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IMAS: An Integrated Manufacturing Application Server for BPR

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Abstract

Information management systems should be reconfigured rapidly to respond to the change of requirements in Business Process Re-engineering domain. Inspired by the trend mentioned above, we proposed the notion of IMAS (An Integrated Manufacturing Application Server for BPR) and researched the connotation of it. Firstly, as the instruction system definition of IMAS, a special BPR language DTBP (Data Translate of Business Process) was described in detail. Secondly, we gave the hierarchical architecture of IMAS which consists of communication layer, platform layer and application layer, and all of the three layers were illustrated in detail. In the end, we make conclusion of this paper and point the future works.

Keywords: Application Server; IMAS; BPR; DTBP

1. Introduction

Just as Ref. [1-2] introduced, in the Ningxia Hui Autonomous Region, Integrated Manufacturing Enterprises (IMEs in short) were bearing the pain of breaks in products chain for a long time. With the competition of R&D enterprises in middle and east regions of China, the IMEs of Ningxia have to give up the top-design of products that had migrated to their competitors. Therefore the low level and repeated producing became the main part of products work of the IMEs in Ningxia. And their situation deteriorates

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while they gradually come into an especial lonely stage of producing processes for the lack of information platform in the Business Process Re-engineering (BPR) aspects.

Generally, without the tightly connection with information platform in the BPR aspects would cause two serious problems reluctantly faced by the IMEs in Ningxia: the first is the high-end chain does not exist in local, and another is local business processes could not share information with the whole business processes of the integrated manufacturing industry in China smoothly. Thus the business operations environment of them is inevitable in a certain position that is asymmetric information resources comparing with their competitors.

Based on the discussion above, we think the most urgent action to release them from the situation is to support them to establish product digital platform, producing management information operation platform and commercial information sharing platform.

Addressing the second platform, recently, we proposed a R&D project aimed at research the technologies of information system platform for BPR and try to development the initial version of platform software which can provide the basic functions representing the key technologies.

According to the fundamental steps of BPR [3] and directed by our research ideas, we have developed the visualized design tool VIMPM based on Visual Paradigm and introduced it in Ref. [4]. In detail, the functions of the tool VIMPM consists of modeling the current processes (the *as-is*) at first, defining the goals of the re-engineering activity (e.g. increase and reduce main process or sub-process) (the *to-be*), and after acute and export them into XML text representing BPR processes. No doubt, the XML text exported by VIMPM should be input into running engine for BPR (the *run-operate*) and receive the computing data sets.

Corresponding to the VIMPM introduced in Ref. [4] that focused on as-is and to-be procedures for BPR, connected with the VIMPM via XML BPR text, this paper focuses on the run-operate function include the BPR instruction language, software architecture and implementation method to construct an Integrated Manufacturing Application Server (IMAS, in short) for BPR. From the view of application software hierarchy, we can consider the server IMAS as a platform to support various application software of BPR running on it. Consequently, we will illustrate the key technologies of IMAS implemented by them in the following sections.

The organization of the rest of this paper is as follows. Section 2 discusses related work. Section 3 gives the instruction system definition of IMAS, a special BPR language DTBP (Data Translate and Business Process). The hierarchical architecture of IMAS by formal method is illustrated with representation structure in XML in section 4. Finally, section 5 summarizes the main results and points out the future work.

2. Related Work

Concerning about the hierarchy of normal composition of computer software & hardware, we seen the application server as a kind of middleware relying on the operation system and support to application software [5]. To reduce the complexity and improve flexibility of software system, distributed system consists of application servers and development tools with other fundamental software were presented to delivery unified system running environment [6]. Usually, middleware should provide a set of services including communication links, session protocols, APIs, common data exchange format, server control mechanism, name/directory, security and management etc [7]. And middleware aimed to increase effectiveness and efficiency of the development, deployment and interoperability of their upper application software under heterogeneous environment [8]. So that the properties of application software are characterized with distributed computing, multi-layers and explicit functional planning features [9-10]. Commonly, based on middleware, large-scale software system consists of interface presentation layer, function process layer and data storage layer [11]. This paper focus on the function process layer for BPR in integrated manufacture, and the Ref. [4] published early focus on the interface presentation layer for

the same research aspect.

From the view of software development methodology, the essence of software development is map from problem domain to different abstract concept layers and computing logics. Specially, we can complete the further logic process map from higher layer down to lower layer through an implementation of concept model map from higher layer down to lower layer [12]. Along with the development of visual technologies for software, human-computer interface has become a hot point in human-computer interaction research area [13]. Simultaneously, software development methodologies were increasingly giving rapid growth including component-oriented methodology presented in Ref. [14].

Resent years, many researchers have explored a lot of subareas of BPR including relative definitions, formal representing methods, software systems cover the whole lifecycle of BPR from requirement, whose studies primarily involve the concept, specification, method, architecture, technology, tools etc.

Addressing to the method to use the WWW to gather the information mentioned above, the Ref. [15] gave an overview of BPR information for researchers, practitioners and providers of enabling technologies. The flexible and scalable manufacturing systems are primary requirement for manufacturing enterprises. Ref. [16] proposed a methodology to document the needs for such a management control system as part of a BPR process. BPR has been a popular business improvement strategy for the past decade. However, in this area, smoothly solving the gaps between research of technology and innovation management were a key problem for manufacturing systems playing a kernel role in modern enterprises. Ref. [17] made conclusions that the key challenges for successful BPR implementation are changing and culture, ensuring extensive communications and dealing with resistance to change from middle management. No doubt, intelligence computing theory and techniques play an important role on the business intelligence research and industry circles. Ref. [18] introduced the first AI tool designed specifically for BPM (Business Process Modeling), one of research aspects in BPR. Applied BPR can be used in many specific domain of modern society. Through redesigning the information system process of the logistics system, Ref. [19] tried to make the information process more effectively and efficiently. To analyze the competence and impact of tools for BPR, Ref. [20] revealed the relation between effectiveness and efficiency, which showed that BPR tools are related to effectiveness rather than efficiency of the projects. Addressing to the inherent conflict for BPR leaders on choosing the appropriate style, Ref. [21] found that successful BPR leaders use leadership styles that fit the type of task that needs to be done and the needs of the people that will perform the task. On the aspect of process modeling and redesign method for BPR, Ref. [22] introduces The EPRE method was presented by Ref. [22] for analyzing business processes and supporting process redesign tasks. With respect to the use of process modeling languages to support BPR activities in relation with product development processes, Ref. [23] presented relative methodology and guidelines about it. As a novel concept in service computing, SOA has been a general architecture in service-oriented large-scale software development, Ref. [24] proposed a SOA-based ARIS model for BPR. To change the business process dynamically in the execution stage, Ref. [25] proposed a dynamical BPR model and a micro-kernel structure for the adaptive workflow management system model and Ref. [26] introduced a tool about BPR in PA. As a front tool to output BPR design processes in XML for the IMAS, the tool VIMPM about BPR in integrated manufacturing is proposed by Ref. [4].

3. Definition of Instruction System for IMAS

Following the discussion above, the application server IMAS is illustrated from this section. In this section, we introduce the definition of integrated manufacture business processes and the corresponding instruction language DTBP (Data Translate and Business Process) with explanation to how to control business processes by the DTBP.

3.1 Definition of Business Processes

The generation of textual version of Integrated Manufacturing Business Processes should be according to a series of national, industry, provincial and enterprise standards. Although we could not found the most suitable corresponding standards for BPR in integrated manufacturing enterprises, yet we can get reference standards about relative research areas with BPR, e.g. Enterprise Resource Planning (ERP) National Standards from Ref. [27-30].

Definition 1 Business Process Reengineering: BPR: Take the enterprise business processes as transformation of object, and essentially concerning and analysis on business processes according to requirements of customers, to redesign and reconfigure the business processes completely based on strategy aims and ideal process model of enterprise, so as to make enterprises can be adapted to modern business environment with feature of customers, competitors and variability. (Translated from A.1.4 in Ref. [27])

Definition 2 Process; work flow:

Automatic or semi-automatic realized full or part business processes supported by computers. In this procedure, documents, information or tasks can be transformed according to determined rules in order to achieve cooperation of members in organization for whole aim of business. (Translated from A.2.5 in Ref. [27])

3.2 An Instruction Language - DTBP for BPR

To support the application software of BPR operating on IMAS, IMAS should supply an operation mechanism for it through special language for BPR. Addressing to the requirement of the language, the instruction language should be defined formally including morphology, grammar and semantics.

Specifically, for morphology, we should construct a resource allocation system to map the various virtual resources into vocabulary of the language, that means each vocabulary of the language represent a determinate virtual resource, e.g. business name, business remark, business code, process sequence number, process label, process name, process type and so on.

In terms of grammar, the language should have the ability that assemble the vocabulary of lexical into meaningful statement to be complied and translated into low-level language further into APIs of fundamental system successfully.

We cannot completely finish the definition work of instruction language just by morphology and grammar. That means the semantics rule of the instruction language should also be defined in order to conduct various resources to be manipulated and involved in the calculation orderly.

Based on the discussion above, we can make a conclusion of the instruction language that its main purpose is to complete Data Translate of Business Process tasks, and then we named it as DTBP language in short. Consequently we proposed the lexical and grammar formalized rules of DTBP as follows.

<DTBP>::=<Bname>(<Rem>)?<Business_code> <Process_code> (<Flow_seq> <Flow_label>?
<Flow_name> <Type_code> <Flow_desc>? <Fail_label>? <Return_code> (<Flow_param>)[0-9]+)+.

In DTBP, each domain is defined as following:

<Bname>::=([A-Z]|[a-z])[0-20]
<Rem>::=([[A-Z]|[a-z])[0-20]
<Business_code>::=<System_code>[0-9]|[A-Z]|[a-z]
<Business_code>::=<Sub_System_code>[0-9]|[A-Z]|[a-z]
<System_code>=[Communication|Platform|Application]
<Subsystem_code>=[Sub-CM|Sub-PF|Sub-Ap]
<Flow_seq>::=[000-999]
<Flow_label>::=([A-Z]|[a-z])[0-6]
<Flow_name>::=([A-Z]|[a-z])[0-20]
<Flow_type>::=[0-2](0:Consequence,1:Judgement, 2:Branch,3:Concurrent,4:Loop)
<Type_code>::=[000000-999999]

<Flow_desc>::=([A-Z]|[a-z])[0-20]
<Fail_label>::=([A-Z]|[a-z])[0-6]
<Return_code>::=[0000000-9999999]
<Flow_param>::=<Param_name> <Param_value>

Following the lexical and grammar of DTBP introduced above, we present the resource allocation system diagram of DTBP as Figure.1 to represent its semantics information partially. And limited in the space of this paper, the detailed description of its semantics will be illustrated in our extended papers.

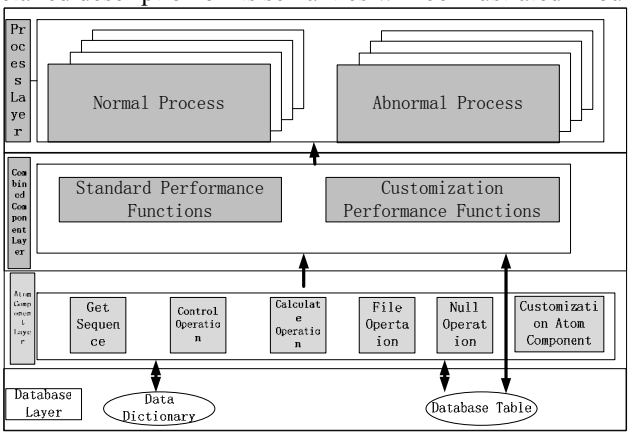

Fig.1 Resource Allocation System Diagram of DTBP

4. Hierarchical Architecture of IMAS

According to the resource allocation system diagram in Fig.1, the main application of DTBP is to manipulate and translate business process data. Apparently, the application software assembled by DTBP should be translated or complied firstly and executed on the platform of IMAS. So in this section, we introduce the hierarchical architecture of IMAS. As our design, IMAS consists of three major function layers including communication, platform and application layer. Then the application software of business processes can run on application layer via platform layer and communicate with outer system by communication layer. Following we will illustrate the three layers in abstract.

4.1 Communication Layer of IMAS

Communication Layer is responsible for communicating with outer system or software via asymmetric or symmetric network protocols and transformed data into IMAS or out from IMAS. In this layer, the security control and connection verification are necessary for assure the integrity and validation of BPR processes in XML format output from VIMPM [4].

4.2 Platform Layer of IMAS

Platform layer is responsible for executing BPR processes programmed with DTBP according to resource allocation system controlled under the server engine of IMAS. In the progress of processes executing, combined components consists of atom components are called by instruction of DTBP to compute variables of BPR and storage into database.

4.3 Application Layer of IMAS

Application layer construct “Application-Business-Process” system consists of metadata configuration, application data configuration, business data configuration, process data configuration, message format configuration and institute & communication configuration. And Fig.2 showed the hierarchical architecture diagram of IMAS.

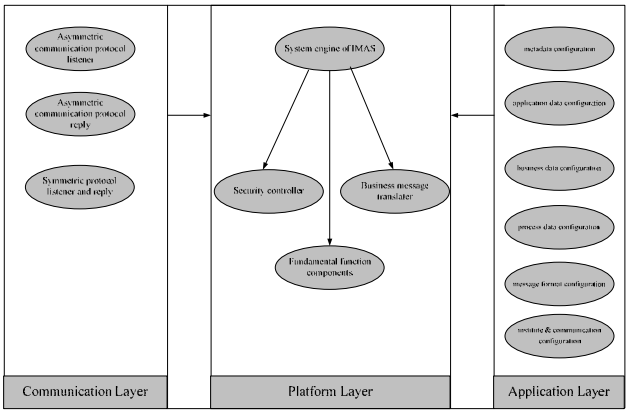

Fig.2 Hierarchical Architecture Diagram of IMAS

5. Conclusion and Future Work

To collaboration with the development of visualized tools VIMPM [4] for BPR, this paper proposed an integrated manufacturing application server, named as IMAS to support the BPR application software running on it as a platform conform with the BPR instructions assembled with DTBP language and translated from output from VIMPM. To illustrate the detail of IMAS, we firstly given the definition of basic concept and introduced DTBP language followed with hierarchical architecture of IMAS. In the future, we plan to export the output log of IMAS to VIMPM in order to improve the quality of design from VIMPM so as to construct a recursive development environment for integrated manufacturing application software design.

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