evaluation of workflow present some new characteristics:
1. Services are implemented by workflow, and workflow is another kind of services.
2. Multiple processes interact with event/messages and share the common resource or data.
3. The processes change dynamically along with the change of services. It requires ensuring the usability of services and selecting service components in real time which also result in the difficulty in evaluating the workflow performance.

As a result, a new workflow paradigm, Service-Oriented Workflow (SOWF) comes up into being. Many studies have been dedicated to workflow performance management in services eco-system. [1] presented a QoS model for the METEOR workflow system. [2] studied the modeling and implementation of organization centered workflows in Web service environment. IBM developed a SOA-based workflow management system “intelliFlow” [3]. HP Laboratories proposed a service composition model and realized a prototype system [4].

However, most existing performance evaluation systems focus on customers and markets in business domains without consideration of the relation with IT domains, thus result in the disjunction of business and IT systems. In order to address this issue, we proposed a new performance evaluation model in this paper.

2. Performance evaluation model
A service-oriented performance evaluation model is shown in Figure 1. The business system and IT system are divided into five layers:

Figure 1. Service-oriented performance evaluation model
The bottom layer is IT infrastructure layer, and the corresponding KPIs (Key Performance Indicator) are throughput, delay, etc. Service composition layer is used to composite required services according to user’s requirements. This layer’s KPIs contain functional indicators (used for estimating whether the function of the service matches user’s demand) and non-functional indicators (used for estimating the quality of the service, also called QoS). The corresponding KPIs of Business process layer and Business Activity layer are process-related indicators and activity-related...
indicators. The Business strategy & design layer faces end users and managers.

Most existing performance evaluation models merely consider the mapping from business strategy layer to business process layer, or merely consider the performance of Network in IT layer, thus resulting in the disjoint of business and IT systems. The evaluation model in Fig.1 takes into account both systems synthetically, and introduces Service composition layer to present the particularity of services sufficiently.

3. Workflow performance analysis method

There are mainly three kinds of performance analysis methods:

1. Model analysis mainly utilizes different kinds of stochastic Petri-nets to build corresponding continuous-time Markov chain model or queue theory model, based on which the performance parameters of the system can be obtained.

2. Workflow simulation could use business process simulation tools, Petri-net simulation tools, or discrete event dynamic system simulation tools. Simulation in service-oriented environments must deal with multiple processes sharing common resources and organizations, with interaction of messages and events.

3. Data analysis is based on history data or runtime data. Data warehouse and data mining technologies are often used to analyze data. The mining and analysis of history data could master the rules of business operation, and the monitoring and analysis of run time data could master the operation status of business process in time.

4. System implementation

The business process performance management system consists of five layers. Process models are built in Business operation layer, based on which process execution and simulation are implemented. Corresponding data is stored into specific database in Original data layer. Data extractor extracts interesting information from original data layer and stores the information in business process information data warehouse in Data extraction layer. Then OLAP and data mining tools in Business analysis layer support the optimization, monitoring and decision-making of business process in Application layer.

Our system is founded on CimFlow, a workflow management system developed by CIMS Center, Tsinghua University. A new simulation tool and data analysis tool joined in existing system. Now the prototype system could invoke services released by system or Network, such as web service and some automatic application.

Figure 2. User interface for workflow performance analysis system

Fig.2 is the advanced analysis page of workflow performance analysis system. Users could make analysis in different perspectives of time, organization, resource or instance. After specifying the value of each dimension of selected perspective and choosing the measure items from measure lists, the analysis system will create chart diagram for analyzing, including the charts and data forms.

5. Conclusions and future work

In this paper, a service-oriented performance evaluation model is proposed to merge business systems and IT systems. Three kinds of workflow performance analysis methods are discussed and the prototype system is depicted. Future efforts will be dedicated to the automatic mapping of KPIs in different layers, service-oriented simulation and data mining algorithms for performance analysis.

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