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Excellent Manufacturer Scouting System (EMSS) for Korean Molding Industry

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Abstract. As up-to-date competitive environment of manufacturing business has accelerated global outsourcing, the selection of the right partners becomes more important than ever in securing competitiveness. To have the best partner selections, it is necessary to discover potential partners (either suppliers or buyers) located in all over the world and to evaluate their capability to produce eventual profits. e-marketplaces of manufacturing services are collaboration systems that support cooperation between suppliers and buyers. The objective of this paper is to present a web-based collaboration system, referred to as excellent manufacturer scouting system (EMSS). EMSS provides collaboration services for discovering, evaluating, negotiating and cooperating to ensure interoperability amongst manufacturing companies. EMSS employs an ontology-based mechanism for semantic interpretation, and it is equipped with an assessment model of core manufacturability. In this paper, a supply chain collaboration model using EMSS for molding industry is also proposed.

Keywords: Interoperability; Supplier scouting; e-Marketplace; Manufacturability assessment; Manufacturing service.

1 Introduction

Nowadays, owing to the competitive environment of manufacturing business, the manufacturing paradigm has been changed toward global collaboration. Especially, construction of collaboration network via global outsourcing is a representative strategy for manufacturing companies to survive. Thus, discovery and selection of the right partners becomes more important in securing competitiveness. In such a line of thought, manufacturing companies should efficiently find out competitive outsourcing partners located anywhere in the world, and the potential outsourcing partners should effectively inform their core capabilities to the global customers. Actually, it has been shown that the ability to establish partnership with global customers provides competitive advantage to SMEs in Korea over those in other developing countries such as China, Vietnam, and so on [1].

Recently, a target of global outsourcing has been changed from non-core services such as human force for back-end business operations to a higher value-added business such as knowledge outsourcing. Thus, collaboration style for global outsourcing has been changed from ad hoc buyer-supplier relationship to a strategic partnership (i.e., long term exclusive relationship) as illustrated in Fig. 1.

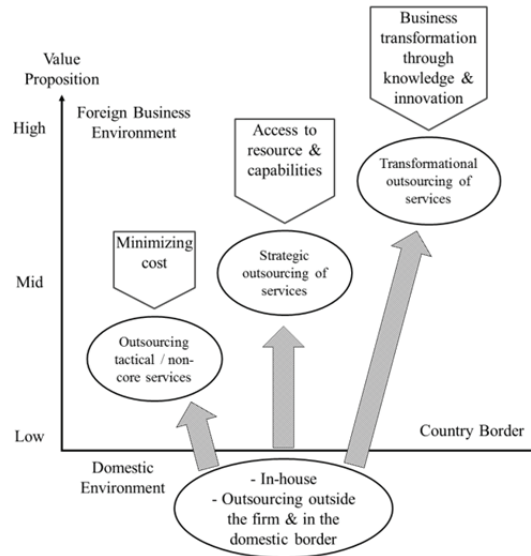


Fig. 1. Change of the collaborative approaches [2]

In this paper, a web-based collaboration system that provides collaboration services for discovering, evaluating, negotiating and cooperating is presented to ensure interoperability amongst manufacturing companies. The system is referred to as excellent manufacturer scouting system (EMSS). EMSS is a sort of e-marketplaces for manufacturing services that support strategic cooperation between suppliers and buyers. EMSS is equipped with ontology-based semantic interpretation mechanism to secure interoperability, and it employs an assessment model of manufacturability.

In Section 2, existing e-marketplaces are briefly introduced. In Section 3, EMSS is presented. Then a supply chain collaboration model using EMSS for molding industry is presented in Section 4. Finally, Section 5 is devoted to concluding remarks and further research topics.

2 Manufacturing e-marketplaces

In general, manufacturing companies exhaust their resources and time to find a new collaboration partner by means of participating in various industrial expositions or conferences. They have recently used various websites or e-marketplaces (e.g., alibaba.com, EC21.com, mfg.com) for searching and scouting their buyers or suppliers in order to reduce costs. Conventional websites that support supplier discovery

services just provide general or brief information of manufacturing companies in a list format; or they restrictedly assist in establishing business contracts between buyers and suppliers mainly by human. However, the basic information is insufficient for evaluating company's manufacturability.

Alibaba.com [3] is a well-known e-marketplace specialized in manufacturing industry. It focuses on the service on commercial transactions such as product lists, product search, supplier search, buyer search, intermediary services, and so on. However, it does not provide matching services and evaluation services for buyers and it only provide a simple searching service by using keywords. Therefore, buyers have to evaluate suppliers by themselves. Furthermore, the quality of searching service is not good enough to find right suppliers effectively because of its limitation of keyword searching.

EC21.com [4] focuses on not only manufacturing industry but also other industries such as agriculture and service industry. Its services are similar with those of alibaba.com but EC21.com provides company's homepage and catalog services. However, such additional services are insufficient for practical support for matching buyers and suppliers.

Mfg.com [5] provides not only searching services but also matching services and negotiation service between buyers and suppliers in manufacturing industry such as molding, forge welding, assembly, and so on. Buyers can find a suitable supplier easily and conveniently by using it. However, the level of services provided depends on the membership fee monthly paid. Furthermore, because the discovery process is performed by human, it is inefficient in terms of cost and time. We also cannot get accurate evaluation results, reflected by human's subjectivity.

In sum, legacy e-marketplaces provide limited searching services based on keyword search methods, and they do not provide matching and evaluation services except for mfg.com. Even mfg.com employs a manual evaluation mechanism. Thus, it is required to build more effective searching mechanism based on a semantic search rather than simple keyword search. In addition, an automated evaluation method of core capabilities of manufacturing companies should be developed. Furthermore, the discovering services are required to be incorporated with post-discovering services devoted to negotiation and collaboration. EMSS proposed in this paper meets these requirements.

3 Excellent Manufacturer Scouting System(EMSS)

3.1 Supply Chain Formation

EMSS serves manufacturing services that plays a role of a matchmaker between buyers and suppliers. EMSS helps globally located buyers to discover and evaluate outsourcing partners, and provides potential suppliers with business opportunities. Fig. 2 shows overall procedure for supply chain formation via partner selection using EMSS, that consists of three stages including 1) discovery, 2) negotiation, and 3) collaboration. In the stage of discovery, which is the scope of this paper, EMSS provides a buyer with candidate suppliers that conform to its requirements of manufac-

turing capabilities, quality level, etc. The buyer makes the final selection of its supplier in the stage of negotiation, and then orders are placed to the selected supplier for making products or services in the stage of collaboration. It is assumed that a web-based collaboration system, referred to *i*-MFG, is employed in the collaboration stage. *i*-MFG was developed by a government-led project in Korea, and it serves various functions for collaboration[6-9].

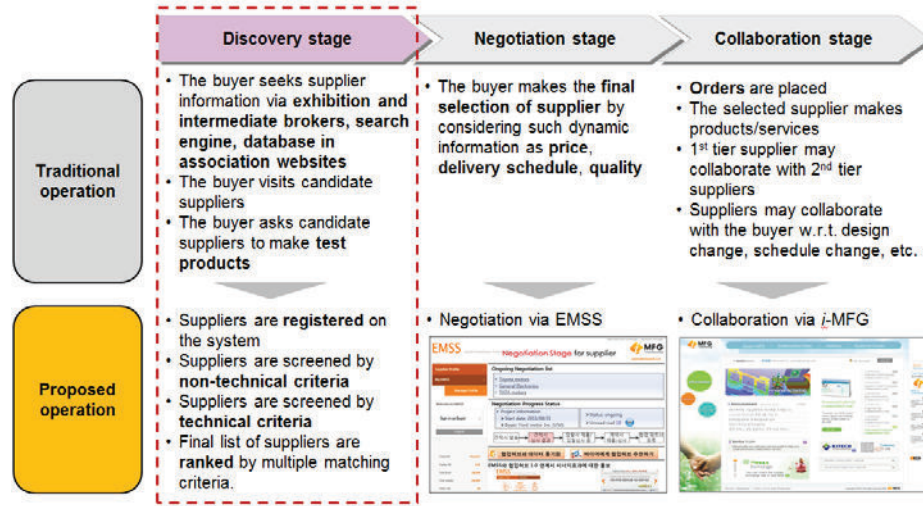


Fig. 2. Overall procedure for supply chain formation

3.2 Supplier Discovery Process

Supplier discovery process of EMSS includes 1) filtering, 2) matching, and 3) ranking, as illustrated in Fig. 3. At the filtering phase, EMSS filters out inappropriate suppliers from registered suppliers, based on non-technical criteria such as general information, exportation experience, customer portfolio, etc. Non-technical information is usually expressed as a string type of text. Therefore, a text-based keyword matching method incorporated with a binary search is applied to find out suppliers that meet the non-technical requirements of a buyer. For example, if a buyer wants to find a supplier located near a harbor, EMSS finds out suppliers of which profile shows some related keywords such as ‘near harbor’ or the names of principal harbor cities. Other suppliers are eliminated from the search space. At the matching phase, EMSS selects some suppliers that meet the technical requirements of a buyer. Because technical requirements are usually described by various terminologies in isolation, their true meanings may not be uniformly interpreted. Thus, EMSS employs an ontology-based method for semantic interpretation of technical requirements. In the final step, i.e., ranking phase, EMSS evaluates capabilities of selected suppliers, based on additional non-technical criteria. Their ranked list is reported to the buyer, and the buyer goes through a negotiation process with the recommended suppliers.

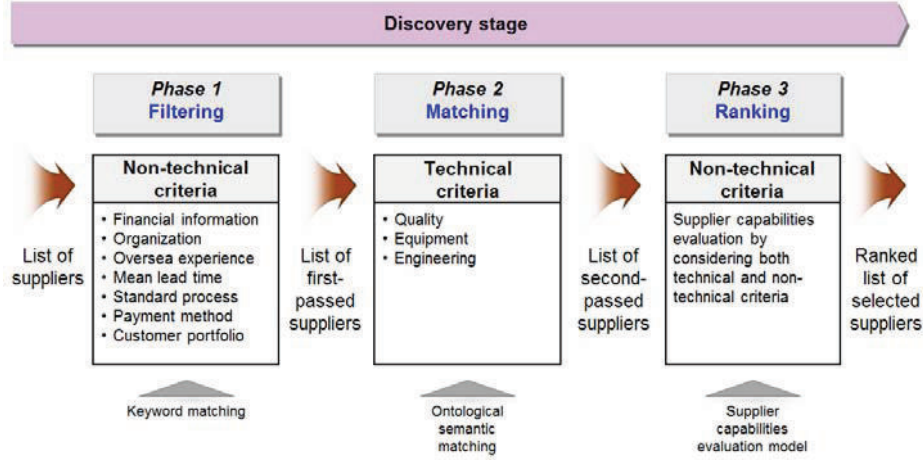


Fig. 3. Supplier discovery process in EMSS

3.3 Ontological Model of Manufacturing Capability

EMSS is equipped with an ontological model for manufacturing capabilities and requirements to secure interoperability between buyers and suppliers. 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 [10]. In this paper, we propose an ontology model for molding industry that is devoted to semantic matching between buyer's technical requirements and supplier's manufacturing capabilities.

Fig. 4 shows the first layer of ontology for molding industry. Hexagon means an association that expresses relationship between topics or subordinates and superiors. Decagon indicates a target like a class or an object in the object-oriented modeling notations. Square means occurrence that contains knowledge or data such as the name of tools, process data, and information of quality certification, and so on.

The proposed ontology model contains technical criteria such as product quality information, equipment names, model numbers, and the type of a mold. It also contains non-technical criteria such as company names, financial information, overseas experience, etc. Currently, we are still under development of ontology for EMSS by using protégé software [11], Manufacturing Service Description Language (MSDL) [12], and web ontology language (OWL) [13] are used for designing and developing ontology as well as database.

For semantic interpretation of buyers' requirements, we use an inference method based on the proposed ontology model to calculate similarity of suppliers' features (such as capable manufacturing processes, feasible equipment and tools, etc.) with the requirements. For example, a buyer wants to find a supplier who has manufacturing capabilities of milling, drilling and 3D design, and principal features of potential suppliers are shown in Fig. 5. In this case, the profile of supplier 2 does not explicitly have the capability of 3D design. However, the capability of supplier 2 can be implic-

itly inferred because 'mold 2' requires the capability of 3D design. Consequently, supplier 2 is preferred in terms of the buyers' requirements than supplier 1 who does not have milling capability but has limited drilling capability by tool 2.

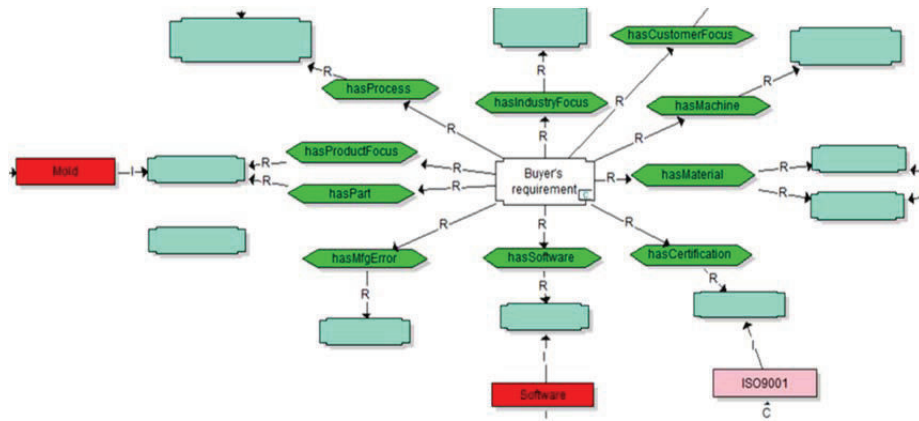


Fig. 4. An ontology for molding industry

Finding suppliers who have {Milling, Drilling, 3D design}

Inference Features	Supplier 1	Supplier 2
Process described in supplier profile	3D	-
Tool described in profile related to such process	Tool2	Tool1
Mold described in profile related to such process	-	Mold2
Total set of capable process	{'3D', half of 'D' by Tool2} = {'3D', $\frac{1}{2}$ 'D'}	{'M' + 'D' by Tool1, 'D' + '3D' for Mold2} = {'M', 'D', '3D'}
Similarity	50% (=1.5/3)	100%(=3/3)

Supplier 2 is more similar to the company which buyer wants to find

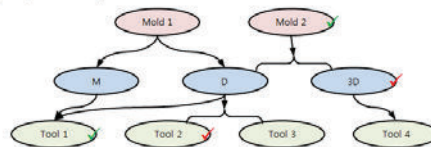


Fig. 5. An exemplary scenario of manufacturability inference

3.4 Manufacturability Assessment

EMSS is equipped with an assessment model of manufacturability to evaluate capabilities of suppliers, selected in the matching phase of supplier discovery process, and make a ranked list of them. In the ranking phase, the selected suppliers are evaluated based on a non-technical criterion that is hierarchically decomposed into following performance criteria; 1) general information, 2) finance, 3) quality, 4) management, 5) product, and 6) strategy and innovation, as shown in Fig. 6. Each perfor-

mance criterion has various sub-criteria to rate the candidates quantitatively. The sub-criteria are also decomposed into next-tier sub-criteria, if necessary. Even though qualitative criteria such as strategic policies and mission statements are excluded from automatic calculation while rating them, they are evaluated in the measure of “yes” or “no”. Fig. 7 illustrates an example of evaluation result.

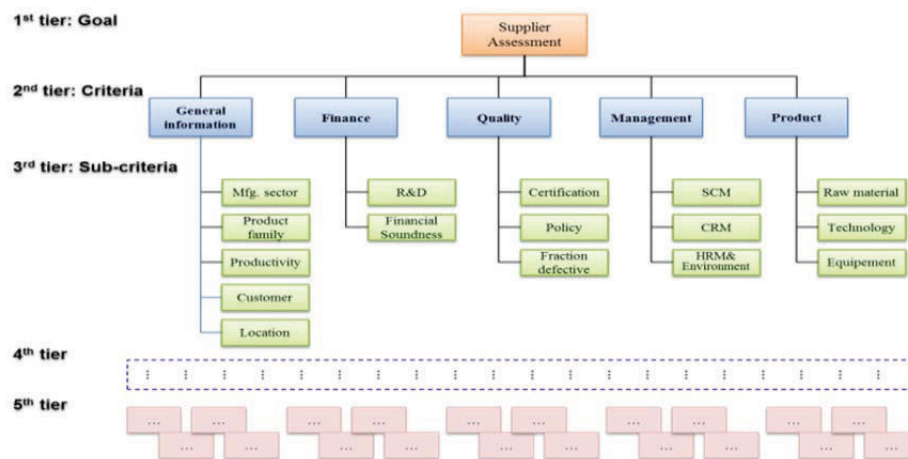


Fig. 6. Hierarchy of assessment criteria

Search Result

Evaluation Result (G:0.2, F:0.2, Q:0.2, M:0.2, P:0.2)

Group	Number of companies	Company name	Location
1st Group	3	BumjinMold	Ulsan
		Daeil Mold	Busan
		Daesung Mold Co.	Busan
2nd Group	3	Gangil Mold	Busan
		Hankuk Mold	Ulsan
		Kukyoung Mold	Ansan

Number of Found Suppliers : 24

Adjust weights if necessary						
	Service & Customers	Facilities & Human Resource	Quality Assurance	Contact & Delivery	Financial Status	Total Score
Weight	0.2	0.2	0.2	0.2	0.2	1.0

* Change Weight Value before RUN

Run

Fig. 7. Supplier evaluation module in EMSS

4 Collaborative Business Model

Fig. 8 shows an overall collaborative business model for EMSS-based supply chain. EMSS provides buyers with collaboration services to discover and evaluate outsourcing partners. In addition, some customized services are also provided for buyers and suppliers. EMSS amasses profiles of suppliers and buyers in order to evaluate suppliers' manufacturability to meet buyer's requirements. Based on the profiles, EMSS provides customized services such as introducing of a language translator, a shipping agency, or a banking agency, etc.

EMSS is required to provide an interface service to *i*-MFG for both buyers and suppliers. The buyers cooperate with selected suppliers via *i*-MFG. In addition, EMSS is required to cooperate with trade agencies (either public or private) in order to offer extensive information on various business opportunities.

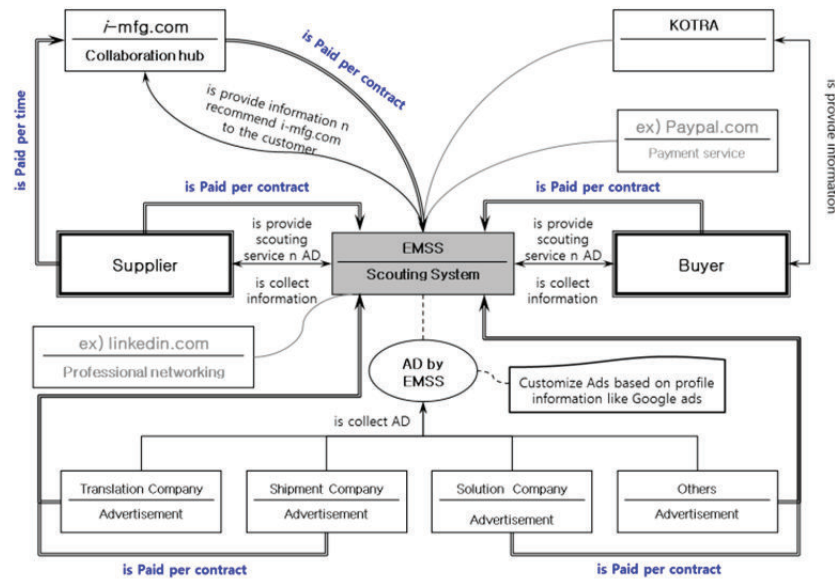


Fig. 8. Collaborative business model in EMSS-based supply chain

5 Conclusion

EMSS is a web-based collaboration system that implements an e-marketplace for manufacturing capabilities and provides discovery and evaluation services of outsourcing partners. Eventually, EMSS supports systematic construction of supply chains in collaboration with *i*-MFG system. In this paper, overall framework for supply chain formation based on EMSS has been presented. EMSS secures interoperability by means of an ontological model for technical descriptions, and it provides an evaluation mechanism for manufacturing capabilities based on non-technical criteria. Currently, EMSS is under development for Korean molding industry.

Acknowledgements

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