Chapter 6
Costing of Web service based on Quality

6.1 Overview

Service-Oriented Computing increasingly gains momentum in academia and industry as a means to develop adaptive distributed software applications in a loosely coupled way. Software services, as the main entities in SOC, have some distinct properties such as platform independence or a uniform interface description enabling an easier integration and use within and across organizational boundaries. One of the main assets of service-orientation is composability to develop higher-level services, so-called composite services, by re-using well-known functionality provided by other services in a low-cost and rapid development process. Web services can be provided against payment of a certain amount of money, usually the price of a Web service is defined by the provider. The price may be fixed for each invocation, or proportional to the actual service demand to each Web service method that is used. Providers may also request higher fees for services hosted on better or faster hardware [69].

The cost of a service represents the monetary value that is associated with a specific service operation when invoking it. Typically, cost is calculated per invocation however, more advanced pricing strategies can be implemented and defined in the SLAs, such as usage contingents (e.g., 100 $ for the first 1000 invocations, then 80 $ for the next 1000). The common unit ‘$’ is used for costing the Web services because most of the Web services are consumed globally. As complex pricing strategies are usually modeled on a higher level, it is assumed that a cost value can be assigned to a service to achieve
optimization of composite services without the awareness of all details specified in the
SLA. Pricing information of a Web service is to be published in UDDI registries, along
with information about the service provider and links to the WSDL documents about the
provided services. When potential service consumers search for the Web services in the
registries, the pricing information is also retrieved. In this chapter a method is proposed
to calculate the cost of the Web service as per the offered quality.

6.2 Calculation of Cost based on QoS

Web services technology provides a new computing model, in which
infrastructures and application systems are hosted by service providers and made
available to service consumers via Web services such that the total benefits of both the
service providers and the service consumers are optimized to the QoS requirements of
service requests [55]. While currently majority of Web services are available free, over a
period of time increased business dependencies of customers on Web services are
resulting in demands for better Quality of Service. Investments in newer technologies to
improve Quality of Service results in increasing cost of service, which needs to be offset
by revenues. While service providers seek predictability in revenues, customers and users
of the Web services seek flexibility in pricing by not being charged for services not used
and service features that are not provided. QoS thus becomes a key determinant of
pricing in Web services [38].

Here the cost of the Web service is calculated only for the offered quality. The
quality of the service is evaluated based on the functionality of the Web service. The
customer requirement is the main aspect for confirming the functionalities. So, here the
goal is to pay the service only for the functionality reached.
Let, $C_s$ is the cost fixed for the Web service $S$, with assured quality $Q_s$ during its selection. Our goal is to calculate the actual cost based on the actual QoS of the selected Web service $S$ during its usage.

The actual cost can be calculated as follows

$$\text{Actual Cost} = \frac{C_s \times \text{Actual QoS}}{Q_s} \quad \cdots \quad (6.1)$$

The billing is done for every ‘N’ requests and the corresponding actual QoS and cost of the Web service is recorded as in Table 6.1. The recorded cost for the specific billing term is send to both the provider and customer as report. Here the Web service “NewsReaderService” is considered to evaluate the better performance than the expected level. More details about all the 10 Web services can be referred from Table 4.1

<table>
<thead>
<tr>
<th>Terms</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
<th>VII</th>
<th>VIII</th>
<th>IX</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual QoS</td>
<td>0.602</td>
<td>0.653</td>
<td>0.662</td>
<td>0.668</td>
<td>0.702</td>
<td>0.714</td>
<td>0.714</td>
<td>0.742</td>
<td>0.743</td>
<td></td>
</tr>
<tr>
<td>Actual Cost</td>
<td>0.79</td>
<td>0.86</td>
<td>0.87</td>
<td>0.88</td>
<td>0.90</td>
<td>0.92</td>
<td>0.94</td>
<td>0.95</td>
<td>0.98</td>
<td>0.98</td>
</tr>
</tbody>
</table>

In Figure 6.1, the graph of actual cost for the continuous terms shows that there is a benefit for the service provider of Web service “.” when the QoS is increasing.
In normal cases, the cost of the Web service is calculated as per the expected quality and cost fixed at the time of selection of the Web service [24]. The violation from the guaranteed level is reported to management for further action. Implementing penalty for the violation of guaranteed level always leads to confusion and withdrawal of service. But, here the cost is calculated as per the actual QoS in each term that will directly benefit the customer if the guaranteed quality is reached. Also the provider is benefited in cost based on the actual QoS, some times more than the fixed cost. The graph shows that the cost of “NewsReaderService” gradually increased from 0.79 to 0.98. For this Web service 0.85 is the cost fixed for each invocation of the service during its selection but, here the average cost for all the terms is 0.91. It clearly indicates that there is remarkable improvement in the quality of the service as per the performance of the service. Also it is
a chance for the provider to earn more financial benefit and increase the service reputation when the quality is improved

6.3 Results and Discussions

The Figure 6.2 (a) to (j) shows the cost should have to pay for the Web service for the offered QoS. Also it gives the deviations from the asserted and agreed cost that is fixed at the time of selection of the Web service.
Figure 6.2: Comparison between asserted and actual cost for continuous terms.
The actual cost of the Web service for a billing period and the corresponding asserted cost at time of selection of the Web service are given in the Table 6.2 and Figure 6.3. More details about all the 10 Web services can be referred from Table 4.1

**Table 6.2: Comparison between asserted and actual cost**

<table>
<thead>
<tr>
<th>Cost</th>
<th>WS1</th>
<th>WS2</th>
<th>WS3</th>
<th>WS4</th>
<th>WS5</th>
<th>WS6</th>
<th>WS7</th>
<th>WS8</th>
<th>WS9</th>
<th>WS10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asserted cost(cent)</td>
<td>1.2</td>
<td>3.55</td>
<td>0.85</td>
<td>2.52</td>
<td>5.58</td>
<td>3.15</td>
<td>0.75</td>
<td>1.84</td>
<td>2.72</td>
<td>4.25</td>
</tr>
<tr>
<td>Actual cost(cent)</td>
<td>0.89</td>
<td>3.23</td>
<td>0.91</td>
<td>2.7</td>
<td>5.3</td>
<td>2.18</td>
<td>0.87</td>
<td>1.37</td>
<td>2.6</td>
<td>4.42</td>
</tr>
</tbody>
</table>

**Figure 6.3: Performance of actual cost in comparison with asserted cost**

The Figure 6.3 shows that in most of the cases the actual cost is less than the asserted one because the actual QoS of the Web service is not up to the mark in comparison with the guaranteed level. But to some extent the customer is satisfied that he is paying only for the quality that is delivered. In some service (WS3, WS4, WS10) the
cost is little higher than the asserted cost because the quality of the service is improved in each term. Monitoring the shortfalls in each term and updating the service to reach the non-functional parametric values to the guaranteed level results in financial benefit to the provider of the service.

6.4 Summary

Research on Web service composition has become increasingly important in recent years due to the growing number of Web services over the internet and the challenge of automating the process. This cost evaluation method presented in this chapter helps the enterprises that have embraced the Web service in order to reduce the cost of Enterprise Application Integration (EAI) as well as to improve operational efficiency of their mission critical business processes. The proposed costing based on offered QoS method definitely leads to the improvement in quality and customer satisfaction when comparing to other QoS and cost evaluation models. This approach can potentially improve the utilization of resources and increase the benefits of both service provider and consumer.