

# Skill-Competency Management Architecture

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**Abstract:** For e-learning quality management from the perspective of external consistency, it is necessary to connect learner profile record and human resources information systems. Some technology standards about learner and competency information have already developed, however these have not been still effective to integrate various learner and competency information and to connect to HRIS. Reviewing existed specifications, a skill/competency management architecture is developed. This consists of seven entities and connects to LMS and HRIS. And this will facilitate to choose current specifications and to develop data-bases and applications which are able to deal with learner and competency information commonly.

**Keywords:** Skill-competency management, e-Profile, Competency information, Modeling, Evidence information

## 1. Background

There are various issues in e-learning. Recently, the issues of quality management and learner management are very significant. From the perspective of quality management, problems of mechanical materials or functions and insufficient infrastructure are decreasing, while issues related to organizational process or learning content and service are more important.

In this paper, external consistency of e-learning is focused on. e-Learning should not exist as stand alone, and be related or integrated to other systems. However, the current existed system and specifications are insufficient to realize collaboration between e-learning and other systems such like human resources information system (HRIS) or personnel information management system.

From the perspective of quality management on e-Learning, it is needed to examine whether e-learning has provided appropriate learning, or brought learning results to learners. In other words, external consistency of Learning Management System (LMS) or e-learning should be considered as to see the collaboration effect for the purpose of learning itself. The purpose of learning is implemented to system and managed by personal record data and competency information. Competency in this paper is a term of generic use for knowledge, skill, ability, attitude, other characteristics, personality and behavioral performance.

Preparatory to this consideration, here are typical entities which are related outside of LMS. e-Learning should realizes external consistency taking collaboration with systems related to LMS. Learner information integrated in existing LMS is not also covered sufficient information to make relation to other systems.

On the other hand, development of various LMS raised expectation for information technology standard around the millennium. As e-learning providers and user requested to

deal with various learning contents by single LMS, so issue of standard was common specification of learning content and system conformance. However, currently business model of e-learning is changing, it raises expectation for different types of standards which are standards of learner profile. Learner profiles are used to bridge among various LMS as "a passport" in e-learning.

And in human resources domain, employment is faced rapid change which is globalization. Large companies have employees from various countries, so they paid lot of cost and attention for development information system and recruitment. Specification standard will reduce these efforts.

## **2. Issues in Learner and Human Resources Information**

On the other hand, development of various LMS raised expectation for information technology standard around the millennium. As e-learning providers and user requested to deal with various learning contents by single LMS, so issue of standard was common specification of learning content and system conformance. However, currently business model of e-learning is changing, it raises expectation for different types of standards which are standards of learner profile. Learner profiles are used to bridge among various LMS as "a passport" in e-learning. Current Human Resources (HR) related systems, which are including Human Resources Development (HRD) tools, skills management systems, e-Learning, and etc. - have been developed using Internet technologies. Every employee is able to access these systems and data in workplace. The other movement is that the operations in HR section are recognized as one of the main targets for outsourcing [1]. This means HR operations and data need to be interoperable in order to communicate between the customer organization, their employees, and outsourcing service providers.

From the late of 1990s, some industrial and academic organizations have developed information technology specifications or standards in HR domain on the global level for meeting with these issues and its environment, for example, IMS global consortium, HR-XML consortium, IEEE-LTSC, and also ISO/IEC JTC1 [2] [3] [4]. These independent standards are similar and their relationships are confusing. This paper will introduce each of them, identify their characteristics, and show each relationship.

Various problems which should be solved by or supported with information technology still remain on HR related systems [5]. Based on Hirata and Brown [6], some typical problems are; 1) HR information cannot be shared with different HR related platforms, 2) HR information is not used within HRD easily, because it usually does not deal with skill and competency detailed information in HR related systems, 3) Individual status of possession degree and proficiency about skill and competency could not be deal with almost HR related systems and skills management systems, 4) Individual developmental paths cannot deal with most HR related systems. 5) Individuals and organizations cannot design their career strategy and career path using existing common dimensions with HR related systems, 6) Skill and competency evidentiary information is required to be shared, 7) Evaluation biases in human assessment are hard to avoid without supporting systems. 8) Human assessment cannot be reflected by everyday operation and work performance using HR-related systems. A variety of HR related systems have been developed to solve these problems. Developed in order to replace human labor about their repetitious, boring, and uninteresting works, these systems have focused on processing of huge amounts of data or data delivery. It can be said that their attempts can solve or support only certain parts, and HR related systems are expected to be more effective and helpful for HR operations in near future. Namely, HR related systems have to pay attention to the typical characteristics of skill and competency, which are "hypothetical construction", "multi-scalable", and "multi-operational".



As these type of information model, HR-XML (Resume), IMS : LIP (Learner Information Package) or IMS : e-Portfolio have already been available [8]. Each model is used in a different situation. In addition to the models, HR-XML : SIDES (Staffing Industry Data Exchange Standards[9]) which focuses on operations and data transactions during the operations is seen.

The second entity is “skill/competency information”. This entity is reference and describing information concerning taxonomy and/or structure of competency. These are so many types of taxonomy and/or structure of competency. For example, in Japan, The Skills Standards for IT professionals (ITSS), Embedded Technology software Skills Standards and so on. were developed by Ministry of Economy Trade and Industry (METI) and Information-technology Promotion Agency (IPA) [10] [11]. Of course, the other countries are also developed such like standards. For example, the National Skills Standard Board (NSSB) has published some skills standards for each industry. The Department of Labor in U.S. (DoL) has developed and operated huge occupational definitions and needed skills and abilities for each occupation as O\*NET project for a long time.

However, these taxonomy and/or structure are described in different manner, and usually written in natural language. Furthermore, these are implemented to system in different manner. So the issue causes that integrated data management has not realized yet with interoperability, HR-XML: Competencies [12] or IEEE: Reusable Definition for Competency (RDC) have already been suggested as specifications of information model to implement competency information. An instance data of competency in e-profile refers to this information model, so this relationship between e-profile and skill/competency information makes sure traceability. However, though these information models are useful to identify competency, they are not able to define or to describe the semantic information of competency directly.

So this reason, “skill/competency semantic information” is necessary as the third entity. In order to solve the problem what “skill/competency information” can not deal with semantic information, the third one, this entity represents data about semantic content of competency and deals with relation among different competency structures. Each organization and each country has original competency models or skills standards. If an employee change his organization or job, his information about skill and competency can not be understood by new organization currently. So semantics information about skill and competency is needed in real issue.

The fourth entity is “level information”. Level information compensates for lack of information on competency or educational objectives information. Some of competency taxonomies is hard to divide. Though the level information can be integrated into competency information itself, it is better to define and to manage level information and competency information separately for interoperability. This entity can be directly applied to European Qualifications Framework (EQF) model or mutuality model.

The fifth entity is “evidence information”. As mentioned before, in e-learning these are about learning activity logs, learning results, examination scores, date of learning completed and so on. For example, bases of an appraisal data value – “grade: A” in e-profile are each information of attendance rate and each daily examination result score and final test result, which are evidence information. Personnel records of action observation and individual business performance information are included except information related to e-learning. This information is intended to improve validity and reliability of information in e-profile.

The sixth entity is “assessment method and metric”. This entity is concerning ways, processes and rules of assessment to acquire the competency information. Essentially each skill and competency concept is depended on the way of assessment, so skill and competency can be observable and measurable. It is important to make the way of assessment clear. What are measured by a different method is generally considered to be a different competency. The examples of this type of information model are ISO/IEC 19796-3 [13] which focuses on quality, or HR-XML: Assessment which focuses on transaction during operation [14].

The seventh entity is “meta model”. This entity is concerning meta-model to cross-refer to the each competency information, and to clarify difference of design, format and structure for competency. If an employee change his organization or job, his information about skill and competency can not deal with in new organization. So such a meta-model is useful to harmonize among deferent domains and countries.

#### **4. Mapping Existing Specifications into S-March**

These are several models, specifications or current approaches as discussed previously. Some of entities as information-objects related to competency have been already developed individual models to be deal within information systems. Various types of modeling methods for information technology are used, QC (Quality Control) techniques, PERT (Program, Evaluation, and Review Technique), DTD (Document Type Definition), CRM (Conceptual Reference Model), UML (Unified Modeling Language), water flow diagram, metadata, ontology and so on. Information related to competency are also developed using these various modeling methods. This has caused confusion to use and to understand them. For development international standards, it is needed to map various types of model and specifications.

In this section, existed specifications or current approaches for describing competency information or operating transaction of competency related information are analyzed by modeling methods along “S-March”.

The table (table 1) shows that some types along the horizontal. And also typical methods for developing models are indicated below each model. For example, the 1<sup>st</sup>. type of model is “conceptual object relation model”, and “CRM” and by UML” are useful to develop a specific “conceptual object relation model”. And the 3<sup>rd</sup>. type of model is “object model”, and “class diagram by UML” or “ontology: simple or shorthand version” are useful to develop a specific “object model”.

The table shows that some target information related to competency is aligned along the vertical. The target information are divided along the objects which explained before the chapter. “P” means e-Profile, “C” means Skill/Competency information, “L” means level, “E” means evidence information, “A” means assessment method and metrics, “U” means usability, “W” means whole information related to competency. “W” is useful as system architecture or harmonizing to different models or systems. “O” means operation and data transaction, O is useful to make relationship and implement to system these objects. So O applies as arrow line in figure 1 to connect between each information entity.

This table let us understand the characteristics of each model or specification.

#### **5. Discussion**

e-Learning should not operate stand alone. Learning is closely related to evaluation, assessment, work, career and personal development. That means learning objectives and learning results have direct relationship to user requirement.

Table 1 Mapping into S-March

		Type of Modeling										
Target information	Object	Conceptual object relation model	Conceptual object model	Object model	Object data model	Object data instantiation procedure	Object data management model	Knowledge base	Conceptual business operation model	Business operation model	Transactional operation model	Transactional operation instantiation rule
Typical → Modeling Methods		CRM, Collaboration-D	Structural class-D, Ontology	Class-D, Simple ontology	Binding, Object-D	Sequence-D	State-D	Ontology (core, domain, task)		Use Case-D	Activity-D	Sequence-D
Competency management operational information	W								J/TanalysisFlow:SN			
Skills mgmt architecture (abstract level)	W	SMA:JP										
Regal and Privacy	W											
CRM Comp-tency	W	ISO24763										
Common participant information	P			ISO19788 LIP:IMS	ePortfo:IMS(packaging)							
Skills management operation	P								JobProfiling:SN			
Comp. Info. relation data	C			RDC:IEEE Competencies:HR-XML								
Comp.-job semantic info.	C		SkillObject:SN	Competencies:HR-XML SkillObject:SN					SkillObject:SN	SkillObject:SN		SkillObject:SN
Comp. content meta info.	C		SkillMeta Model:JP		SkillMeta Model:JP			SkillMeta Model:JP				
Comp. structural aggregation	C		CompMap:IEEE		CompMap:IEEE							
Skill/comp.-model operation	C						ProficiencyMgt Model:JP					ProficiencyMgt Model:JP
Comp. Domain Ontology	C		SkillOnto:JP	CompDic:SN				CompDic:SN SkillOnto:JP				
Comp./processing(task) Ontology	C		SkillOnto:JP	Job/TaskDic:SN				Job/TaskDic:SN SkillOnto:JP				
Proficiency information	L		ProficiencyModel:JP		ProficiencyModel:JP			ProficiencyModel:JP				
Evidence asset data	E			EvidenceAssetModel:JP								
Competency assessment information	A											
LET, labor exchange, policy and design	U											

e-Learning system and learning contents data have get much attention to implement into system, and to shear of them, meanwhile learner and competency information have developed as sub-components used only in e-learning.

However, learner and competency information and related system are keys to develop and manage human resources. So in this paper, we focused on learner and competency, suggested the system architecture called S-March.

S-March showed all of core entities to deal with and to implement learner and competency information. This will help to develop and optimize such kinds of information into database and application.

While reviewing existed specifications, we recognized lack of various types of specification as standards. It is needed to facilitate and develop more standards in this area.

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