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Business Collaborative System Based on Social Network Using MOXMDR-DAI+

Jong-Sub Lee*, Seok-Jae Moon**

**Professor, College of General Education, Semyung University, Jecheon, Korea*
***Professor, Institute of Information Technology, Kwangwoon University, Seoul, Korea*
E-mail : 99jslee@semyung.ac.kr, msj8086@kw.ac.kr

Abstract

Companies have made an investment of cost and time to optimize processing of a new business model in a cloud environment, applying collaboration technology utilizing business processes in a social network. The collaborative processing method changed from traditional BPM to the cloud and a mobile cloud environment. We proposed a collaborative system for operating processes in social networks using MOXMDR-DAI+ (eXtended Metadata Registry-Data Access & Integration based multimedia ontology). The system operating cloud-based collaborative processes in application of MOXMDR-DAI+, which was suitable for data interoperation. MOXMDR-DAI+ applied to this system was an agent effectively supporting access and integration between multimedia content metadata schema and instance, which were necessary for data interoperation, of individual local system in the cloud environment, operating collaborative processes in the social network. In operating the social network-based collaborative processes, there occurred heterogeneousness such as schema structure and semantic collision due to queries in the processes and unit conversion between instances. It aimed to solve the occurrence of heterogeneousness in the process of metadata mapping using MOXMDR-DAI+ in the system. The system proposed in this study can visualize business processes. And it makes it easier to operate the collaboration process through mobile support. Real-time status monitoring of the operation process is possible through the dashboard, and it is possible to perform a collaborative process through expert search using a community in a social network environment.

Keywords: *Metadata Registry; Business Process, Social Network; Mobile Cloud; Multimedia Content, Ontology.*

1. Introduction

Currently, companies made an investment of cost and time for changes with a new business model. Accordingly, it rapidly changed in application of collaboration technology based on cloud, mobile computing, and social network business [1]. Generally, the collaboration environment for optimizing business processes in the companies was BPM [2, 3]. BPM (Business Process Management) supported smooth business collaboration between persons in charge based on user-interface. BPM-based systems provided functions such as sharing, expert, mobile, and governance. In other words, the collaborative processes should support the environments for mutual sharing, and it required a system supporting a function of expert for active collaboration. In addition, it provided a mobile service for collaboration available anytime and anywhere and managed policies relevant to the collaboration and change [4, 5]. Major functions of BPM were such as process management according to access authorities, real-time state of business processes, communication between persons in charge, opinion exchange for the business processes, and connection of the posted opinions with

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Corresponding Author: msj8086@kw.ac.kr
Tel:+82-01-7753-8086, Fax:+82-2-916-4751
Author's affiliation: Institute of Information Technology, Kwangwoon Univ., Korea

the business processes. Recently, these functions changed to collaborative business processes using a social network [6]. We propose a social network-based collaboration system for process management in a cloud environment. The proposed system converted the way of operating the processes in BPM-based collaboration to social network-based collaboration. In addition, the system was applied to run the social network-based collaborative processes using MOXMDR-DAI+ [7, 8]. MOXMDR-DAI+ provided interoperable services for processes of data sharing and exchange between individual local systems in the cloud environment. In the existing method of operating processes, there occurred heterogeneousness such as schema structure and semantic collision due to queries in the processes and unit conversion between instances, and this study aimed to solve the problems in application of MOXMDR-DAI+. In addition, GS (Global Schema) and LS (Local Schema) suggested in this study were applied to the methods of processing queries in the processes [9]. The GS, in which global schema-based SQL query was included in the process logic, was composed of DML (Data Manipulation Language), defined by creation rule, and complied with rules of ANSI standards. In addition, the LS included SQL query, in which the GS was redefined based on local schema in accordance with conversion rule in the process logic. The LS was also composed of DML, defined by creation rule, and complied with rules of ANSI standards. In addition, it applied creation rules 1, 2, and 3 of queries to the LS as defined by the GS. The system suggested in this study could support following services. First, it could visualize the business processes. It would enable easy access and wide application for operating collaborative processes through mobile support. Second, it could monitor real-time state of operating processes through dashboard. In other words, it would enable connection of processes, business polities, and related documents by providing a modeling environment for process visualization. Third, it could search experts in a community of a social environment to perform collaborative processes. It would provide detail information of the business processes such as histories and comments in real time. The rest of this paper is organized as follows: Section 2 describes the related work, Section 3 defines the proposed system, Section 4 describes its MOXMDR-DAI+ Mechanism, Section 5 describes application example, and Section 6 contains the conclusions and future work.

2. MOXMDR-DAI+

XMDR-DAI+ (eXtended Metadata Registry-Data Access & Integration) was an agent to solve metadata schema and data structure and semantic collision according to data integration using XMDR, which was an extended concept of MDR, saving metadata of relational database to object-oriented database [7]. In other words, it was storage combining MDR with ontology to prevent collision between schema structures of scattered data and instances. The MOXMDR-DAI+ applied collaboration system provided a data integration service for interoperation between local systems using a single view type of application. In addition, it provided association information between the instances using concepts of metadata registry and ontology thesaurus for data integrity and retrieval service. In addition, it had a function of mapping-converting of global schema and local schema in data sharing and exchange using entity schema between local databases, suggested standards required for constructing queries in collaboration using query-based workflow for data interoperation, and provided conversion mechanism and processing module of scattered queries in data migration for functions of replication, alignment, and merging.

Figure 1 is a model for solving metadata heterogeneity that occurs in collaboration. A conceptual XMDR model with key relations in the Figure 1 showed a good example of ontology resource management. MOXMDR-DAI+ was composed of and defined by various classes in Registered_Item like as Relation and Concept (map to univ: Multimedia Professor, univ: Student, univ: Multimedia Department). Among the classes, Relation class formed inheritance relations with concept class and played a role of property reference concerning Binary_Relation class. It defined relations between concepts and concept classes defining relations between concepts and semantic standards in the same class such as Relation_Role, Link, and Link_End. On the other hand, relation class identified relations between Link class and Relation_Role class, and Link_End class identified relations between Link class and Concept class. Thus, Link and Link_End class explained and expressively distinguished more than one component of Relation [10].

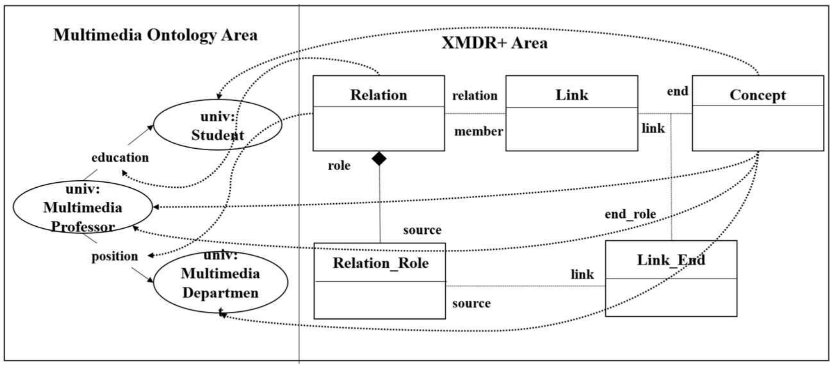

Figure 1. MOXMDR-DAI+ conceptual model

In addition, MOXMDR-DAI+ was designed to consider the scope of relations between levels of instances and concepts of ontology thesaurus. The methods of data interoperation using MOXMDR-DAI+ as explained in this study were as follows:

- **Alignment Method**: Adding connection information between schemas while maintaining an existing form of schema as similar to merging method. However, this method was used when hierarchy structures of both schemas (global schema and local schema) were the same.
- **Merging Method:** Combining two different schemas to create a new schema. In integrating MOXMDR-DAI+ based schemas as suggested in this study, combination of global schemas defined based on *Concept_System* with local schemas newly registered had the same meaning in registration to the global schemas; and it was used in mapping between the schemas which had different hierarchy structure.
- **Replication Method:** Integrating domains, which were not registered to *Concept_System* of MOXMDR-DAI+. It was inputted by local schemas to compare metadata, class hierarchy, and etc. with global schemas, and then, the schemas were integrated through a specific integration method; the processes were repeated until all data in the local schemas was integrated.

In algorithm 1, domains between inputted data of the local and global schemas, metadata, and hierarchy information were compared and analyzed to be integrated through appropriate sub-algorithm. The order of processes of algorithm 1 was as follows:

3. Proposal System

3.1 System Overview

This chapter suggested a social-based collaboration system in which collaborative processes were run and changed rapidly and easily in real time in a cloud environment, providing a modeling environment for process visualization such as connection of related documents. Figure 2 is the overall system configuration diagram of MOXMDR-DAI+ for business collaboration in the social network environment proposed in this paper. As shown in Figure 2, the proposed system configuration consists of social applications, collaboration systems, process resources, and legacy systems.

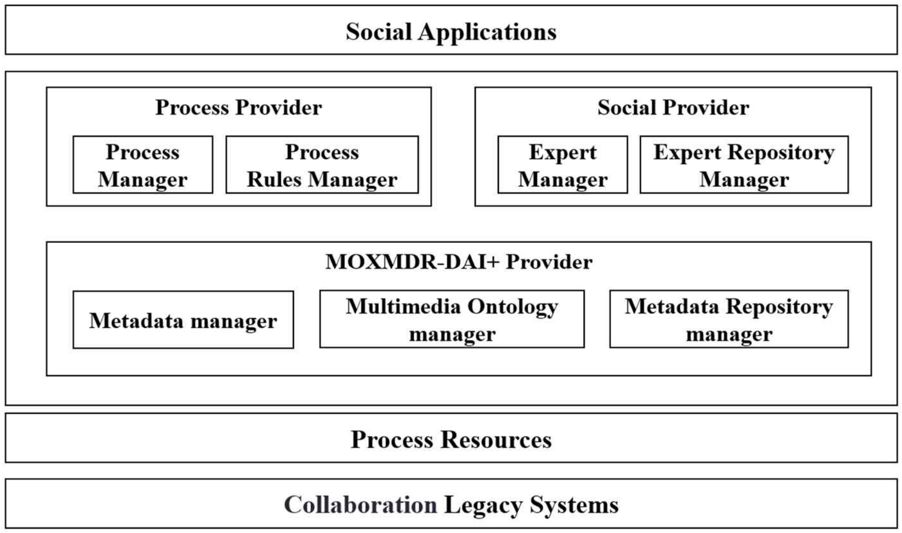

Figure 2. Proposal system composition

In addition, the Collaboration System was composed of Process Provider, Social Provider, and MOXMDR-DAI+ Provider. The component of each hierarchy was explained as follows:

- **Collaboration System**: This hierarchy, was a core part of this system, connected and matched business processes scattered in the cloud based on MOXMDR-DAI+ and prevented query collision in operating the collaborative processes. In addition, this hierarchy was composed of Process Provider, Social Provider, and MOXMDR-DAI+ Provider.
- **Process Provider**: Process Provider provided information from process storage when a user requested a process list. Moreover, it confirmed the authority of user who requested the process and rule information of the process.
  - **Social Provider**: Social Provider provided expert list information in a social environment when a user intended to find an expert who could select and run processes for collaboration.
  - **MOXMDR-DAI+ Provider**: In interoperation (sharing and exchange) of process collaboration between the locals in a cloud, MOXMDR-DAI+ Provider solved mapping of schema or data collision. Once more, this hierarchy was composed of Metadata Manager, Ontology Manager, and Repository Manager.
    - ✓ *Metadata Manager*: Metadata Manager defined semantic problems of schemas, which were necessary for collaborative process, and expressive collision problems as standard schemas to manage information of mapping criteria.
    - ✓ *Mutiemedia Ontology Manager*: Ontology Manager managed roadmap information of mapping processes defined as the standard schema.
  - **Metadata Repository Manager**: Metadata Repository Manager saved and managed all metadata schema used in process collaboration between the locals in a cloud.
- **Process Resources**: This hierarchy collected processes run in business collaboration of each local system.
- **Legacy Systems**: This hierarchy was local systems included in a cloud environment.

3.2 System Overview

The Figure 3 shows a process in which a user requested process information and expert list information. In the Figure 3, User (Request) requested the process information to Process Manager (a). Process Manager retrieved the process information through Process Repository (b, c). Process Manager requested to retrieve rule information of the process in relation to the retrieved process information to Process Rules Manager (d).

The retrieved rule was meta information of the process and information of the authority. The process list and process rule obtained through (a)~(d) were shown to User (Request).

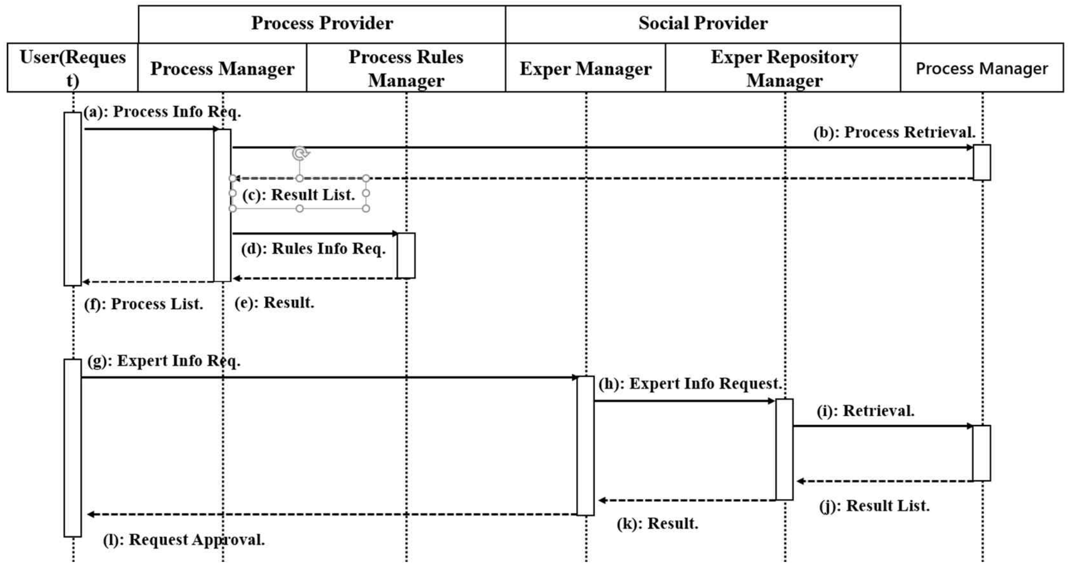

Figure 3. Proposal system sequence 1

Afterwards, User (Request) confirmed the process list and then requested the list of expert information for operating processes in collaboration (e). Requested Social Expert Manager retrieved the expert information through Social Expert Manager (f, g, h, and i). In other words, appropriate experts for the processes in collaboration were retrieved. The experts retrieved in Social Expert Manager were requested approval for operating processes (j). Then, the user (expert), who was requested for approval, determined whether to approve according to the process details (k). In the Figure 4, the user (expert) viewed the requested process details as shown in the Figure 3, and then the entrusted process was run after approval. In the Figure 4, collaborative process list was given to User (Expert) through Process Provider (a). The user (expert) requested appropriate metadata schema information for operating the process to Metadata Manager based on the process list (b).

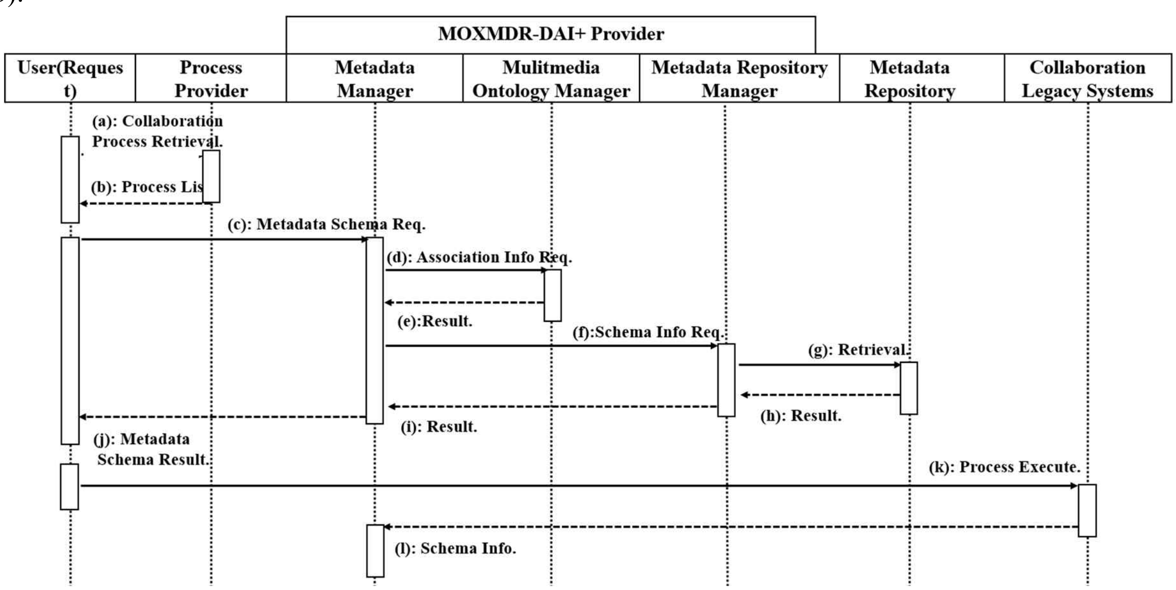

Figure 4. Proposal system sequence 2

Sequence 1 of the system was implemented as the same code in Figure 5. The Metadata Manager requested the related schema information to be processed in the metadata schema and schema profile information to Metadata Repository Manager (c, d, e, f, and g). Afterwards, the user (expert) was provided the schema profile information and the related schema information, defining the process to run through each collaboration local system (h, i).

```
Algorithms 1: System execute flow ( expert request );
public class SysExecute extends Thread {
    private SocialExpertMger sem; private SocialExpertRepositoryMger serm;
    private ProcRepository pr; private ProcRules prs;

    public void Agent_Execute(Strng str) {
        ArrayList<proc> procLList = new ArrayList<proc>;
        HashMap<idx, expert> experInfo = new HashMap<idx, expert>;
        procList = procProvider();
        expertInfo = socialProvider(procList);

        public void run() {
            pr = new ProcRepository();
            prs = new ProcRules();
            sem = new SocialExpertMger();
            serm = new SocialExperRepositoryMger();
            ….
        }
        public experList socialProvider(procList pl) {   ….
            try {
                    expertRep = sem.reqInfor(pl);
                    expertList = sem.reqInfo(expertRep);
            } catch( Exception e ) { e.printStack(); }
            return expertList;
        }
        public procList procProvider() {  ….
            try {
                    ResultSet rs = pr.retrievalProc();
                    procList = prs.reqInfo(ResultSet rs);
            } catch( Exception e ) { e.printStack(); }
            ….
            return expertList;
        }
    }
}
```

```
Algorithms 2: System execute flow ( process control );
public class SysExecute extends Thread {
    private MetadataMger mdm; private MultimediaOntologyMger monm;
    private MetadataRepostioryMger mrm; private CollaborationLegacySys cls;

    public void Agent_Execute(Strng str) {
        ArrayList<procList> procInquiry = new ArrayList<procList>;
        HashMap<idx, schema> hms = new HashMap<idx, schema>;
        procInquiry = procProvider();
        schemaInfo = retrievalSchema(procInquiry);

        public void run() { ….
            mdm = new MetadataMger();
            monm = new MultimediaMger();
            mrm= new MetadataRepositoryMger();
            cls = new CollaborationLegacySys();
            ….
        }
        public schemaInfo retrievalSchema(proInquiry pi) {   ….
            try {
                    associationInfo = monm.reqInfo(pi);
                    schemaInfo = mrm.reqInfo(new MetadataRepository(), associationInfo);
            } catch( Exception e ) { e.printStack(); }
            return schemaInfo;
        }
        public procList procProvider() {  ….
            try {
                    ResultSet rs = pr.retrievalProc();
                    procList = prs.reqInfo(ResultSet rs);
            } catch( Exception e ) { e.printStack(); }
            ….
            return expertList;
        }
    }
}
```

Figure 5. System sequence 1: logic flow **Figure 6. System sequence 2: logic flow**

4. Application example & Performance Analysis

This study applied asset management process to social network-based collaborative processes between local systems. The mobile-based application cases showed social business-based collaborative supports throughout application of assets-registration of purchase resolution-retrieval of PO-process of rental. An applicant was performing "Do the Process" to purchase a monitor in the Figure 10. (1) Inputted ID to start the process. (2) confirmed the expert list. (3) requested business collaboration to 'Pachoiski. 'Pachoiski of (1) confirmed the request message sent by the applicant in the Figure 11. (2) was the list containing overdue requests for collaboration.

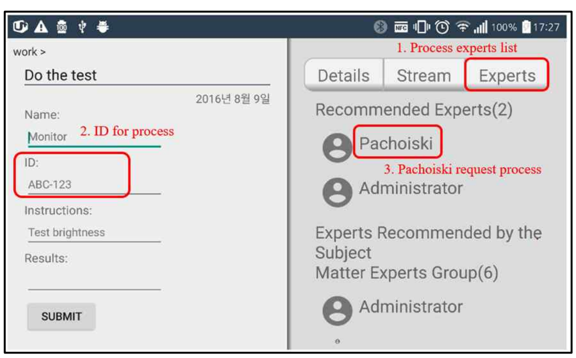

Figure 7. Application example 1

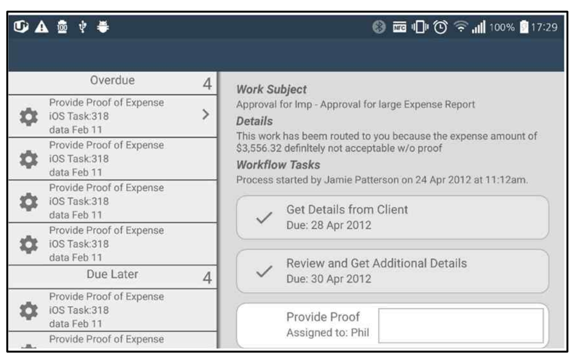

Figure 8. Application example 2

Table 1 compares the schema integration results when the global schema and the local schema are applied based on the two asset systems. Global and Local schemas of the asset management process, as the class, structure of property, the number of instances for matching queries were different, the numbers of Class, Link, Link_End, Relation, Binary_Relation, Property, and Instance, which were the internal components of MOXMDR-DAI+, were increased after integration as shown in Table 1.

Table 1. Result of the integration of different schema

Schema elements	Local Schema		Global Schema
	Asset System 1	Asset System 2	
Class	191	353	476
Link	168	538	893
Link_End	301	1375	1705
Relation	168	538	629
Binary_Relation	119	604	585
Property	208	254	381
Instance	35	37	59

Table 2 shows the integration accuracy and recall between different schema structures in the asset system compared in Table 1.

Table 2. Accuracy & recall of integration between schema of different structure of schema

Schema elements	Accuracy.	Recall
Class	0.79	0.72
Link	0.75	0.69
Link_End	0.82	0.60
Relation	0.75	0.55
Binary_Relation	0.70	0.49
Property	0.95	0.63
Instance	1.02	1.01

The performance of MOXMDR-DAI+ applied collaboration system was evaluated by data access services in the social network-based processes and results of the collection services.

5. Conclusion

We proposed a social network-based collaboration system using MOXMDR-DAI+ for process management in a cloud environment. The suggested system converted the method of collaborative processes to MOXMDR-DAI+ applied collaboration process based on the social network. MOXMDR-DAI+ provided data interoperable services between local systems in the cloud environment. The problems were solved by MOXMDR-DAI+ in the system; and GS and LS-applied integrated operation service was provided for processing requests of the social network-based processes. In addition, a uniform viewer provided for request and processes of collaboration to users through the social network enhanced more effective services for collaborative business processes. First, it enabled visualization of business processes. The mobile support enabled easy and wide access to the collaborative processes, and even non-experts could check the processes to handle and change the processes easily and rapidly. Second, it monitored real-time state of processes through dashboard. Providing a modeling environment for process visualization, it facilitated connection of such as processes, business policies, and related documents. Third, experts could be retrieved in a community for operating collaborative processes in the social network. In future studies, silo policy for data in operating collaborative business processes based on the social network should be settled based on big data. Furthermore, a big data-based framework and a way of conversion processing of data in noSQL method should be suggested.

Acknowledgment

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