

Increasing Business Service Interoperation through the WSDL Extension

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Abstract

To support business services interoperation, the BSD (Business Service Document), which is an extension of the Web Service Description Language (WSDL) the web service specification of the World Wide Web Consortium (W3C) was designed. The WSDL presents comprehensive standards for the interoperability of software components and W3C delegates extensions of WSDL to the users for their own purposes and objectives.

In this article, BSD Creator, which can generate well-formed and valid BSDs, was designed and implemented. Also, the BSD Operation Pilot System where service providers can publish BSD specification documents and service users can search for services, was implemented and presented. BSD Creator and the BSD Operation Pilot System, which are the outcomes of this study, were assessed for their quality and usefulness using ISO/IEC 9126.

The outcomes of this paper will be the basis on which industry groups can construct a Business Services Interoperation System, and are expected to contribute to the revitalization of business service interoperation.

Keywords : Web Service, WSDL, Business Web Service Framework

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1. Introduction

To keep pace with the rapidly changing business and customer environment, the businesses should adopt the “Now Economy” for fast sensing and response. Enterprises are now required to acquire agility through transition to a Real-Time Enterprise (RTE) equipped with the ability to understand earlier and deeper, and respond faster [13].

A new information system architecture is necessary to acquire the agility to support an RTE. That is to say, IT architecture is required to support business agility by making a transition to a Service-Oriented Architecture (SOA) which exposes application independent business services [10].

Along with the evolution of IT technologies, there have been efforts for distributed processing of software components and improvement of interoperability is consistently evolving [6]. Remote Method Invocation technology such as CORBA (Common Object Request Broker Architecture) and DCOM (Distributed Component Object Model) perfectly supported distributed processing, but as they are the proprietary technologies of specific vendors, there were limits due to dependency on the operating environment [9].

Accordingly, a web service framework supporting interoperability between heterogeneous platforms was proposed with initiatives from the World Wide Web Consortium (W3C) [16], and the industry broadly accepted the framework as the standard technology for the interoperability of software components [8].

Recently, standardization organizations such as the W3C, the Web Services Interoperability Organization (WS-I), and the Organization for the Advancement of Structured Information Standard (OASIS), introduced the WS-* Extension, a second generation web service and suggested more specific schemes for addressing, reliable messaging, policy framework, meta data exchange, and a security framework for revitalization of web services.

Supporting SOA with W3C's web service architecture and efforts to improve interoperability among IT services are diversely presented in the extension of the Web Service Description Language (WSDL) [19].

WSDL presents comprehensive standards, and delegates the extension or redefinition of detailed description to individuals for uses or purposes of interoperability. OASIS, taking the initiative to revitalize e-business through a specialized web according to such principles, suggests standard specification, including Universal Description, Discovery, and Integration (UDDI), ebXML, and WS-BPEL, and supports a richer exchange of service descriptions.

Based on this, the AICPA (American Institute of Certified Public Accounts) commonly shares Company Profiles Reports drawn up in XBRL (eXtensible Business Reporting Language) for sharing and exchanging in web environments [3]. Also, IBM proposed the WSLA (Web Service Level Agreement), which is an extended WSDL, so that users may select a service based on assessment of service quality [12].

Even though the W3C web service framework the interoperability of IT components and pro-

vides a reliable protocol, it is necessary to extend WSDL to adopt service interoperability which has actively been discussed in the industry recently [2].

Even for purchase of products or services in general commercial transactions, detailed profiles of the company providing the product or services and a profile of the service itself are necessary. Also, motives for purchasing products or services bring the trust based on ample quality information on the relevant product or service forward as the foremost factor.

Service interoperability can be said to be just like this. When the concept of interoperability is evolved to the business service stage, not the software component, it is expected that the need for diverse service information other than software component binding information will increase.

In order to raise the reusability of rich IT resources through increase of in interoperability, it is necessary to extend WSDL, web service description, to include not only the binding information of the software components but also the information necessary for business interoperation.

Thus, this study defines and designs the Business Service Document (BSD), which extended WSDL from the perspective of business service interoperation to revitalize the introduction of the web services framework.

Also, to smoothly apply extended BSD, BSD Creator, which can automatically generate validity-verified BSD, and the Business Service Document (BSD) Operation Pilot System are designed and implemented.

The outcomes of this study, the BSD, the BSD Creator and the BSD Operation Pilot System will be verified through the ISO/IEC 9126 quality assessment model.

The contributions are expected to extending business interoperability through the presentation of a framework for stable business service interoperation.

2. Theoretical Background

2.1 Interoperability and Web Service

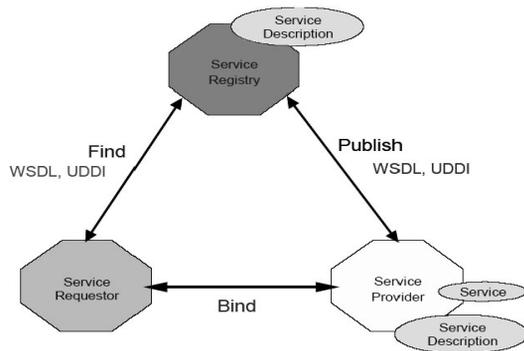
IT technology for distributed processing, along with network development, has consistently evolved. Especially, the interoperability technology of software components that support the agility of IT services has evolved with the IT evolution.

In recent times, Sun's CORBA and Microsoft's DCOM is introduced for sharing or invoking object components under a distributed environment. CORBA and DCOM had no restrictions in homogeneous operating environments, but there were restrictions in heterogeneous operating environments. There were limits based on restrictions on interoperability due to dependency on the operating environment [18].

To overcome such limits and support interoperability between the heterogeneous environment, W3C presented a Web Service Architecture and WS-I presented message and document inter-exchanged specifications on binding of distributed services.

Basically, the W3C Web Service Framework is composed of systems in which service pro-

viders write up WSDL and publish in the UDDI. Service requesters acquire necessary information by finding the service specifications in the UDDI and binding the relevant services as shown in <Figure 1>.



<Figure 1> Web Service Architecture

However, as the W3C Web Service Framework places the interoperability of software components as its main purpose, the framework supports the interoperability of IT services or components while showing limits in support of the interoperability of business services.

The Web Service Framework does not support the interoperability of all services, but as a comprehensive guideline, it delegates relevant user groups for matters of detailed definition including the extension of WSDL [4].

As a web service, there are shortcomings for a system supporting the interoperability of business services as users have difficulty selecting services due to limits on searching for services function, absence of service value assessment information, and so on [2].

The problem of dependency on the operating environment was solved as Web Services pur-

sued after neutral and open architecture by using XML (Extensible Markup Language) open standards such as WSDL, UDDI, SOAP (Simple Object Access Protocol), so on [16]. However, because of loose standards such as regulating only the basic specifications and interface, there are many restrictions until utilization for real B2Bi (Business-to-Business Integration).

That is to say, the absence of a business profile creates difficulties for service requesters to find services and to evaluate the value and quality of services in the UDDI.

2.2 Service Specifications

It is necessary to extend WSDL for the business service interoperation.

We will look into the variety types of service specification documents according to the uses and purposes of relevant communities in the Web Service system in order to develop BSD, the business service specification document proposed in this study.

(1) Definition of service specifications

Specifications have a lexical definition of "apparent and detailed contents", and service specifications are defined as "something that provides detailed explanation of all the contents on services."

Generally, a specification document is represented in the form of XML for reasons of interoperability and the systemicity of information structure, semantics, so on. Especially, a service specification document is used for the provision of information on the web or to provide an ex-

planation of the services provided.

The most representative specification among service specifications is WSDL of Web Service which contains binding information on software component.

WSDL means the specification document that explains Web Service and/or the specification language used to describe the document specifications.

WSDL as a specification document is a service specification document that describes API (Application Programming Interface) for building and using Web Services including web service operation and attributes, parameters used for sending messages, and the type of return values.

WSDL as a language is an XML-based standard specification language describing service specifications.

In addition to the above, diverse forms of specification for diverse purposes are extended, re-defined, and used.

(2) Extension of Service

WSDL, the W3C specification document has been diversely extended and redefined.

OWL-S is an ontology specification language for OWL (Ontology Web Language) based technology and a developed form of DAML-S (DARPA Agent Markup Language). DAML-S is a specification extended from WSDL by the Defense Advanced Research Projects Agency (DARPA) of the United States Department of Defense to improve ease in searching [11].

OWL-S provides more extended search, request, selection, and composition by bonding

Semantic Web base upon WSDL. OWL-S, unlike WSDL, provides an extended structure and item elements in order to support automated inter-operation and reasoning among services with different integration and scope of knowledge[15].

OWL-S automatically supports services including search and request, and composition and interoperation between services. The major elements of OWL-S are the descriptions of service provider and the service profile which describes service information and characteristics. There are process models making inter-operation between and structure of agents and services possible and service grounding which specifies the methods of the service approach and materialization and binds with WSDL [15].

XBRL is a specialized XML specification standard for the AICPA to share and exchange business reporting in the web environment[3].

XBRL aims to guarantee inter operation of reporting among enterprises by unifying not only financial statements but also financial information, ledger statements, annual and quarterly financial statements and specifications of the company's external and internal information.

XBRL divides a financial statements framework that is based on enterprise information into manufacture, banking, insurance, non-finance, and other finance aspects according to the similarities of each industry. XBRL also defines the tags of each account headings and extracts account headings commonly used in various industries, and supports them to make them into a meta data to be reused.

WSLA is an XML-based web service quality

contract standard specification focusing on usability among software quality characteristics extended from WSDL and defined in ISO 9126 by IBM [12]. WSLA specifies the obligations of service providers for parameters such as usability of web service, length of response time, amount of processing, compliance of parameters and so on.

Thus, WSLA enables users to select web services after taking quality into consideration, and monitor and control web services through quality management[12].

WSLA is composed of parties and service operations that describe all the enterprises related to contracts in order to make clear the services' responsibilities, partly specifying the SLA Parameters and Metrics, the Service Description (where a service provider states the service content), and Obligations defining the warranty that service users and providers will provide to each other.

3. Necessity of Business Service Interoperation Specification

The Web Service proposed by the W3C smoothly guarantees the interoperability of components between the heterogeneous environments and thus is widely accepted as a representative technology to realize Service-Oriented Architecture and distributed computing environments.

However, the Web Service only presents broad standards for interoperation of software components and delegates extension by usage and purpose as individual tasks[4].

Thus, WSDL specifications are insufficient for supporting interoperation of business services, a requirement in the recent real-time enterprise environment.

Especially, the specifications of WSDL, the Web Service specification document, defines the minimum API and function-oriented rules to guarantee interoperability and thus, it needs to be extended to include the following to apply to the real B2Bi environment.

First, the specification document should include business profiles for inter-operation of business services.

The business service profile includes detailed explanations of the business services and service providers.

W3C's WSDL is a specification that defines and understands the Web Service API and, thus, does not contain information on business services.

Only the WSDL itself does not help service users to understand the services provided, and without elements describing enterprise profiles, it is difficult to identify company status.

If users are unable to get the profiles of companies which are Web Service providers, users do not trust on the web service provided by these company.

Thus, specifications expressing the business context are essential to acquire reliable business interoperability between users and providers.

Second, the business service specification document should contain quality and value assessment information.

In the real world, the services are selected by evaluating the quality and value of provided service. But the W3C's WSDL does not contain

specification for service quality and value information. So there is a generic limitations in the WSDL to support business service.

As service value information is not stated in WSDL, it is impossible to search for and select services based on a service value assessment. The absence of value information leads to the absence of service guarantees, which creates an obstacle to the revitalization of the service market.

Thus, reliability according to service interoperation should be increased when QoS (Quality of Service) information on service quality, price, and so on is provided.

Third, items to extend the search function should be included to facilitate searching for business services.

WSDL has a partiality to the grammar rules of the Web Service API and there is a deficiency of detailed specification on services. Accordingly, it is difficult for a service requester to find the optimum service in various ways. That is since it does not support searching for the quality of a conditional clause, service searching based on conditions is not easy.

Thus, the specification element will be extended to enable service discovery using service contexts.

Lastly, standardization of service specifications is necessary so that business discovery and selection are become easy.

WSDL of web services is a loose standard regulating only the minimum standard supporting the interoperability of software components. The W3C comprehensively delegates user groups to extend or redefine WSDL according to uses

or purposes.

Thus, in order to make business services compared, assessed and selected in the UDDI, more specified and standardized specification document regulations than WSDL will be necessary.

4. Design of Business Service Document

4.1 Definition of Business Service Document

One of the research purposes of this paper is to design a BSD by expanding WSDL so that the Web Service specification document will contain a business context as well as assessment information on service values.

Thus, business service document and related terms are defined as below.

“Business Service” is defined as “business components that are well-defined, self-contained, and independent from status or circumstances of other services, providing services to internal and external business components.”

“Business Binding” is defined as “a service user’s action of searching a business services document and selecting relevant business services.”

That is business binding is defined as the act of service requesting enterprise seeking web services in searching for a company profile, service profile, and so on, in the Service Registry, and selecting the relevant services after comprehensively assessing service quality, reliability, so on.

Business Service Document (BSD) is defined as “a document specifying details of business

service interoperability by expanding W3C’s WSDL so that it contains business service context.”

Business Service Document Creator (BSD Creator) is defined as “a document editor that can automatically generate well-formed and valid BSD.”

4.2 Design of Business Service Document

To increase the interoperability of business services, it is necessary to expand WSDL in which information on only the components binding is expanded so that it can include the service profile, company profile, document profile, service quality profile, and so on, which are essential when business binding takes place.

Although there have been occasions that WSDL has been expanded to DARPA, XBRL, WSLA, and so on in each area as necessary and used, there has been no case that includes all the necessary information from which a service user can select a service list in the UDDI.

Accordingly, in this study, BSD with expanded WSDL is designed and presented in-

cluding useful information among which a service user may select business services.

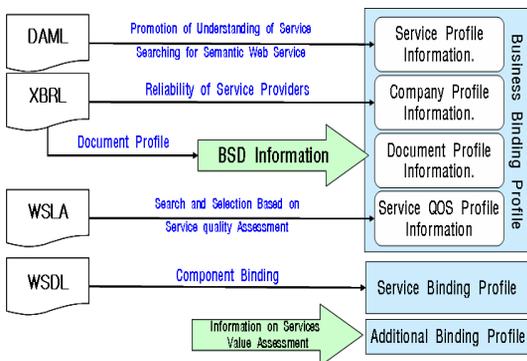
The structural concept of the BSD is as shown in <Figure 2>.

The BSD was structured, as presented in <Table 1>, with three major component elements of the “business binding profile” describing business services themselves, “service binding profile” provided by WSDL, and “additional binding profile” containing assessment information of service values, by adopting experiences of DAML, XBRL, WSLA, and so on.

The business binding profile was categorized as the service profile, company profile, document profile and service quality profile. The service binding profile is composed of the WSDL’s component binding profile. The additional binding profile is composed of service values and other related information.

The definition and contents of each BSD sub-element are defined as below.

- Service Profile : It is composed of elements promoting understanding of services and



<Figure 2> Concept of BSD Structure

<Table 1> Business Binding Profile

Category	Element	Meaning	Reference
Service Profile	Service Profile	Detailed Service Profile	DAML-S
Company Profile	Company Profile	Service Provider Profile	XBRL
Document Profile	Document Profile	Detailed Document Profile	BSD original information
Service QoS Profile	Service QoS Profile	Service QoS Profile	WSLA

making any search of the meaning of the services possible. The composition of the elements and definition are adopted from a description of DAML Services (DAML-S).

- Company Profile : The composition of the elements and the definition have adopted from the standardized description of Company Profiles Reports from Accounting Association in order to attain reliability.
- Document Profile : Elements and definition have been adopted from elements of the document profile of the standardized description of Company Profiles Reports from the Accounting Association.
- Service Quality Profile : This is composed of elements for service quality assessment. The composition and definition of elements have been adopted from WSLA descriptions.
- Service Binding Profile (WSDL) : WSDL has been adopted and it is composed of the minimum elements for component binding.
- Additional Binding Profile : This is composed of service value profile, other related information and WSDL reference elements.

4.3 Requirement of Business Service Document

BSD should be drawn up as a well-formed document with strict standard rules based on the general requirements of the specification document[20].

A well-formed BSD is defined as a document structured according to the established grammars, with the elements and values complying

with standards, and verified validity[7]. Requirements for a well-structured BSD are defined in <Table 2>, and the definition is as follows.

- Structure and meaning of elements : For standardization of the BSD description, the expressed elements and meanings will be standardized in the form of XML based on tags.
- Range of element values : The domain of the element values is defined by setting forth element schema.
- Exchange of standardized information : The interoperability of information is supported by defining the meta data of the elements.
- Meta data element searching : Through searching meta data registered in the Meta Data Registry (MDR), one-to-one matching through mapping the reference tables is performed when generating user definition elements.
- Management of meta data : To support broadening of the BSD description, the meta data of the BSD elements and structure schema of elements are registered and managed.

<Table 5> BSD Requirements

Category	Requirements
Structure and meaning of elements	Tag-based elements
Exchange of standardized information	element Schema
Metadata element searching	Mapping Table
Management of metadata	MDR

5. Implementation of Business Document Creator

5.1 Design of Business Document Creator

As it is core document for the business service interoperability, a well-formed BSD should be drawn up as a well-formed specification document.

In this study, BSD Creator is designed as a concept framework as presented in <Figure 3> to generate a BSD document that is structured according to the established grammar rules, with its elements and values complying with standards, and its validity verified. The detailed process is shown below.

- BSD Template creation : The BSD definition is registered in advance in the metadata system and a BSD Template (schema) complying with the ISO/1179 standards is created [14].
- Standardization of BSD Document Structure : When a user creates a new BSD, the document structure is standardized by

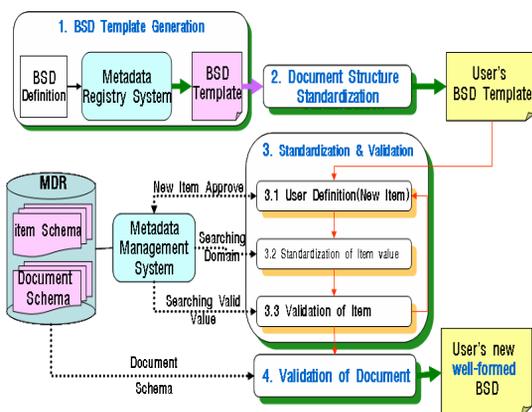
using the BSD template registered in MDR in advance.

- Standardization and verification of BSD elements : Elements values created using element domain and valid values in the MDR are standardized and verified. In the case of user defined elements, to construct an accurate document that complies with the grammar rules, only the elements approved by the MDR system as a new element can be created [14].
- Verification of validity of document : After document element creation has been completed, a final correct, valid, and well-formed document is generated by verifying the validity of BSD that has been created through utilization of the document schema of the MDR[1].

5.2 Implementation of Business Document Creator

BSD Creator which is a BSD specification editor is implemented by Visual Studio.NET 2005. Its major functions are storing the XML form of BSD and registering to BSD Registry, etc. through the generation and integration of binding profiles and verification of validity.

By selecting “creating new document” on the BSD Creator’s initial screen on <Figure 4>, BSD Creator automatically creates an empty BSD Template and generates a DOM document on 3 areas of business binding profile, service binding profile, and additional binding profile.



<Figure 3> Concept framework of BSD Creator



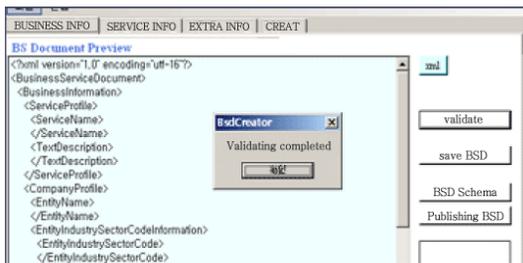
<Figure 4> Initial Screen of BSD Creator

The XML based BSD document is created as shown in <Figure 5> by automatically integrating the business binding profile elements defined by the service provider and the service binding profile of the existing WSDL.



<Figure 5> Generation of BSD Document

The XML based BSD document created performs verification test as in the example presented in <Figure 6>.



<Figure 6> Validity Test of BSD

The final BSD created by BSD Creator is presented in <Figure 7>. BSD Creator also implemented the “BSD publication” function, which automatically registers the final BSD to the UDDI.

```
<?xml version="1.0" encoding="utf-8" ?>
- <BusinessServiceDocument>
- <BusinessInformation>
- <ServiceProfile>
  <ServiceName>Calories Calculation Service</ServiceName>
  <TextDescription>if you input food name, we provide and calculate calories of food automatically.</TextDescription>
</ServiceProfile>
- <CompanyProfile>
  <EntityName>DONGGUK FOOD Corp.</EntityName>
  <EntityIndustrySectorCodeInformation>
    <EntityIndustrySectorCode>ISI2234</EntityIndustrySectorCode>
    <EntityIndustrySectorCodeDescription>Manufacturing</EntityIndustrySectorCodeDescription>
  </EntityIndustrySectorCodeInformation>
  <CorporationRegistration>23-394837-129</CorporationRegistration>
  <Representative>Dongguk KIM</Representative>
  <OfficeAddress>1st. phil-dong junggu seoul, Korea</OfficeAddress>
  <EntityContactInformation>
    <EntityPhoneNumber>02-2260-8814</EntityPhoneNumber>
    <EntityFaxNumber>02-2260-8814</EntityFaxNumber>
    <EntityEmailAddress>kimdongguk@dongguk.edu</EntityEmailAddress>
    <EntityWebsiteAddress>http://dongguk_wellbeing.com</EntityWebsiteAddress>
  </EntityContactInformation>
</CompanyProfile>
- <DocumentProfile>
```

<Figure 7> BSD generated by BSD Creator

6. Implementation of the Operation Pilot System of the Business Service Document

A pilot system was developed to operate well formed and valid BSDs that were created by BSD Creator and it is being operated at <http://210.94.200.247/webservice/board/>.

Instead of using the database system used in the Web Service’s UDDI, the Business Services Interoperation Pilot System uses the URL registering method as presented in <Figure 8>.

By implementing URL registering method, the system can load the latest version of BSD from the service provider’s server on a real-time basis. So the system can reflect any changes of the BSD by the service provider on a real-time basis.

Business Service Document UDDi Application

- Member Information
 - NAME
 - E-Mail
 - Homepage
 - XML Address
 - Service Price /month unit of year
- Application Information
 - Title
 - Contents

<Figure 8> BSD Published GUI

The BSD Operation Pilot System has been implemented with the addition of various functions, such as searching by titles, writers, contents, and so on rather than being limited to key words so that the finding of necessary services is become easy.

Business Service Document UDDi SHOW ALL LISTS

SORT | SELECT

TITLE	PRICE	registerID	DATE	READ	BINDING RATE
Calories Calculation Service	₩200,000/mon YEAR	Dongguk Kim	2008-09-04	4	25%
Searching of Professor Status Service	₩300,000/mon	David Lee	2008-09-04	53	1.88%
Graduation Approval Service	₩1,500,000/mon	Batistar	2008-08-19	11	9.09%
Late fee Calculation Service	₩700,000/mon YEAR	Hulk Hogan	2008-08-19	16	25%
Well-being Food Matching Service	₩2,000/mon YEAR	Muhyun No	2008-08-18	19	5.26%

< Next Page > 1 page / 2 pages

[Detailed] [Information] [Help you]
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<Figure 9> Service finding GUI

Also, to represent the characteristics of the BSD containing necessary considerations for selecting services, such as price, business success rate, quality information, and so on, the GUI was designed as presented in <Figure 9>.

It is also possible to easily find services find-

ing available by adding diverse alignment functions including price ranges, business success rate, number of hits, and so on.

As presented in <Figure 10>, it is arranged that service requesters are provided with detailed business information on service providers, which is stated in the BSD.

Business Service Document UDDi Information

- Member Information
 - NAME Dongguk Kim
 - E-Mail kimdg@dongguk.edu
 - Date 2008-09-04 5:19:27
 - Homepage http://wellbeing.dongguk.edu
- Application Information
 - Title Calories Calculation Service
 - Contents if you input food name, we provide and calculate calories of food automatically. you can make timetable comfortable and get body healthy by schedule that is made by our Service
 - BACK | MODIFY | DELETE

Business Service Document Elements Specification

- Service Profile
 - Service Name Calories Calculation Service
 - Service Explanation if you input food name, we provide and calculate calories of food automatically.
- Corporation Profile
 - Corp. Name DONGGUK FOOD Corp.
 - Representative Dongguk KIM
 - Register Number 23-394837-129
 - Standardization Division CODE IS12234
 - Code Explanation Manufacturing
 - Corp. Tel 02-2260-8814
 - Corp. Fax 02-2260-8814

<Figure 10> Business Information of Service Providers

7. Quality Assessment

7.1 Quality Assessment Items

Generally, quality assessment of a new system surveys users on the degree of improvement or performs quality assessment by applying the ISO/IEC 9126 quality assessment model[5].

In Korea, as there is a lack of experienced Web Service users and UDDi operation has not become common yet, quality assessment of out-

comes from the study was performed with the application of ISO/IEC 9126 rather than with a questionnaire.

ISO/IEC 9126 assesses six major items of functionality, reliability, usability, efficiency, maintainability, and portability.

However, as ISO/IEC 9126 is a comprehensive assessment standard that includes all the softwares, the standards for quality assessment of the outcomes from this study need to be re-constructed [5].

Especially, as the BSD Creator and the BSD Operation Pilot System which are outcomes of this study, are not composed of a single software system, reliability, efficiency, maintainability, and portability are excluded from the quality assessment items. Thus, detailed assessment items on functionality and usability are assessed as presented in <Table 3>.

7.2 Quality Assessment

BSD, the extended WSDL document proposed in this study, is a design of specification elements and thus, is excluded from quality assessment subjects, and quality assessment will be limited to BSD Creator and the BSD Operation Pilot System.

<Table 3> Items of Quality Assessment

Main Quality	Sub-Characteristics
Functionality	Suitability
	Accuracy
	Interoperability
Usability	Understandability
	Learnability
	Operability

As for methods of quality assessment, BSD will self-assess whether each element in BSD is properly standardized for each assessment item in <Table 3>. BSD will also check whether all the specification elements can be properly integrated and standardized, and can be applied to heterogeneous systems without restricting any functions, including the elements with differences of legibility that arose out of using different Application Development Tool.

(1) Functionality

Suitability assessed whether BSD Creator generates appropriate elements according to the grammars rules defined by the BSD schema.

As BSD Creator was implemented to control the grammar issues of BSD referring to BSD schema MDR and to verify its validity, it was evaluated to generate appropriate BSD.

Accuracy assessed whether BSD Creator was implemented to make the values of BSD elements to belong to the predefined domain.

The BSD Operation Pilot System was designed to establish the domain of each element in terms that the UDDI operator sets the BSD schema, and BSD Creator was implemented to make the input value of each element belong to schema defined in advance when creating a BSD. Also, it was implemented in a way that dependency among each the elements was verified at the stage of validity verification so that accuracy of the element values according to cross-references is maintained.

Interoperability assessed whether a BSD can be used among heterogeneous systems without restricting functions.

By adopting XML 1.0 standard, the BSD can be used regardless of the differences in runtime environments and the BSD Operation Pilot System was developed based on a browser, the BSD and its Operation Pilot System was evaluated to support interoperability.

(2) Usability

Understandability assessed the level of understanding of the BSD Operating Pilot System held by service providers using BSD Creator which generates a specification document and service requesters searching BSD in the UDDI.

To promote user's understanding, element of the BSD specification document adopted existing and already standardized company profiles reports specification and service quality specification, and commonly used business elements are used in the BSD Creator and the BSD Operation Pilot System.

And also the help functions with detailed explanation are added.

For learnability, BSD Creator and the BSD Operation Pilot System were implemented with Windows applications.

Thus, it was assessed that novice users can understand systems using general e-commerce GUI and that user accessibility to GUI was assessed to be identical to general applications. Also, as the system adopts business standard items and terms, the receptiveness of users was evaluated as high.

Operability assessed the information renewal of the publication of BSD and BSD Operation Pilot System.

BSD Creator was created to enable publica-

tion of the completed BSD with only one click of a button. And also the BSD Operation Pilot System was implemented to make information renewal in UDDI easy and to guarantee timeliness, by referencing BSD's URL in the service provider's server.

Therefore it was evaluated retaining operability through the automation to the process of publishing BSD and maintaining UDDI.

8. Conclusion

8.1 Summary of the Study

As the enterprise environment turns to a competitive system of survival and we enter an era of the "Now Economy" requiring the immediacy of enterprise responses, it is the time to require IT solutions that can support real-time enterprises.

There have been consistent efforts for distributed processing of software components and/or improvement of interoperability for Service-Oriented Architecture and the W3C's Web Service framework is broadly accepted as a solution.

WSDL, Web Service specifications presents comprehensive standards for the interoperability of software components and delegates extension of WSDL by uses and purposes as individual tasks.

For interoperation of business services, the needs to extend WSDL specification has been raised. There have been cases that various organizations extended WSDL specification, and there is a tendency that the extension is made

to execute specific purposes rather than a perspective of comprehensive business services interoperation

Thus, in this study, BSD, a service specification document, was designed as a WSDL extension for business services interoperation. BSD is designed in a structure composed of the business binding profile, service binding profile, and additional binding process, and the requirements of BSD were defined with the process to generate this were presented.

Also, BSD Creator to produces an accurate, valid, and well-formed BSD, and the pilot system to operate this were developed and presented.

By presenting BSD with BSD Creator and the BSD Operation Pilot System, it is expected that this paper will contribute to a base to construct business services interoperation system by industry groups in the future and revitalize business service interoperation.

8.2 Future Work

To increase the level of completion and the availability of a business interoperation system with BSD and BSD Creator, further studies as discussed below are necessary.

First, a process to confirm the usefulness of the BSD Operating Pilot system with real industry is necessary.

Although BSD Creator and the BSD Operation Pilot System were produced to generate BSDs, to verify validity, it is necessary to apply and test these outcomes in the industry.

Second, a study of the development of BSD

Schema Creator is necessary to improve the quality of BSD.

BSD Creator generates valid BSDs by referencing the BSD schema. In this study, the BSD schema was developed manually, but in order to be applied to and used in the actual industry, useful tools to write up BSD schema easily will be necessary.

Lastly, once the usefulness of the outcome of this study has been verified through the BSD Operation Pilot System and the BSD Schema Creator is developed, the efforts to disseminate the outcome of this study in the industry will be necessary.

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