

Framework and System for Supplier Scouting Enabling Web-based Collaboration

Sangil Lee, Kwangyeol Ryu, Kezia Amanda Kurniadi, Yongju Park

Abstract—Nowadays, many manufacturing companies try to reinforce their competitiveness or find a breakthrough by considering collaboration. In Korea, more than 900 manufacturing companies are using web-based collaboration systems developed by the government-led project, referred to as *i-Manufacturing*. The system supports some similar functions of Product Data Management (PDM) as well as Project Management System (PMS). A web-based collaboration system provides many useful functions for collaborative works. This system, however, does not support new linking services between buyers and suppliers. Therefore, in order to find new collaborative partners, this paper proposes a framework which creates new connections between buyers and suppliers facilitating their collaboration, referred to as Excellent Manufacturer Scouting System (EMSS). EMSS plays a role as a bridge between overseas buyers and suppliers. As a part of study on EMSS, we also propose an evaluation method of manufacturability of potential partners with six main factors. Based on the results of evaluation, buyers may get a good guideline to choose their new partners before getting into negotiation processes with them.

Keywords—Supplier Scouting, Supplier Discovery, Collaboration, Web-based Collaboration System, Excellent Manufacturer Scouting System (EMSS)

I. INTRODUCTION

NOWADAYS, many manufacturing companies try to reinforce their competitiveness by considering collaboration. In Korea, more than 900 manufacturing companies are using web-based collaboration systems developed by the government-led project, referred to as *i-Manufacturing*[1-6]. The systems support similar functions in Product Data Management(PDM), Manufacturing Execution System(MES), Product Lifecycle Management(PLM), Project Management System(PMS), etc. Web-based collaboration system provides many useful functions for collaborative works.

However, this system does not provide linking or scouting services between buyers and suppliers. Therefore, in order to find new collaborative partners, it is necessary to develop and add functions or a system to the existing collaboration systems, which support a creation of new connections between buyers and suppliers via web such as alibaba.com, and mfg.com.

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However such systems as alibaba.com or mfg.com just provide general information or engage in business contracts between buyers and suppliers by human force. In such cases, the system users have to pay a lot for their membership and contracts. This might be a big burden for small sized manufacturing firms to use such system.

Therefore, in this paper, we proposed a new supplier discovery and scouting system, referred to as Excellent Manufacturer Scouting System(EMSS). EMSS plays a role as a bridge between overseas buyers and suppliers. EMSS connects buyers to suppliers by two phases: discovery and scouting. Using ontology concept enables EMSS to discover suppliers who buyers want. During the discovery phase, EMSS chooses several suppliers based on the buyer's preference. In other words, EMSS extracts candidate companies for buyers. Then EMSS recommends potential suppliers to the buyer according to ranks given by using the assessment method proposed by this research during the scouting phase.

In this paper, we briefly introduce existing web-based collaboration systems in Section 2, and describe EMSS in Section 3. Then we suggest a manufacturability assessment method for EMSS in Section 4 before addressing concluding remarks in Section5.

II. WEB-BASED COLLABORATION SYSTEM

In order to facilitate collaboration of Korean SMEs, *e-manufacturing* pilot project was launched to develop web-based collaboration system in 2004. In 2007, the project has been enlarged with a new name of *i-manufacturing*[7]. A total of 11 distinctive collaboration systems were developed by the *i-Manufacturing* project until the end of 2010.

Collaboration systems have been developed by focusing on embodiment of functions according to the demand from users. Until now, we still try to improve and to accommodate user's opinion. In the meantime, collaboration systems become complicated by reflecting user requirements for functions or services. As a consequence, a current collaboration system consists of various functional modules and services, which is called a function-centric system. All functions of collaboration systems are provided as a type of Application Service Provider (ASP) so that users can utilize them anytime and anywhere if the users are connected to the internet. Table I summarizes the main functions of each collaboration system[8].

TABLE I
FUNCTIONS OF COLLABORATION SYSTEM

System Name	Main Functions
Design_Hub	<ul style="list-style-type: none"> - Managing collaboration project information and history of injection molds - Managing standard work templates and distributing drawings and documents - Online conference with 2D/3D Computer Aided Design (CAD) drawings - Searching project/data information according to user's permission to access
Blow_Hub	<ul style="list-style-type: none"> - Managing collaboration project information and history of blow molds - Managing standard business templates - Providing part library supporting parametric design of parison & blow molds - Same functions supported by the Design_Hub
Production_Hub	<ul style="list-style-type: none"> - Planning & scheduling outside orders by simulation(with delivery or cost) - Distributing specification of parts or modules to the cooperating companies - Reporting the production status to customers via SMS(Short Message Service) - Providing online Computer Aided Engineering (CAE), inspection services
Engineering_Hub	<ul style="list-style-type: none"> - Online CAD/CAE conference with customers - Managing projects and history of engineering services - Finding experts for customers by facilitating on-line communities - Computer Aided Inspection (CAI) tools for verifying CAD drawings
Automold_Hub	<ul style="list-style-type: none"> - Managing three types of collaboration projects (styling, inverse design, and parts development) - Providing collaboration tools such as Photo-Clinic(online voting tools/AHP), on-line Computer Aided Styling (CAS) conference, CAI, etc. - Supporting tools for developing design mock-up of automobile parts
Press_Hub	<ul style="list-style-type: none"> - Managing project information and history for producing press molds - 2D CAD visualization with mobile device(e.g., PDA) - Managing test information and history of press molds developed
Automobile_Part_Hub	<ul style="list-style-type: none"> - Managing project information and history for producing automobile parts - Providing on-line Digital Mock-up (DMU) conference as well as CAD and CAI conferencing tools
Module_Mass, Production_Hub	<ul style="list-style-type: none"> - Collaborative procurement system for automobile parts or modules - Sharing collaborative schedule for mass production of automobile parts - Managing distributed design information between companies
Automobile_Quality_Hub	<ul style="list-style-type: none"> - Managing quality information of automobile parts between companies - Supporting inspection specification and technical know-how with quality DB - Managing analytical information of middle and large sized automobile parts by using MOLDFLOW for molding flow analysis and ANSYS/NASTRAN for structural analysis
AutoPart_Dev_Hub	<ul style="list-style-type: none"> - Collaboration model and system for developing interior parts of an automobile - Managing collaborative BOM (c-BOM) for making automobile parts - Comprehensive management of mold, jig/fixture during whole processes
AutoModule_Dev_Hub	<ul style="list-style-type: none"> - Collaboration model and system for developing a functional engine module - Managing collaborative projects for developing sub-module among companies - Quality management during design processes through FMEA

However, as the number of functions increases, it becomes more difficult to discover where the function is in the menu. Therefore we proposed new system architecture for collaboration system as a process-centric system and open platform for manufacturing knowledge-based collaboration

system as illustrated in Fig. 1. By applying the process-centric system architecture, a user can utilize collaboration systems in an easier way because the system assists the user to follow appropriate processes or workflows.

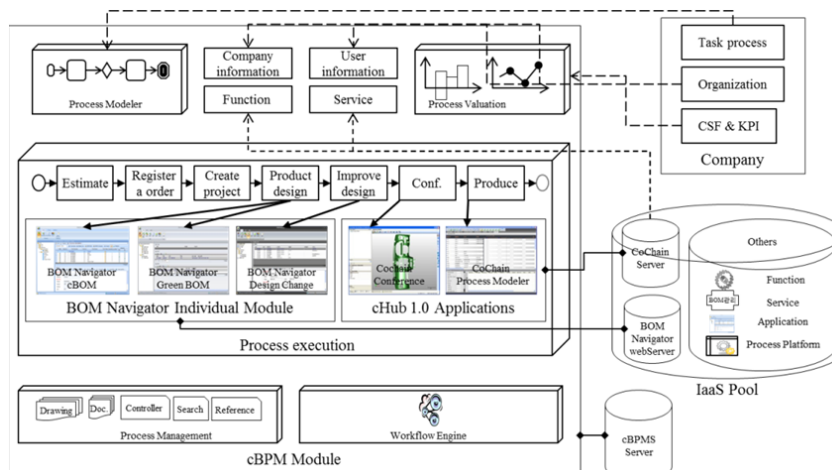


Fig. 1 Process-centric system architecture for collaboration system

An open platform for knowledge-based system indicates the integration of manufacturing knowledge by using social networks. By applying the open platform, users can deal with typical tasks such as e-mail and amass various kinds of knowledge such as schedules, to-do lists, and so on in the collaboration system. Collaboration system can also interface with other tasks and support user to reconfigure the system. Fig. 2 shows an open platform for manufacturing knowledge-based collaboration system.

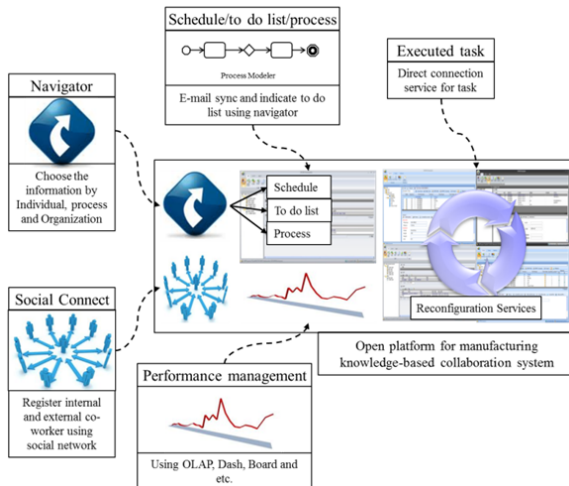


Fig. 2 Open platform concept for collaboration systems

III. SUPPLIER SCOUTING FRAMEWORK AND SYSTEM

As mentioned previously, collaboration system provides many functions and services for collaborative works. However, a linking service between buyers and suppliers is an exception. Many SMEs, especially mold SMEs in Korea, want to find their collaborative partners easily. In addition, the manufacturing paradigm is changed toward global collaboration or global outsourcing to increase manufacturers' competitiveness. Global collaborative network will be one of important future strategies.

In the past, global outsourcing is usually used to obtain human force for operations of back-end business processes and call centers. Nowadays, however, global outsourcing become a higher value-added business such as Knowledge Process Outsourcing(KPO). In this situation, collaboration style has been changed from buyer-supplier relationship to a strategic partnership as illustrated in Fig. 3. In order to find a new collaborative partner, companies exhaust their resources and time to participate in industry expositions or conferences, for example. Sometimes they use business agencies and websites (e.g., alibaba.com, mfg.com) for searching and scouting their buyers or suppliers. Some websites supporting supplier discovery are giving a way of connecting overseas customers. However, they just provide general or brief information or engage in business contracts between buyers and suppliers mainly by human force.

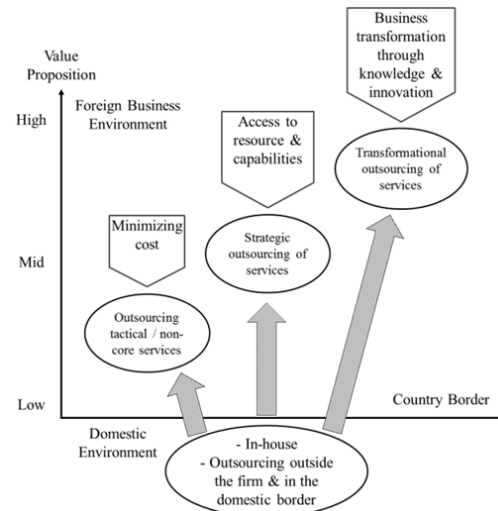


Fig. 3 Change of the collaborative approaches

Fig. 4 briefly shows the purpose of EMSS, which indicates making the whole connection between buyers and suppliers regardless of their regional boundaries. EMSS connects buyers to suppliers throughout two phases: discovery and scouting.

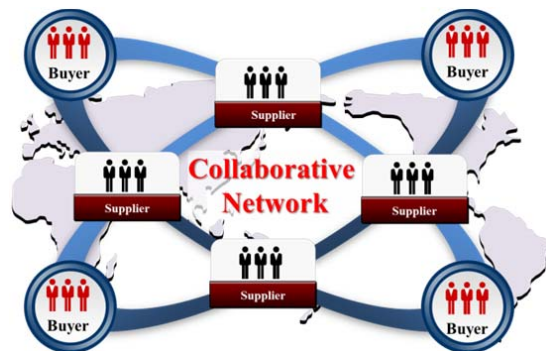


Fig. 4 Purpose of EMSS

Discovery phase consists of two steps. At the first step, EMSS collects buyers' demand including non-technical criteria such as general information, overseas experience, customer portfolio, etc. Non-technical criteria are usually described as a form of text or string. Therefore, EMSS tries to find the same requirement that meets the conditions specified by buyers by using a keyword matching method. EMSS also retrieves technical criteria for buyers demand. Technical criteria consist of sentences, numbers, or strings. Therefore, at the second step, EMSS tries to find out the same requirement that meets the conditions specified by buyers by using an ontological semantic matching method.

In the scouting phase, EMSS evaluates suppliers by considering technical and non-technical criteria as illustrated in Fig. 5, and finally gives buyers the ranked list of selected suppliers in order for them to go through the negotiation processes with suppliers recommended.

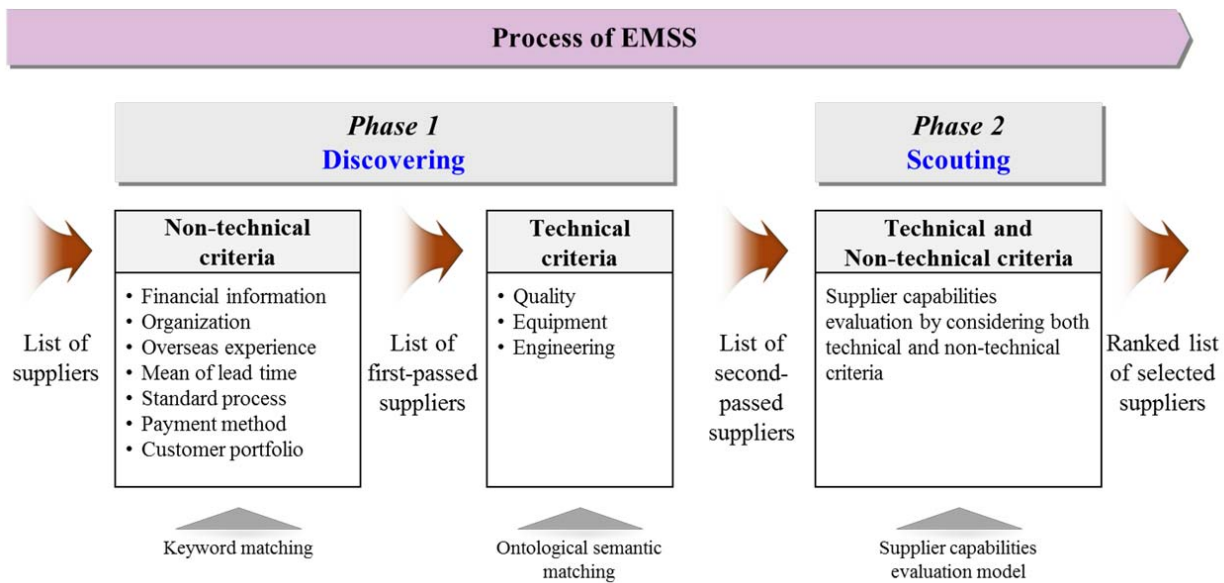


Fig. 5 Two phases to discover suppliers in EMSS

For discovery phase, we use ontology models in database. Usually, ontology formally represents knowledge as a set of concepts within a domain, and the relationships between those concepts. It can be used to reason about the entities within that domain, and may be used to describe the domain[9]. In this paper, we apply ontology concept for representing mold

companies. To apply ontology concept, we need to analyze “which criteria is important for discovery and scouting phase, respectively” and “which customer wants to their supplier”, for example. We classified such criteria into two groups : technical and non-technical. The ontology map we have developed is illustrated in Fig. 6.

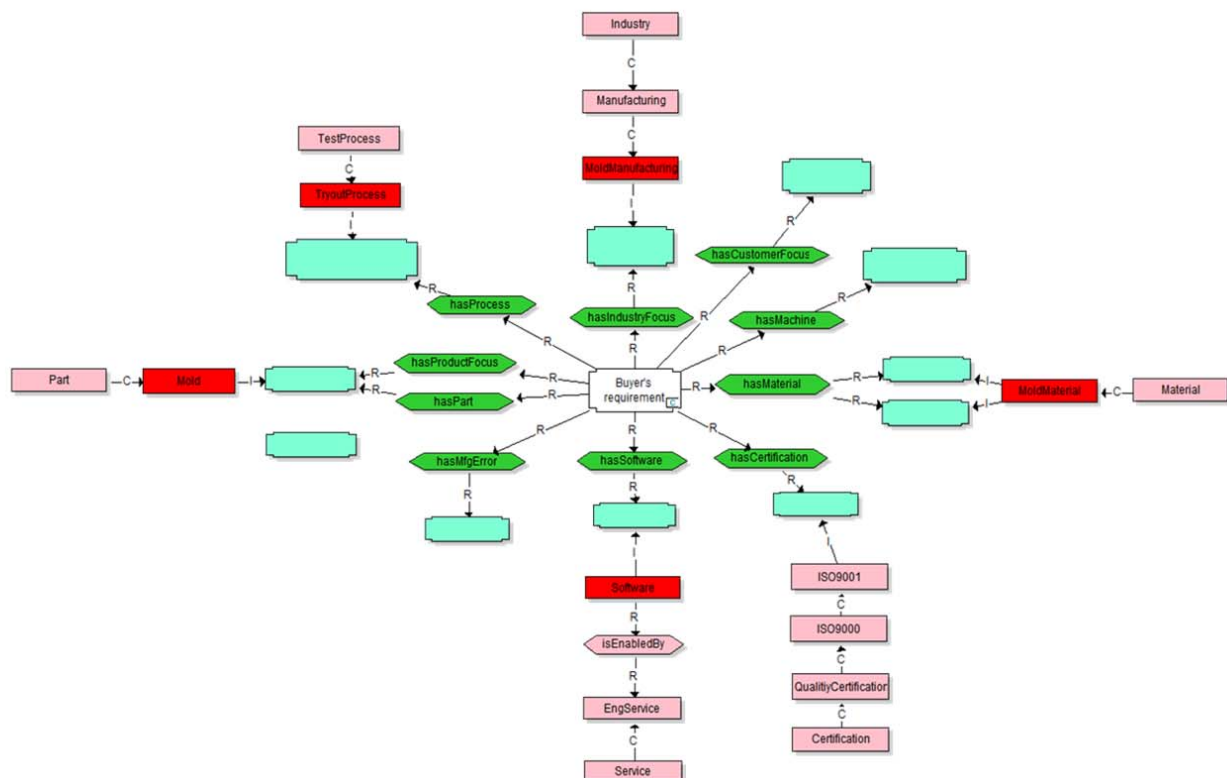


Fig. 6 A mold industry ontology map for the EMSS

Fig. 6 shows the first layer of an ontology map of mold industry, which is used by EMSS. The component in the center of Fig. 6, which indicates buyer's requirement, is a starting point to discover supplier. Hexagon means an association that expresses relationship between topics or subordinates and superiors. And decagon figure indicates target like a class or object in the object-oriented modeling notations. Square means occurrence that contains knowledge or data such as name of tool, process data, and information of quality certification and so on.

Ontology map contains technical criteria such as product quality information, equipment name or model number and type of a mold. It also contains non-technical criteria such as company name, financial information, overseas experience, etc. Currently, we are still under development of ontology map for EMSS by using protégé software[10], Manufacturing Service Description Language (MSDL), and web ontology language (OWL) [11] for designing and developing ontology as well as database as illustrated in Fig. 7.

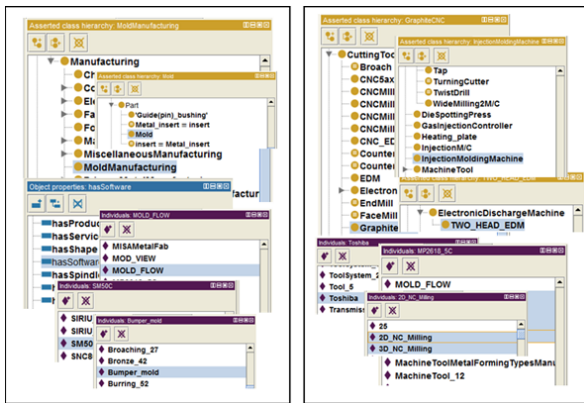


Fig. 7 Ontology instance, property, and class in the EMSS

IV. EVALUATION METHOD FOR MOLD COMPANIES

In the EMSS, after the discovery phase, a buyer can see the potential suppliers who are satisfied with buyers demand. The buyer, however, does not know which company is the best for his demand. In this case, the buyer should analyze supplier one by one, or he may contact a few among them. To facilitate the buyer's easy selection for better suppliers, the EMSS recommends suppliers with their ranking scores. For this, we suggest an evaluation method of mold companies. The method has six major indices, as described in Table II.

TABLE II
SIX MAJOR INDICES FOR THE EVALUATION METHOD

Index	Description
General information	Basic information about company
Finance	Finance information including R&D ability
Quality	Quality certification and product quality information
Management	CRM, logistics, and environment information
Product	Materials, tool, type of tool, and other information
Strategy & Innovation	Company policy, vision strategy, and other information

Each index has sub-indices which converts qualitative variables to quantitative ones. However, some indices do not need to be converted such as a company policy. Basic information of a supplier, such as an address, the company name, and phone numbers, is not used directly for evaluation. However, these indices can affect the buyer's decision. If EMSS may acquire the buyer's favorite policies or opinion, then such informal information can be evaluated by the buyers in types of "yes" or "no". As a consequence, the suggested evaluation method includes not only qualitative variables but also quantitative variables. There are four assessment types in the evaluation method as illustrated in Table III.

TABLE III
FOUR ASSESSMENT TYPES IN THE SUGGESTED EVALUATION METHOD

Assessment Type	Description
Pass-Type	Indices unnecessary to be assessed
Y/N-Type	Indices assessed satisfied(yes) or not(no)
Score-Type	Indices assessed quantitatively in score
Buyer-Type	Indices assessed qualitatively by the buyer

Pass-type means that indices or sub-indices are not necessary to be assessed such as the address, location, and name of the company. However, a buyer sometimes wants a specific location of a supplier, such as Korea, Malaysia, or US. In this case, those indices can be evaluated by using Y/N-Type meaning that indices or sub-indices satisfied the buyer's requirement (yes) or not (no). Score-Type means that indices or sub-indices are evaluated as a certain value of score, which shows a relative ranking such as product quality, tolerance limit, and so on. Buyer-Type means those indices or sub-indices need a qualitative assessment. They are composed of text or sentences such as strategy, future plan, company vision, etc. In this case, EMSS only shows the contents instead of proceeding the evaluation process in order for the buyer to refer to the suppliers initiatives.

The evaluation method proposed in this research uses a simple equation as illustrated in (1).

$$SS = (w_1G + w_2F + w_3Q + w_4M + w_5P) \quad (1)$$

$$W = \sum_{i=1}^5 w_i, \quad W=1$$

where,

SS = Score of Supplier

w_i = Weight value for following five factors in sequential

G = General information

F = Finance

Q = Quality

M = Management

P = Product

The suggested evaluation method uses weight values which can be adjusted by the buyer. This is because a buyer believes that financial soundness is the most important factor, whereas the other buyer thinks differently. Therefore, before proceeding the assessment, the buyer must adjust the weight values among five factors based on his belief, as illustrated in Table IV.

TABLE IV
EXEMPLARY EVALUATION SHEET

Exemplary Evaluation Sheet						
	General Information	Finance	Quality	Management	Product	Total Score
Full marks	100	100	100	100	100	100
Weight	0.1	0.2	0.3	0.1	0.3	
Score	60	75	89	84	90	83.1

TABLE V
EXAMPLE OF QUALITY EVALUATION INDICES AND SUB-INDICES

Tier1	Tier2	Tier3	Tier4	Assessment	Full marks
Quality	Quality certification	Number of quality certification		Pass-Type	
			AS	Syntax matching (Y/N-Type)	10
		Type of quality certification	ISO		10
			MIL		10
			SQ Mark		10
	Fraction defective	Average fraction defective per year	TS 16949	Score-Type	10
	Quality control	Step of quality control	Name of product		20
	Policy	Obey the policy the 5S		Y/N-Type	10
		Obey the guide of SQA			10
		Obey the monitoring for period of delivery			10

Table IV shows an exemplary evaluation sheet of a certain supplier by a buyer in EMSS. Within full marks of each index, the buyer gives his score respectively. As aforementioned, weight values for each index also should be given by the buyer to get the total score, 83.1 for example. Note that even though the evaluation method includes six main indices, Strategy & Innovation index is not included in Table IV because it is Pass-type.

Table V shows the quality index, which consists of four tiers. Second tier consists of quality certification, fraction defective, quality control, and policy. Each sub-index may have several factors, and each factor has its own assessment type. According to Table V, the evaluation method uses syntax matching (Y/N-Type) to assess most of the quality certification factors. For example, if the syntax of the buyer's demand on the quality certification factor coincides with the syntax of the supplier, EMSS decides whether the supplier's quality of product fulfills the buyer's demand or not. Then EMSS scores the product quality based on decision. Usually, these procedures can also be applied to other factors or indices. When EMSS finishes scoring, it calculates the total score and shows the final ranks of suppliers chosen in the discovery phase.

V. CONCLUDING REMARKS

In this paper, we introduced *i*-manufacturing and web-based collaboration systems, and proposed a framework and system for supplier discovery, which is called EMSS. We also illustrated the evaluation method of suppliers especially for mold companies.

However, there are still many things to study for further research. We should improve our ontology map and specific architecture of EMSS, and revise the evaluation method we proposed. For verification of the evaluation method, we need to compare with another evaluation methods, such as enterprise search planning and evaluation matrix of Patricia Seybold group and Baldrige performance criteria[12-13]. We also need to study on interfacing method of EMSS with existing web-based collaboration systems to be functioned as a whole.

EMSS and the suggested evaluation method are becoming one of initiatives to increase global competitiveness of mold SMEs.

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