Abstract
This paper proposes to apply Chance Discovery methods to software requirements elicitation. The author’s previous studies indicated that requirements definition work of custom-made type application software had been running through the whole software development process. This trend has been seen among small-scale software development projects, especially for web application system and client/server application system. It is necessary to comprehend that requirements definition work continues through the all software development process. Requirements definition is considered to be knowledge exchange or knowledge share between customer and supplier. Customer can be defined as an expert of the application or an expert of an undeveloped (to be developed in the near future) application system. Supplier can be defined as an expert of IT development. The author believes it might be effective to apply the Knowledge Management process to requirements definition. On the actual situation, there are traditional methods for requirements elicitation that is interaction between customer and supplier, for instance, interviewing to customer, reading the requirements definition from customer and discussing with customer. If applying Knowledge Management methods, it can help that interaction smoothly. On the other hand, it is well known that requirements definition is the principle of the project, however the quality of requirements elicitation much depends on personal factors of each supplier (i.e. project managers, system engineers). Experimentally, skillful project manager or leader knows that sometimes customer has true requirements unconsciously. When true requirements are realized, both customer and supplier will be more satisfied. Therefore, the author believes Chance Discovery methods can contribute to lead the project to be more satisfied and more sophisticated for both customer and supplier exceedingly.

1. Introduction
In recent years, it is said that web application and Client/Server application development projects have become smaller in size and shorter in the project term. Also it is said that the smaller and faster the projects are, the enterprises can have the more chance to win and survive in the market place. The authors analyzed such kind of actual projects and mentioned several characteristics of the successful small-scale software development projects [Kamata 2000, 2001] as follows.
1) Successful small-scale projects spend longer term for requirements definition process (over 50% of total project term)
2) Successful small-scale projects spend much workload for requirements definition work (over 40% of total workload of the project)
3) Project owners are two or more departments
1) and 2) suggest that requirement definition, application design, implementation and test processes can run in parallel. It is necessary to comprehend that requirements definition continues through the whole small-scale project process like geologic stratum (Figure1). Last one finding 3) means that the owners are two or more departments in most small-scale projects as oppose to common sense. It means that supplier has to face more stakeholders than larger scale projects have. These new characteristics of the small-scale project maybe an impact on supplier. The author supposes that the supplier could manage issues within the project term in traditional type or longer-term project because of enough term and workload. But for small-scale project, it is more difficult to manage issues within project term, because of short term, limited workload and limited budget.
Moreover, the existence of technical stakeholders might be a recent big change. As far as the author knows, the owners of the project that uses web or new technologies often organize the investigation team for making central requirements and recommendations. The technical stakeholders often participate in that team and they are influential to project members and project owners. Actually, these technical stakeholders can control requirements strongly. Therefore, supplier has to seek the technical stakeholders for eliciting the requirements in such projects. Formerly, there were traditional stakeholders who can control budget and requirements so that, the supplier could elicit most requirements from them.

There are some arguments for requirements definition process. For example, Wiegers [Wiegers 1999] and Thayer [Thayer 1997] divided requirement definition process into four sub processes; Elicitation, Analysis, Specification, Verification. Sommerville[Sommerville 1997] indicated good requirements engineering process is composed of three sub processes; requirements elicitation, requirements analysis and negotiation, requirements validation. Robertson [Robertson 1999] divided 9 sub processes in their “The Volere Requirements Process Model”. IEEE recommends software requirements specifications standard as IEEE Std 830-1998. Moreover, each company or project sometimes has its original requirements definition process. But it is generally accepted that requirements elicitation is the first step of requirements definition. There also exits various kinds of methods, tools and templates for requirements analysis and requirements specification from different views and different purposes. However, methods for requirements elicitation are limited and mainly they are manual work. Robertson [Robertson 1999] show how to elicit requirements as “apprentice requirements, determine essential requirements, brainstorm the requirements and interview the users”. Those techniques are well-known and general way to interact with customer. Most technical books or materials of software requirements start from requirements analysis work, therefore the presupposition of those materials is like this: Requirements have already elicited from customer. Unfortunately, entire software development projects start from requirements elicitation in real world. Accordingly, it can be said the methods and tools for requirements elicitation are the way to interact with customer and to understand customer’s domain. Generally, those methods and techniques are used for problem analysis. Those methods and techniques work sufficiently in many cases, however in some cases they do not work sufficiently. Why they don’t work sufficiently in some cases? The author thinks there are two reasons why they do not work sufficiently. First, the success of using those methods depends on supplier’s individual skills and experiences exceedingly. Furthermore, there is “much variation of customer”[Wiegers 1999], for example, one customer might know well what’s necessary for their new system but another customer might not understand the objectives of their new system. These two synergistic bad effects of supplier and customer may lead some cases to be failed. Second, the methods and techniques of problem analysis are effective when customer has problems or issues to be solved, nevertheless, there are some cases that customer seeks a new approach or new solution. In other words, customer requires supplier to propose the breakthrough solution. Therefore supplier should find a revolutionary approach to solve these problems. The purposes of this paper are to propose the way of minimizing the gap of individuals and revolutionary approach to create breakthrough solution.

Technical terms
IEEE Std 610.12-1990 provided the general definitions of terms, I adopt the words as follows.

Customer: The person, or persons, who pay for the product and usually (but no necessarily) decide the requirements
Supplier: The person, or persons, who produce a product for a customer
User: The person, or persons, who operate or interact directly with the product

2. Interaction between Customer-Supplier in Requirements Elicitation

2.1 Knowledge Management Process to Requirement Elicitation

SECI: Socialization, Externalization, Combination and Internalization is a famous model of knowledge conversion [Nonaka 1995]. Nonaka argued the tacit knowledge that contains personal skills and experiences is transformed to explicit knowledge through SECI process. Nonaka reached SECI model through researching Japanese strong companies that created new intellectual assets organizational. Nonaka show some cases in Japanese companies that methods of their knowledge management
and the way to translate masters’ tacit knowledge or techniques to explicit one as “Apprenticing to master”.

![SECI Diagram](http://www.gssm.otsuka.tsukuba.ac.jp/staff/osawa/ChanceDiscovery.html#MEET)

Figure 2. SECI [Nonaka 1995 p.62]

It looks similar to some requirements elicitation techniques, for instance Robertson mentioned as “Apprentice With The User” in order to elicit customer’s requirements [Robertson 1995].

Suppose we apply SECI process to requirements definition, particularly requirements elicitation of small-scale web or Client/Server type projects.

Nonaka suggested to repeat SECI cycle so that, knowledge would be polished up more and more. That shows SECI needs time to repeat. The author’s previous study shows successful web or Client/Server type (small-scale) projects spent longer term and more workload for requirements definition. Those studies also show requirements definition work continues through the whole project life cycle. It may not be difficult to apply SECI process to such small-scale project. If it is true, what kind of knowledge will flow through SECI process in requirements elicitation?

During the project especially requirements elicitation, supplier makes efforts to comprehend customers’ environment and project objectives. Generally, the information contains system elements, business information, organizational information and others. The information provided mainly by customer, in other words that is the information of customer domain. It is proper to regard customer as application domain expert. Customer’s knowledge contains both tacit and explicit one. For example, top100 clients list is the explicit knowledge and the way to communicate with new clients is tacit knowledge. If so, is the supplier just receiving knowledge from customer? The author believes No. Supplier creates requirements specification after eliciting the requirements from customer. It means that supplier receives customer’s tacit or explicit knowledge and then supplier transfers that knowledge to explicit knowledge that contains system elements. So that, supplier can be defined as IT experts.

In actual projects, after this translation, supplier shows the requirements specification or demonstrates prototype to customer for verification. In many cases, customer and supplier repeat the cycle two or more times. This process can fit to SECI process. The knowledge of customer or supplier may flow through SECI process more sufficiently.

### 2.2 Chance Discovery for Requirement Elicitation of Software Development

SECI process would be effective for supporting better communication between customer and supplier. However, those knowledge management processes including SECI can be helpful for both customer and supplier. However they can’t cover unconscious or subconscious knowledge usually.

In real world, supplier sometimes faces incomprehensive situations during requirements definition, for instance, customer has unclear requirements, has vague requirements or vague objectives, etc. Some of them are certainly solved by existing techniques, for example: domain dictionary would be helpful for communication with customer. But it is not so easy to elicit unclear, vague, unconscious or subconscious requirements. But it is important to elicit unconscious or subconscious knowledge and requirements, because rarely they being “Chance”.

What is “Chance”? Osawa [Osawa 2002] indicates chance as “chance defined as an event or a situation which gives significant impact on human decision making” and “In other words, a chance here is a new event or situation that is unnoticed”. It is mentioned in his homepage [http://www.gssm.otsuka.tsukuba.ac.jp/staff/osawa/ChanceDiscovery.html#MEET] that “The essential aspect of a chance is that it can be a new seed of significant future changes” and as follows

The "discovery" of a chance is to become aware of and to explain the significance of a chance, especially if the chance is rare and its significance has been unnoticed. Desirable effects of opportunities should be actively promoted, whereas preventive measures should be taken in the case of discovered risks.

Osawa’s argument of “Chance Discovery” coincides with the author’s idea. If supplier could elicit unconscious or subconscious customers’ knowledge or requirements, it may help to create breakthrough solution. Moreover the breakthrough solution, it can produce much benefit or revolution (new products, new methods, techniques, new business model, etc.) for both customer and supplier. These benefits may become arms for survive in the marketplace of both customer and supplier.

If customer’s unconscious or subconscious knowledge and requirements would become to be an explicit one in the near future, those knowledge and requirements might lead customers’ business to be desired. When those knowledge and requirements are discovered earlier and implemented, that system may have prominent value. On the other hand, for supplier, if they can elicit customers’ unconscious or subconscious knowledge and requirements earlier, they accomplish the system as close as customers’ final requirements.

It means that supplier may earn better customer satisfaction, moreover reducing project cost because of reducing re-development work. Rarely, they may earn next contract
from same customer. Hence, both customer and supplier may have better results than not elicited unconscious or subconscious knowledge and requirements. Of course, it is needless to say every case can’t fit this success story.

2.3 Combination Approach with Knowledge Management and Chance Discovery

Assuming knowledge flows through SECI process, tacit knowledge would be socialized by knowledge owner (whom the knowledge has) or someone at first. The tacit knowledge can be classified as noticed and unnoticed. Noticed knowledge means as same as unconscious and subconscious one. It is possible to transfer from tacit knowledge to explicit one as far as the knowledge owner noticed. The best way to transfer is the knowledge owner transfers the tacit knowledge to explicit one by oneself. Another way to transfer is that someone apprentices to the knowledge owner in order to master that skill, then the apprentice transfer it to explicit one. Nonaka shows the example of second way [Nonaka 1995].

A computer programmer had apprenticed herself with the master baker at Osaka International Hotel, gained a tacit understanding of kneading.

If neither master nor other people noticed that tacit knowledge, it was impossible to be apprenticed usually. However, such unnoticed knowledge sometimes hides chance.

Let’s move on requirements definition. The noticed requirements from customer would become explicit as documents or other unnoticed requirements would become explicit in latter of the project or after the project. The techniques like brainstorming, interview or prototyping are effective to elicit such unnoticed requirements in some cases. However, brainstorming and interview are much depends on individual skill of supplier. Those techniques can usually elicit requirements from limited scope of the project, if there might be a chance outside of the existing scope, they can’t be elicited.

Then, the author proposes to apply SECI process and tools to the whole requirements definition work and apply Chance Discovery methods especially to requirements elicitation. Chance Discovery field has effective methods and tools to elicit hidden demand from customer.

3. Cases

In this chapter, it is shown two actual cases and one trial case that applying KeyGraph [Osawa 1999] and Influence Diffusion Model [IDM] [Matsumura 2001] in order to evaluate them for eliciting customers’ unconscious or subconscious requirements in early phase of the project.

3.1 Background of the Actual Cases

The author analyzed 35 actual projects [Kamata 2000] and categorized 16 of 35 as small-scale projects. In that analysis, 50% of 16 small-scale projects failed and they had some distinctive characteristics.

Table 1 shows the one characteristic that is state of applying change management. It indicates that all delayed small-scale projects didn’t apply change management except one project. By contrast, most on-scheduled projects applied change management, and actually these change management utilized Web or Groupware to reduce workload. It means that they used like Web Bulletin Board System (BBS), Mail software or Groupware as a place for information exchange or repository. These systems are similar to the repository of knowledge management tool. If this kind of change management was the one of success factors, it indicates knowledge management is effective method for successful small-scale projects.

Moreover, the author mentioned that requirements definition work including requirements change and requirements add were the largest factor of delayed delivery. And another result of that analysis show every project had additional requirements or change requests during project. Therefore, this kind of change management can contribute to lead small-scale projects to success. When the author interviewed project managers and project members of those successful projects, they commented like this: Though requirements addition and requirements change had been continued until project completion, requirements were manageable for us. On the other hand, delayed project team commented like this: Endless requirements addition and requirements change made bad influence on project schedule. Where comes from the difference between on-scheduled and delayed projects? The author shows two actual cases that Chance Discovery occurred during project.

3.1.1 Case 1

The term of case1 project was only one month. It was a typical small-scale and successful project that the author researched before. They kept the change management process even very short term. The way of change management was “Utilizing e-mail repository database”, in detail, a project manager prepared database to store and keep e-mail between customer and project team ordered by date. A project manager had started this tool in order to record the interaction with customer hence he could find customer’s sign earlier. It means customer sent mail that contains requirements to project manager, he listed those mails by date. Occasionally, he found something difference in customers’ mails, it might mean a sing of requirement change. Then he responded to customer or asked about there was demand of requirement change. In total, this project manager found three requirements change before customer required, also this project team could prepare those requirements change earlier than usual. Consequently, this project could keep delivery date and
customer satisfied their outputs. The author thinks this might be Chance Discovery case.

3.1.2 Case 2
Another case is also the author interviewed three years ago. This project term was only two months. This project had a database that contains various kinds of data between customer and project team. A project manager stored every electrical data in that database then he checked consistency. Sometimes he found something difference among those data then he asked customer whether a mistake or change requirement. As same as case 1, this repository helped to find change early. Of course this project could keep delivery date and good customer satisfaction. As a matter of fact, this customer ordered three more projects after this project.

3.2 Trial Case: Applying KeyGraph and IDM
The success of above two actual cases depended on personal skills of project manager. Unfortunately, every supplier doesn’t have such skill always. If supplier can utilize methods and tools of Chance Discovery, both customer and supplier would become more satisfied. Hence, the author has come to decide to apply some methods and tools of Chance Discovery as a trial.

I have analyzed a discussion type electrical text data, which is stored in Lotus Notes® database and that is owned, managed, and used by one department (Figure3). This database has several categories and participants can create a new comment, adding comments to previous comment, or read them. The comments are chained like this: main topic—replied comment—replied comment to previous replied comment. Participants can discuss at any time and at any place. This kind of database is often found on the Internet world. For analysis, the author selected “Focused IT area of 2002” category from several categories. There are two reasons why the author selected this category. First reason is that it resembles the situation of the beginning of web application or particular projects in a way that special task team is organized and team members are discussing using the database. Second reason is another similarity to such kind of project: a manager of this department requested participants whom belong to that department mostly, to discuss “Focused IT area of 2002” in order to decide business focus area of their department.

The author analyzed these text data by two methods with tool, one is KeyGraph another is IDM. Osawa indicated that KeyGraph as a Co-occurrence based Indexing and he shows “KeyGraph, on which the most important terms (keywords) are extracted” in his homepage [http://w3.sys.es.osaka-u.ac.jp/~osawa/KG.html]. IDM can measure the degree of influence of participants, comments and words. Originally, IDM is devised as a method of analyzing the data of text-based communication on the Internet in order to find out the opinion leader and fascinating topic of that community.

The author has applied those two methods and tools to “Focused IT area of 2002” data in order to discover unconscious or subconscious requirements and stakeholders who are influential on this topic. Figure4 shows the one of the results of KeyGraph analysis. Here the author could grasp the relevance of terms and participants, and earn the view of total concept of that category. Figure5 to Figure7 are results of IDM analysis. Figure 5 shows the frequently appeared words versus influential words. The result shows that the top influential word is the 16th frequently appeared word. It indicates that the words used frequently may not mean influential. This
chart has suggested the unconscious idea the participants had “SINE” and “MTS” were the requirements of participants.

<table>
<thead>
<tr>
<th>Frequent Contributor</th>
<th>Influential Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A : 12 times</td>
<td>1. D</td>
</tr>
<tr>
<td>2. B : 11 times</td>
<td>2. C</td>
</tr>
<tr>
<td>3. C : 10 times</td>
<td>3. A</td>
</tr>
<tr>
<td>4. D : 7 times</td>
<td>4. B</td>
</tr>
<tr>
<td>4. E : 7 times</td>
<td>5. E</td>
</tr>
<tr>
<td>6. F : 3 times</td>
<td>6. H</td>
</tr>
<tr>
<td>6. G : 3 times</td>
<td>7. Y</td>
</tr>
<tr>
<td></td>
<td>10. W</td>
</tr>
</tbody>
</table>

Figure 6. Result of IDM: Influential Participant

Figure 6 shows the frequent contributor versus influential participant. This chart also indicates that a frequent contributor may not be influential. Figure 7 shows the influence map among participants. The arrow shows the existence of influence, an arrowhead shows direction of influence and numerical value affixed to the arrow means the degree of text-based relevance of messages. Figure 6 and Figure 7 helped to find out the stakeholders. The database owner strongly agreed that participants A and D are most influential to other participants. And the owner evaluated those results and gave consent to the results in general.

Many participants were interested in home office, however they didn’t look so. The database owner soon decided to adopt the home office for that department. Presently, 50% of that department uses that system. Moreover after this adoption, neighbor departments began same system.

It can be said that if there were same kind of data like discussion type database, communication repository for the project members or e-mails between customer and solution provider, etc. and to be applied the methods and tools of Chance Discovery, it helps supplier to discover the unconscious or sub-conscious requirements or technical stakeholders.

4. Conclusions

The author proposes the combination approach of knowledge management and Chance Discovery in order to do better requirements definition. The methods and tools of knowledge management might be effective for shallow level. The methods and tools of Chance Discovery might be effective for deep level.

Knowledge management is one of the author’s recommendations. Some methods and tools of knowledge management are effective for both supplier and customer to know each domain more. Therefore, SECI process can help to explicit customer’s tacit knowledge. As the author show two cases utilizing repository that similar to knowledge management’s one in former section, it can help to control customer’s requirements and system suppliers’ preventive action for keeping delivery date finally.

Chance Discovery is second one of the author’s recommendations. It may look uncommon method for usual projects, but two cases show the importance and advantage of it. One case the author tried to utilize the methods and tools of Chance Discovery then they could come into deep level of customer. Hence, they can help to elicit customer’s unconscious or sub-conscious requirements earlier while system supplier doesn’t have enough skill and experiences personally. Chance Discovery may contribute to better and advanced solution for both customer and supplier.

There is difference between applying method of knowledge management and applying Chance Discovery method to requirements definition. Knowledge management may contribute to lead the project to achieve expected results of customer. On the other hand, Chance Discovery can contribute to lead the project to be over coming to customer’s expectation. Because the author thinks Chance Discovery can discover customers’ hidden demand that is not explicated yet. It is difficult for knowledge management to cover such area.

However, there maybe opposition to my propose, for example, the question “Does every project or system development need such advanced way?” The answer is “Maybe no, but maybe yes”. Does every system supplier and customer knows customers’ true requirements or
expectations? The answer is “No”. The author believes if there is better way to create more benefit for both customer and supplier, it should be utilized.

This approach may become advanced competence that might be an essential factor for survival. Therefore the author proposes this way: Applying methods and tools of knowledge management and Chance Discovery for advanced requirements definition.

References