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An Enterprise Application Development Framework Which Changes According to Need – SmartADF

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Abstract

While there are a majority of enterprises using the J2EE technological structure design and solutions, it is difficult to fulfill the requirements in the complex and various, multi-point and wide-spread business implementation level by relying solely on object and interface oriented technology. SmartADF (Smart Application Develop Framework-Java) is a rapid application development framework. It is a framework suitable for developing the enterprise applications software based on J2EE framework. It adopts a strict hierarchical design. Hence, different levels of developers can find the right level to work. The use of interface coupling between the layers could be realized. It has been proved by the practice result that SmartADF provides a more abundant set of components and technical specifications to develop fast, stable and efficient enterprise applications compared with the traditional J2EE development framework, which improves the efficiency of developers.

Keywords*: J2EE framework, Smart ADF, Enterprise Applications Software, BizVoucher*

1. Introduction

Nowadays, many enterprises use the structural design and solutions of J2EE technology. The classic structure of J2EE, Model - View - Control (MVC), is the most commonly seen structure which the J2EE application is based on. MVC is mainly suitable for interactive web applications, especially when there are large numbers of pages, many visitors and displayed data.

The SmartADF development framework is a framework based on the classic J2EE framework to develop enterprise application software. The framework has several new concepts:

1.1.Using Models to Meet the Needs of Changing Enterprise Applications

This framework views enterprise application software from four dimensions: interface, data model, workflows and data flow. These four dimensions constitute more than 80% contents of the enterprise application software. It can be said that enterprise applications are created, changed and evolved according to these four aspects. This method is a model-driven enterprise application strategy, which also provides the whole SmartADF theoretical basis and the central concept. SmartADF also provides an excellent solution techniques and methods by the four dimensions.

1.2 SmartADF Adopts Model Driven Technology (MDA)

It performs business analysis, modeling, development and testing based on the design platform of fully modeled by using model-driven technology (MDA). Eventually, it provides a business system with strong reusability, high stability,

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unified style and quality assurance for customers. SmartADF development framework can be implemented to realize the development process control of the speedy SMART project. It directly achieves from project analysis to system deliverance.

1.3 Clarify the Personnel Role of the Project Team

With SmartADF, the role of the various types of work requirements could be clarified in the project development process. The dilemma of "Anything could be done but without good quality" can be overcome.

1.4A New Way to Write Service Code

In JAVA, the service may be category or interface, which is not suitable for writing business service code. While functions orientation, object orientation and interface orientation are supports from the linguistic perspective, the service orientation and the service restructure are supports from the structural perspective. In this framework, the business service is called BSO, namely business service objects. This object is very simple to write. The framework uses the annotation mode, making the writers can provide the BSO prototypes without inheriting a parent class or implementing the interface. Each BSO can have multiple service methods and each of them can specify the input message as well as output message in advance.

1.5The Functions are Extended by Using Plug-ins

There is an extendpoints.xml extension file in a jar package which can be used to define extension points. Thus, when this jar package is placed, the function is automatically perceived. When removed, its extended function disappears.

1.6 SmartADF Offers Integrated Features at Multiple Levels

For example, it provides an integrated way for the applications with the same framework in the core technology layer. Besides, among the application systems developed by the SmartADF, the call is seamless. Moreover, in the core layer, it also provides a pass mode to achieve previous user identifications authorization among different systems. However, in the upper level business process, it can also integrate. At this time, the integration turns into a foreign call within a process so as to achieve business synergistic effect. The upper integration layers, BIS and DIS, provide heavy weight integration. They not only belong to the functional level but also the developmental level. BIS and DIS are developed based on the FFK layer of SmartADF. They have the natural integration ability with the business applications at the upper level.

1.7The Development Framework of SmartADF is Achieved by Model-driven Technology (MDA)

It conducts business analysis, modeling with high stability, uniform style and guaranteed quality based on the design platform of fully modeled. It provides an abundant set of components and technical specifications for the development of rapid, stable and efficient enterprise applications.

This paper will briefly introduce SmartADF, the design and the achievement of BizVoucher which is widely used (a processing model of business evidence) by examples of business proof.

2. The Development Framework of SmartADF Enterprise Applications

SmartADF development framework is established to develop enterprise applications software on the foundation of the classic J2EE framework. It provides a wide set of components and technical specifications for the development of fast, stable and efficient enterprise applications. The functional hierarchy of Smart ADF is illustrated by Figure 1 below:

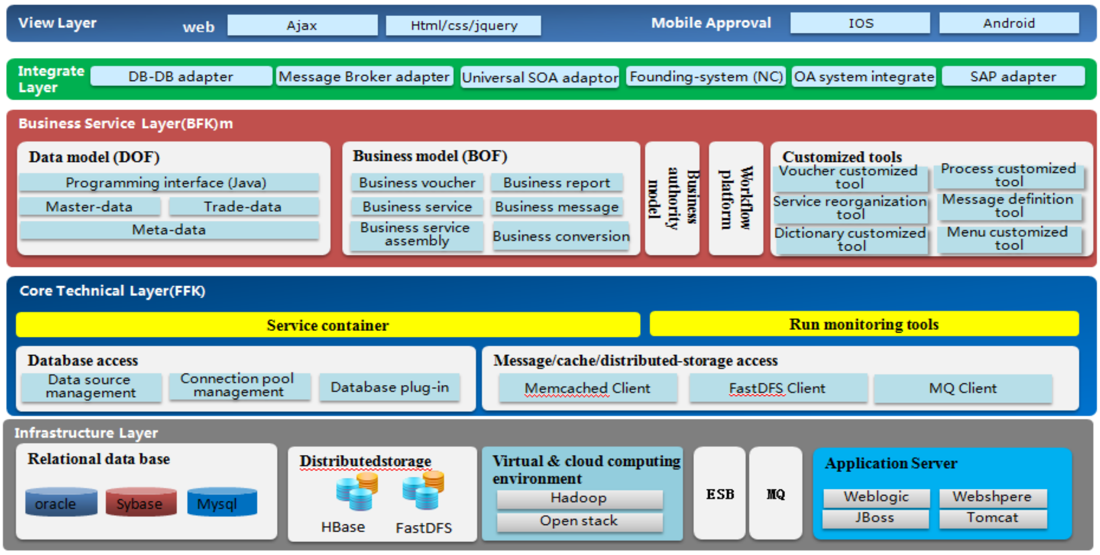

Figure 1. SmartADF Development Framework

2.1 Infrastructure Layer

A wide range of services and products provided by IT vendors, including infrastructures such as database, middleware, MQ, ESB, distributed storage, cloud computing and so on. SmartADF framework has extensive experience to integrate and interoperate with the infrastructure.

2.2 Core Technology Layer

This layer is located in the M layer of MVC model, which is in charge of the management of basic service objects and the database connection pool. Besides, it encapsulates the MQ, caching and distributed storage interface. In addition, this layer also provides a monitor for the frame services running.

2.3 Business Services Layer

This layer is located in the M layer of MVC, which is responsible for the encapsulation of enterprise business functions. This layer provides metadata, master data, transaction data and other models. It also provides business services, business services restructuring, business documents, workflow platform and authority management components. It also offers customized visualization tool so that users can easily configure all documents, workflows and data models.

2.4 Integration Layer

With business integration platform (BIS), it exchanges business data with all kinds of external business systems. It can also achieve the data exchange at the database level and the mutual integration with the deployed core ESB platform.

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2.5 View Layer

This is located in the V layer of MVC and is based on the ajax technology. Pure web service components are developed based on jquery core. The web demonstration of mobile operations system is achieved through interface exploration.

SmartADF integrates a lot of basic functions which contribute to the enterprise applications such as workflow tools, data flow tools, data model, business model *etc*. To realize the enterprise-level data processing, SmartADF foreground mode applies Ajax pure-web technology as the foundation and takes use of Jquery as the core base. From the technical aspect, the prominent characteristics of SmartADF are listed as follow:

(1) SmartADF is extended based on the J2EE standard framework. It makes full use of J2EE core function, allows full play to the advantages of J2EE such as portability, inter-platform ability, high scalability *etc*.

(2) Hierarchical design concept, plug-in extensibility. The purpose of hierarchical design is to achieve logical decoupling. Hierarchical design is able to improve the complexity of system integration significantly. In SmartADF, separating the technology layer and business layer is the first thing in the whole layering process. Then, separate the implementation layer and the framework layer. As the result, different developers can use different framework layers to work.

(3) Model driven. SmartADF is model driven. This feature is mainly embodied in the abstract and realization of the business model. It is model-based that is the obvious characteristic of SmartADF, which is more advantaged than general technical framework. Business is more flexible with model. In addition, changing customer requirements into software products becomes more convenient. Thus customers can acquire the better service.

(4) Interface-service-component-process. In SmartADF, the programmers in technology layer can conduct Interface-Oriented programming, the programmers in business layer can conduct Service-Oriented programming and the programmers in real-customization layer can conduct Component-Oriented programming. Finally, what is presented to the users is a highly flexible, customizable and scalable business application system.

(5) Swing supported. Swing in the J2SE is a powerful set of components. Swing is very suitable for intensive operation software applications, such as accounting system, settlement system and reporting system. These systems have many operating points and high requirements, meanwhile they require the agile reaction. Swing precisely realizes these features. As a part of J2SE, Swing is continually reinforced. It also supports inter-platform, that is to say Swing Can simultaneously run on Windows, Linux and Mac OS operation systems.

(6) WEB supported. Although Swing in J2SE is powerful, there are many occasions, in which Swing is not suitable. For example, when multiple vendors' web systems are integrated and required to unified log in, the application of Swing is difficult to merge. What`s more, in conditions of poor network environment, the utilization of a Swing application is also very inconvenient. Meanwhile, Swing must run in the JRE running environment with client and needs to download JAR package when applying an upgrade.

(7) Customization development. Since SmartADF has adopted abundant technologies and components, the core is very flexible. The finally produced software platform provides high customizability. It is mainly represented in the flowing aspects: service-customized, interface-customized and processes-customized.

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3. BizVoucher Design Application based on SmartADF

3.1The Definition and Related Concepts of BizVoucher

In daily life, as well as in business activities, bills are very common. Those bills are generally deemed as credentials, or vouchers. Voucher is more than the terminology in finance and accounting. It is a kind of credential that certifies establishment of trade or faitaccompli in ordinary living. Therefore, such bills including financial vouchers are all called credentials in SmartADF.

There are various and abundant vouchers in business activities, for example: Personnel Administration (entrant certificate, payroll, personnel redeploy and leave application *etc*.), Production Management (picking list, labor hour statistics list, charger sheet, schedule and duty table *etc*.), Inventory Management (stock-in, stock-out and checking table *etc*.), Sales Management (bill, receipt, invoice and contract *etc*.). There are also many types of voucher in daily life: Consumption (supermarket shopping receipt, MCD or KFC bill, shop sales slip and Express receipt *etc*.), Banking (withdrawal slip, deposit Slip, interest note, trade confirmation, loan contract and loan repayment *etc*.), Fees (water bill, electricity bill, property fee and other bills).

In social activities, these bills and lists are deemed to contain information, which is in order to record events and prove the authenticity. Voucher is the carrier of the information. In the business layer of SmartADF, it takes Voucher to describe all of the documents, including financial credentials.

In general, BizVoucher namely is Business Voucher. Most Businesses in enterprise application system could be abstracted out as collection, processing and analysis of business vouchers. Therefore, business vouchers are the foundation of the whole enterprise applications.

3.2Main Functions of BizVoucher

(1)BizVoucher vouchers management. Vouchers management is according to the business system. There are main management options: Number, Mnemonic code, Name (international), Long text (international), Root-Form, Child-Form, Storage table ID, Parent-Form. BizVoucher utilize standard dictionary to achieve international functions.

(2) BizVoucher column-items management. BizVoucher column-items are stored in standard dictionary. Through column-items management, user can directly copy all the columns in the Storage table. BizVoucher top fact columns often contain some control fields, which provide related business processing control.

(3) BizVoucher data submission. After BizVoucher data-input in foreground mode, every ChldForm is not submitted separately but organized as the BizFormDocument documentation by foreground operation. This BizFormDocument documentation is a kind of business message documentation and has integrated Store data formats. When the documentation is transferred to background system, the background business scheduling service then save it to related Store fact table, which is based on a large transaction.

(4) BizVoucher event-driven programming model. Programmer utilize a set of data window-based, event-driven, entity-based and field-name-separated programming model to control all the events.

(5) BizVoucher reactive function.

(6) Open voucher interface. When voucher interface is opening, the processing sequence is as follow: if sub-voucher is opening, then transfer open-parameters to the background and directly extract required data according to default dimension of filter condition; when sub-voucher is opening, other events (for example: automatic calculate cells) should be suspended temporarily; After sub-voucher is open, current activity is set as first row (if data is present).

(7) Change cell data. First, check if other fields in current row contain calculation formula, when yes then calculate the value; conduct up recursive traversal, search each column of current activity data in Parent-Form, then check the defined source-parameters rules in voucher data model, if they are sub-level dependent and calculation formula is present then calculate; conduct down recursive traversal, search for their Child-Voucher, if there are more than one Child-Voucher then sequential processing. (Attention: this is the recursion traversal.) As for all the rows in sub-voucher (attention: all the rows, not only the current row), search each column and find out its defined source-parameters types in voucher data model, if they are parent-level dependent and calculation formula is present then calculate.

(8) Add a new row. If the data source is *Calculation Formula* and formula is defined, then calculate the value and save it to each column in the new row. For example: voucher number field should come from its parent-level number column (the same with other dimension values). After this kind of automatic initialization, conduct up recursive traversal, search each column of current activity data in Parent-Form, then find out its defined source-parameters types in voucher data model, if they are sub-level dependent and calculation formula is present then calculate;

(9) Delete a row. Conduct up recursive traversal, search each column of current activity data in Parent-Form, then find out its defined source-parameters types in voucher data model, if they are sub-level dependent and calculation formula is present then calculate; conduct up recursive traversal, search for defined filter conditions in sub-level vouchers. Meanwhile, this deleted row should be deemed as current row and each row in sub-level vouchers match filter conditions should be deleted as well.

(10) Switch-over rows. This operation is mainly according to data of current row and data of parent-level vouchers, through an Expression to filter data of sub-level vouchers. This is applicative in financial vouchers. When different rows are selected from accounting entry, sub-vouchers auxiliary accounting need filter processing. (Attention: this is filter, not data re-extract)

(11) Edit status of column items in vouchers. On the one hand, edit status is firstly depend on storage table controller. In the stage of storage table, user is not allowed to edit a column without edit permission. On the other hand, in the stage of vouchers, redefine of formula edit status is feasible. In this formula, any items in vouchers are available. These two aspects are interacting. And last aspect is the response of event callback routines.

(12) Visible status of column items in vouchers. Visible status of column items in vouchers also has two main conditions. First, storage table. Second, the vouchers. On the one hand, visible status depends on visible permission in the stage of storage table. User can`t see the column items without visible permission. On the other hand, in the stage of vouchers, redefine of formula visible status is feasible. The principle is the same as it in edit status.

(13) Operating button of vouchers. new, delete, submit, withdraw, snapshot, print, modify, attachment.

3.3 The Design Concept of BizVoucher based on SmartADF

Business model is quite different from traditional Programming pattern and it is the realization of actual business in software system. This pattern is not to create interfaces and procedures one by one, but break complete business model into: data-form, data-rule, data-source, data-storage, and data-check and business service. This specific model contributes to better understanding and industry adaptability. Typical business model is abstractly represented in Figure 2.

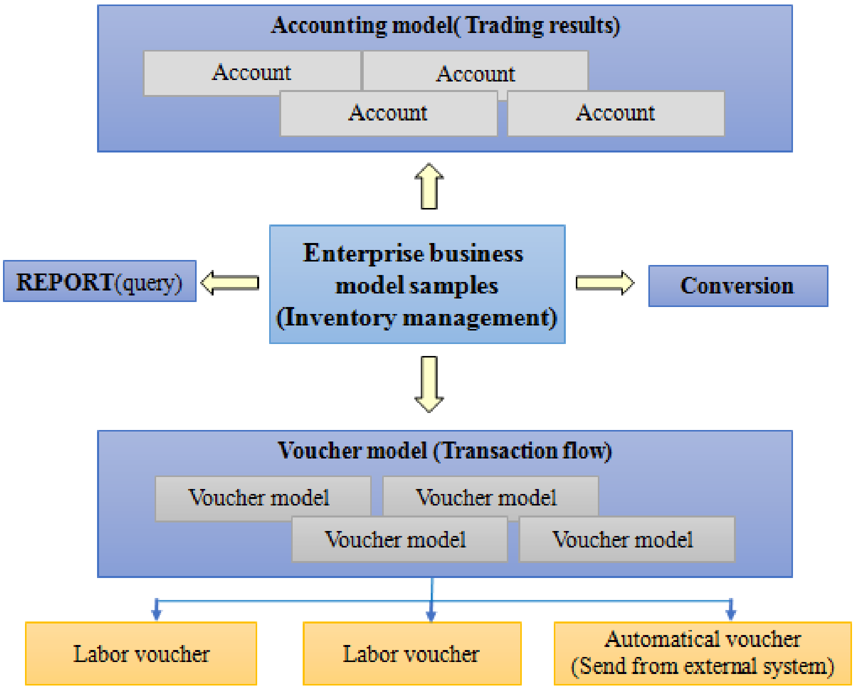
Accounting model(Trading results)
Account
Account
Account
Account
REPORT(query)
Enterprise business model samples (Inventory management)
Conversion
Voucher model (Transaction flow)
Voucher model
Voucher model
Voucher model
Voucher model
Labor voucher
Labor voucher
Automatical voucher (Send from external system)

Figure 2. The Classic Business Model Abstraction Diagram

In general, the preservation process of a business credentials (or so-called business documents) can be divided into several parts as shown in Figure 3.

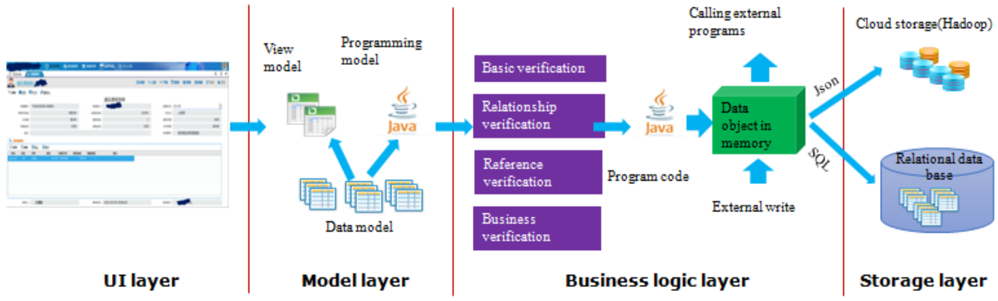

Figure 3. Preservation Procedure of Business Credentials

After establishing business model credentials using the ADF platform, we can model in showing the data to the documents and designing the visual documents on the model layer. Adding new business documents can be done easily and conveniently. The relation among data, model and interface is shown in figure 4.

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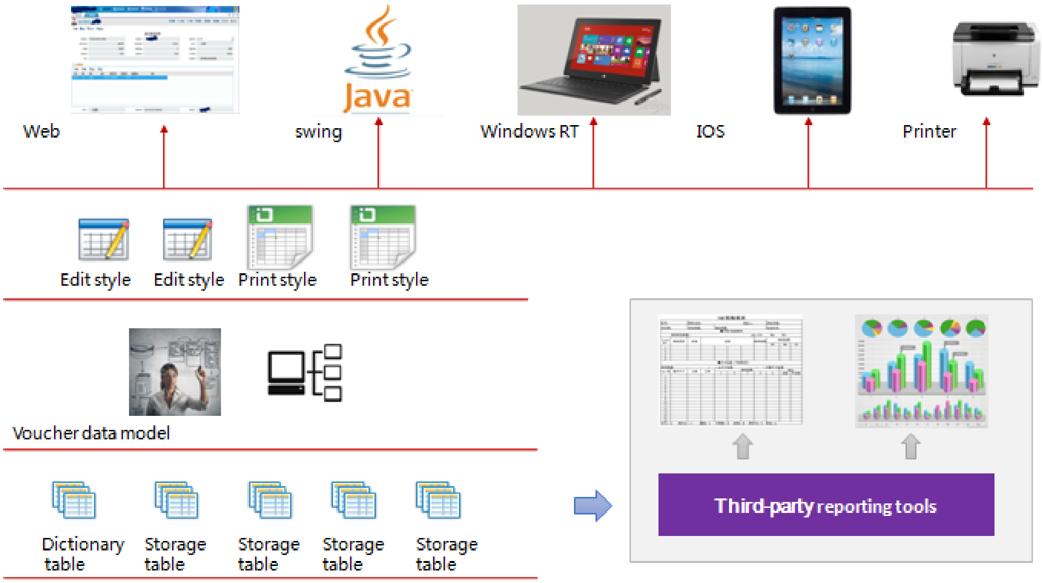

Figure 4. Relationship Diagram Data, Models and Interface

It needs to create a storage model among the database if the Credentials need to exist in the computer. Display model are needed if the credentials to be input by the user. Print layout model are needed if you want to print the credentials. Therefore, the complete definition of credentials should conclude data model, display model, input model and print model.

3.4 BizVoucherr Data Model

Special TBizVoucher are defined to hold their store definition information for describing the credential data storage model. The data base of a credential depends on the storage table rather than the physical table, which is different from other platforms in SmartADF, In order to define the data model of credentials you need to be ready for credential's storage table. A schematic configuration diagram of such a data model is shown in Figure 5.

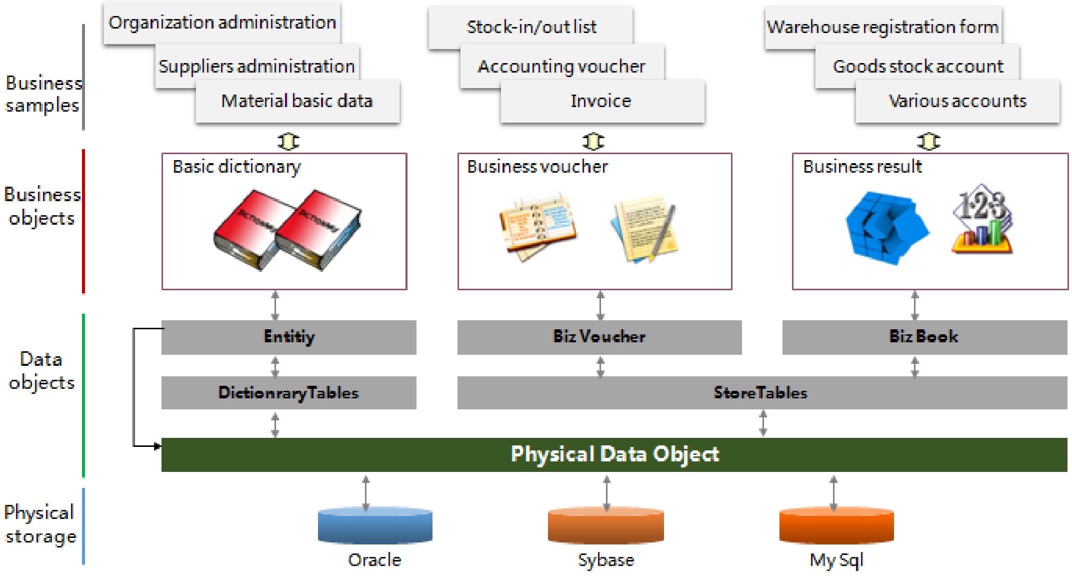

Figure 5. Data Model Diagram

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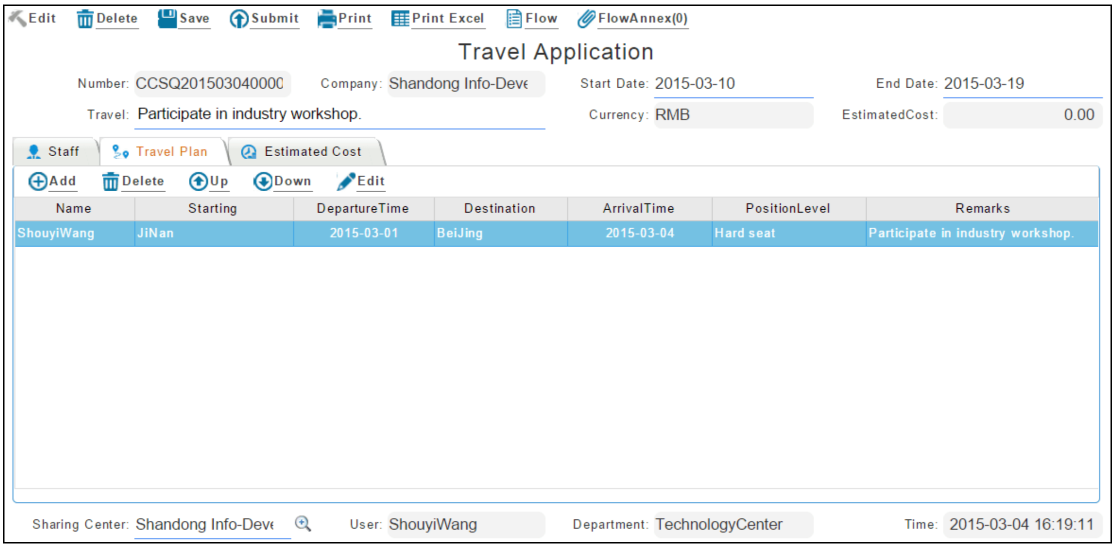
Credentials, according to their different complexity, require one or more storage list to store the data tables. Multiple relationships exist in multiple storage lists. The storage model is hierarchical and is not limited in class and times on the ADF. Relationship between storage lists of different classes and times can be defined, the column's calculation formula of each memory table can defined, including edit and display. The table mentioned above is Store Table completed in the DOF. It uses stored table's full functionality in credential model.

You can directly load data into the data model object after specifying a credential number for quick access to the program and more conducive to exchanging, processing and storage between different data model systems. Data model can also accept some data changes and update a single transaction to the corresponding multiple tables.

3.5 Displaying Components

To show good or enter credentials, you need to establish demonstration model based on data model, it simply is an interface definition display or input format. The same credential has same data model but maybe different in input interface. Therefore, input format is independent of the data model, the data is the data, the interface is the interface. In the ADF, the credentials input interface is displayed interface, just be different in modify state. The customization of input interface is visual, based on cell customization. The result is in XML and stored in system's credential management database. In default state, ADF provides input format customization for only one kind of credential. Under special circumstances, then consider a variety show format customization. a display assembly results is shown in figure 6.



Travel Application

Number: CCSQ201503040000 Company: Shandong Info-Deve Start Date: 2015-03-10 End Date: 2015-03-19

Travel: Participate in industry workshop. Currency: RMB EstimatedCost: 0.00

Name	Starting	DepartureTime	Destination	ArrivalTime	PositionLevel	Remarks
ShouyiWang	JiNan	2015-03-01	BeiJing	2015-03-04	Hard seat	Participate in industry workshop.

Sharing Center: Shandong Info-Deve User: ShouyiWang Department: TechnologyCenter Time: 2015-03-04 16:19:11

Figure 6. Display Components Diagram

3.6. Printout

In ADF, the default realization is that the input interface is the print format; but further adjustment on the width of lines should be conducted in consideration of the perfect printing effect. That is to say, the evidence management just provides a print format for a category of evidence, and if multiple print formats are needed to be defined, further management can be customized on the basis of ADF. As shown in Figure 7.

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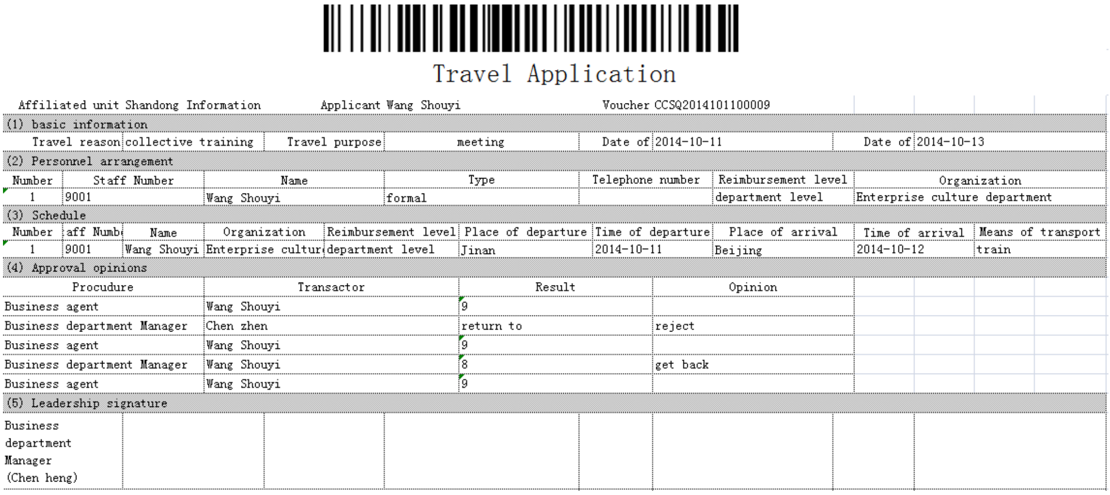

Travel Application

Affiliated unit Shandong Information Applicant Wang Shouyi Voucher CCSQ2014101100009

(1) basic information

Travel reason	collective training	Travel purpose	meeting	Date of	2014-10-11	Date of	2014-10-13

(2) Personnel arrangement

Number	Staff Number	Name	Type	Telephone number	Reimbursement level	Organization
1	9001	Wang Shouyi	formal		department level	Enterprise culture department

(3) Schedule

Number	aff Numb	Name	Organization	Reimbursement level	Place of departure	Time of departure	Place of arrival	Time of arrival	Means of transport
1	9001	Wang Shouyi	Enterprise cultur	department level	Jinan	2014-10-11	Beijing	2014-10-12	train

(4) Approval opinions

Procudure	Transactor	Result	Opinion
Business agent	Wang Shouyi	9	
Business department Manager	Chen zhen	return to	reject
Business agent	Wang Shouyi	9	
Business department Manager	Wang Shouyi	8	get back
Business agent	Wang Shouyi	9	

(5) Leadership signature

Business department Manager (Chen heng)							

Figure 7. Printout

4. Test Result and Analysis

In order to test the SmartADF built enterprise application situation, the most common individual reimbursement is taken as the example, and business interface and business logic are developed as per SmartADF specification. The travel expense form is selected as the business source of the test example in this time, to form the final reimbursement evidence by approval process.

4.1Test on Business Interface Design

The contents of classical travel expense form are taken as the requirement for arrangement, the SmartADF is adopted to design the receipt interface, and conduct overall test on interface structure and interface collected content control. The business requirement is accomplished in a rapid and easy way, to rapidly display the prototype function, and control the logical correctness of input data.

4.2 Test on Business Logic

The logic test includes the logic check of data between receipts for reimbursement and the storage logic control. I can be known from the test that the common computational formula verifications all pass, and logics involving in the combination with specific requirements should be cooperated with special writing processing program.

4.3 Enterprise Application Structure and Test Analysis

SmartADF can realize enterprise business application according to standard process in very short time, with higher efficiency than other methods. In consideration that SmartADF is realized according to standard process and specification, with relatively high modulation and standardization during realizing process, which provides preferable basis for the stability of program. SmartADF conducts packaging in key applied part, and the logic processing and data storage during test process are very robust.

As the enterprise frame of sub-module, SmartADF provides basis during the process of business upgrading. I can provide innate advantages on business modification and interface adjustment. See Figure 8 for the actual SmartADF-based rapid modeling and development working process schematic diagram.

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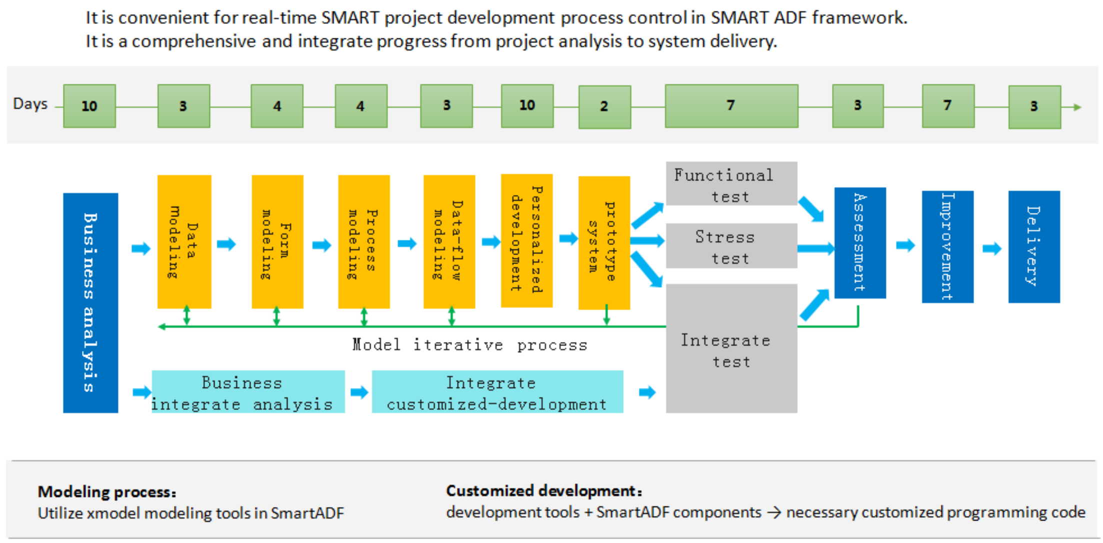
It is convenient for real-time SMART project development process control in SMART ADF framework.
It is a comprehensive and integrate progress from project analysis to system delivery.
Days
10
3
4
4
3
10
2
7
3
7
3
Business analysis
Data modeling
Form modeling
Process modeling
Data-flow modeling
Personalized development
prototype system
Functional test
Stress test
Integrate test
Assessment
Improvement
Delivery
Model iterative process
Business integrate analysis
Integrate customized-development
Modeling process:
Utilize xmodel modeling tools in SmartADF
Customized development:
development tools + SmartADF components → necessary customized programming code

Figure 8. Schematic Diagram for Working Process

5. Closing

This article proposes a kind of frame SmartADF suitable for development of enterprise application software. SmartADF employs strict hierarchical design for different layers of developers to find suitable layer to develop work. Interface coupling is adopted between different layers, and there are totally eight layers: core technology layer, application architecture layer, business structure layer, security control layer, view layer, development layer, customization layer and integration layer. This development frame faces to the developers but not executors. SmartADF provides the developers with rapid and convenient development method, model-based development method, a large number of built in public components, to improve the efficiency of developers, which is an enterprise application development frame depending on various needs.

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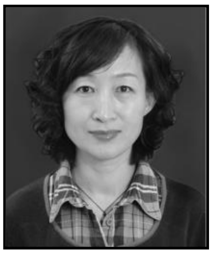

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