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Sub Title	日本とベトナムによる組み込みシステム開発
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Abstract	1. Executive Summary 1.1. Introduction Our ALPS theme is "The Symbiosis Strategy of Embedded Systems Development between Japan and Vietnam –beyond Offshore Outsourcing–". The purpose of our ALPS project is to investigate the critical factors and craft strategic management which leads to the rapid growth in terms of development volume of offshore business. It is necessary to share a system development environment and a communication tool. And it is also necessary to share a common mental to run the projects in the long-term relationship. 1.2. Roadmaps First, in order to find issues of the actual embedded system development, we determined the interviewees on the basis of CVCA. After interviewing with the stakeholders, we grouped the acquired knowledge by related category using the Mind Map and the KJ method. Secondly, we materialized the functions of the system to solve the critical issues using morphological analysis. Additionally from this interview, we thought that communication issue such as the difference in language was a critical issue, and devised the teleconference system as the solutions. We interviewed with the stakeholders again after prototype preparation to validate the developed our system. From this interview, we obtained the positive feedback of the proto type and also found some lacks to solve whole the issues. Whereat, we came up with the new system ideas "Internal SNS" and "Model-driven architecture" which cover the shortcomings. 1.3. Symbio-SYS-tem Through analysis, we proposed a new system named "Symbio-SYS-tem". We aim at "haring the recognition between outsourcers and subcontractors" by the Symbio-SYS-tem. The Symbio-SYS-tem consists of three subsystems, Teleconference room, Internal SNS, Model-Driven Development. The Teleconference room's functions, wide screens and constant connection, give the engineers of both companies visual information to share atmosphere of each companies in Japan and Vietnam, and the other functions of displaying the same document, hand writing by tablet computer and automatic saving to a repository helps them to communicate easily by sharing the same documents and tracing contents of their meetings. The Internal SNS is a platform on website to get information of projects such as the member's names, faces and skills and the schedule, progress and documents. It also becomes a network to connect with the members related to projects by visualizing the connection among engineers and chatting with them. The third subsystem, the Model-Driven Development is that engineers create models of products' structure along the process with a modeling language like SysML or OPM. It gives the engineers the same diagrams and system overview they develop. They can solve the problems such as ambiguity of natural languages, miss-translations of specifications and incompleteness of specifications because of these functions. Each subsystem shall be effective by itself. However, it is more effective when we use the three subsystems in combination such as at a teambuilding phase or order phase. 1.4. Future work Before we launch it to market, we have to do the following things; fist we should make the interfaces between 3 factors clear to use in combination. Also, we have to mention the strategic management to use the system as manual documents, and finally verify and validate this system in actual work though we received favorable reviews about it from the proposers and the professors. In addition, we need to make the contingency plan. In case of that the internet cannot use, the system is not going to work. We have to include the management contents for the case and

	educate the engineers in both companies.
Notes	Student final reports Group L
Genre	Research Paper
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40002003-00002011-0771

Group L

Group L's Theme Proposed by Toshiba System Technology Corporation

ALPS "Symbiosis and Synergy"

theme title: The Symbiosis Strategy of Embedded Systems Development between Japan and Vietnam -beyond Offshore Outsourcing-

Proposer Organization's Name: Toshiba System Technology Corporation
Contact Person's Name: Kensuke KAWAI Contact e- mail: kensuke.kawai@toshiba. co.jp

Abstract of your project theme :

The purpose of the project is to investigate the critical factors of strategic management, which leads to the rapid growth in terms of development volume between the companies with different cultural and technical background. Even between the companies with joint-development experience, the system development projects, especially those for real-time embedded applications, does not always reach the expected level of success.

Beyond offshore outsourcing like those for enterprise applications, there are many difficult features inherent to the embedded systems development such as:

1) the closed nature of hardware, operating system, and middle ware,
2) relatively high goals of real-time performance, reliability and quality, and
3) frequent changes to the functional requirements etc.

It is necessary to **share a system development environment and a communication tool such as SysML.** And it is also necessary to **share a common mental model of standard software platform from the long-term relationship**. Although the proposer company experienced some sound projects with a few companies in Vietnam for several years, the company aims to enhance further this collaborative relationship in a more synergetic fashion.

ALPS Final Report 2011

Group L

Project Title:

The Symbiosis Strategy of Embedded Systems Development between Japan and Vietnam - beyond Offshore Outsourcing -

Theme:

The Symbiosis Strategy of Embedded Systems Development between Japan and Vietnam - beyond Offshore Outsourcing -

Proposer Organization: Toshiba System Technology Corporation

Proposer Organization's Supporter: Kensuke KAWAI & Kazutoshi YOKOHAMA

Keio Mentor: Hidekazu NISHIMURA & Shintaro MURAKAMI

Members:

Takashi MORI

Masashi IKEDA

Hiroko SUGIYAMA

Naoya MURATA

Masayuki WATANABE

Graduate School of System Design and Management

Keio University

ALPS Final Report

Group L

[Theme]

The Symbiosis Strategy for Embedded Systems Development

between Japan and Vietnam —beyond Offshore Business—

[Proposer Organization]
Toshiba System Technology Corporation

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Kensuke KAWAI
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2011.12

Graduate School of System Design and Management, Keio University

1. Executive Summary

1.1. Introduction

Our ALPS theme is "The Symbiosis Strategy of Embedded Systems Development between Japan and Vietnam –beyond Offshore Outsourcing–". The purpose of our ALPS project is to investigate the critical factors and craft strategic management which leads to the rapid growth in terms of development volume of offshore business. It is necessary to share a system development environment and a communication tool. And it is also necessary to share a common mental to run the projects in the long-term relationship.

1.2. Roadmaps

First, in order to find issues of the actual embedded system development, we determined the interviewees on the basis of CVCA. After interviewing with the stakeholders, we grouped the acquired knowledge by related category using the Mind Map and the KJ method. Secondly, we materialized the functions of the system to solve the critical issues using morphological analysis. Additionally from this interview, we thought that communication issue such as the difference in language was a critical issue, and devised the teleconference system as the solutions. We interviewed with the stakeholders again after prototype preparation to validate the developed our system. From this interview, we obtained the positive feedback of the proto type and also found some lacks to solve whole the issues. Whereat, we came up with the new system ideas "Internal SNS" and "Model-driven architecture" which cover the shortcomings.

1.3. Symbio-SYS-tem

Through analysis, we proposed a new system named "Symbio-SYS-tem". We aim at "haring the recognition between outsourcers and subcontractors" by the Symbio-SYS-tem. The Symbio-SYS-tem consists of three subsystems, Teleconference room, Internal SNS, Model-Driven Development.

The Teleconference room's functions, wide screens and constant connection, give the engineers of both companies visual information to share atmosphere of each companies in Japan and Vietnam, and the other functions of displaying the same document, hand writing by tablet computer and automatic saving to a repository helps them to communicate easily by sharing the same documents and tracing contents of their meetings. The Internal SNS is a platform on website to get information of projects such as the member' s names, faces and skills and the schedule, progress and documents. It also becomes a network to connect with the members related to projects by visualizing the connection among engineers and chatting with them. The third subsystem, the Model-Driven Development is that engineers create models of products' structure along the process with a modeling language like SysML or OPM. It gives the engineers the same diagrams and system overview they develop. They can solve the problems such as ambiguity of natural languages, miss-translations of specifications and incompleteness of specifications because of these functions.

Each subsystem shall be effective by itself. However, it is more effective when we use the three subsystems in combination such as at a teambuilding phase or order phase.

1.4. Future work

Before we launch it to market, we have to do the following things; fist we should make the interfaces between 3 factors clear to use in combination. Also, we have to mention the strategic management to use the system as manual documents, and finally verify and validate this system in actual work though we received favorable reviews about it from the proposers and the professors. In addition, we need to make the contingency plan. In case of that the internet cannot use, the system is not going to work. We have to include the management contents for the case and educate the engineers in both companies.

2. TABLE OF CONTENTS

2.1. Table of Contents

2.2. Table of Figures

2.3. Table of Tables

3. Problem Statement

Our theme is “The Symbiosis Strategy of Embedded Systems Development between Japan and Vietnam –beyond Offshore Outsourcing–“. Embedded systems technology is the source of key export products in Japan. Japanese economics highly depends on exports industries of automobiles or consumer electronics products, the core of which consist of the embedded systems technology. In 2009, embedded systems related products account for 52.2% of total Japanese exports. In addition, business and service of almost Japanese industries -retail POS terminals, telecommunication equipment, ATM in financial services, robots in manufacturing etc- cannot exist without embedded systems technology. In other words, Japanese economic activities and daily life are based on the embedded systems technology. In the last decades, almost Japanese embedded systems companies outsource work to foreign countries where wages are lower such as China, Vietnam, and India for reducing productive cost. Especially, in recent days many Japanese embedded systems companies tend to do the business with Vietnamese companies because of the good conditions for not only cost but also training and education, and support from the government. In Vietnam, 70% of the 87million population is under 30 years old and the literacy rate is more than 90%. Though Vietnam is socialism, government strongly supports for the software industry and competitive cost of the outsourcing is 40% lower than China and India.

However, there are many difficult features inherent to the embedded systems development.

The first feature is the closed nature of hardware, operating system, and middle ware. This feature makes it hard to test the deliverables overseas. That is because, they need hardware for testing which is, so to speak, block of copyrights. A lot of regulations hinder exporting the hardware of test equipment. The Second is relatively high goals of real-time performance, reliability and quality, because embedded systems are mainly used for controls of hardware. If the software control systems work badly, it would cause havoc with operational errors and poor sales. Thus embedded systems development needs these features. The last is frequent changes to the functional requirements. The Changes are for not only customer requirements also specifications of hardware. Compared to mechanical, Software architecture is easier to achieve the requirements because of the small physical constrains and it makes the frequent changes easily. These problems are particularly remarkable in companies in tear under 3. Companies in tear 1 or 2 can change the functional requirements on their own according to the customer requirements and they can control the appointed date of delivery on much easier. On the other hand, companies in under tear 3 have difficulties to control their situation and they must work on the restricted delivery time because of their outsourcer's delay. Japanese 95% companies are this middle-small companies and suffering from that kinds of issues.

Therefore, the purpose of our ALPS project is to investigate the critical factors of strategic management, which leads to the rapid growth in terms of development volume between the companies with different cultural and technical background. The system development projects, especially embedded systems development, do not always reach the expected level of success. It is necessary to share a system development environment and a communication tool. And it is also necessary to share a common mental model of standard software platform from the long-term relationship. We focus on the Japanese small and middle company of the embedded systems development and take one of those for instance which experienced some sound projects with a few companies in Vietnam for several years and aims to enhance further this collaborative relationship in a more synergetic fashion.

4. ANALYSIS AND DISCUSSION OF ALPS METHODS

<Table of tools>

4.1. Mind Map

The Mind Map is a graphical technique for creating and representing associated hierarchical information about a subject.

We used this tool two times in the project. First was when the ALPS project started and second was when the project progressed (about ALPS #4). Figure 4.1 and 4.2 are results of Mind Map which was conducted latter. The figure 4.1's subject "Association" was associated with the ALPS

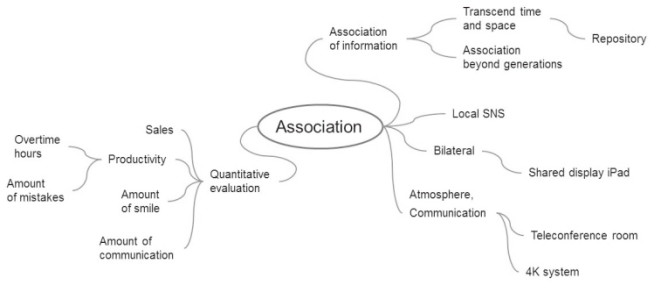


Fig. 4.1. Mind Map about “Association”.

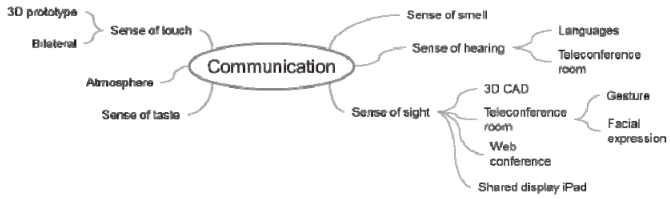


Fig. 4.2. Mind Map about “Communication”.

theme, “Symbiosis & Synergy” and the result of many interviews. The subject “Communication” was used in the figure 4.2 because many people said that communication was the most important for offshoring.

With this tool, we could sort out our feelings. Also, we could visualize required functions and association among existing solutions and our ideas (ex. Teleconference room, Repository).

4.2. Brainstorming

The tool we used the most in the project was “Brainstorming”. After brainstorming, we mainly applied KJ method to the results. KJ method is a method of clustering data into related groups.

At the beginning of the project (after first interview), we brainstormed about “What issues are occurring in embedded systems development and offshore business?” We found that the issue was little cost advantages in offshore business. Fig. 4.3 shows the result of the brainstorming.

At the middle of the project, we used the brainstorming tool to generate solutions to the issues. By the brainstorming, we derived three important keywords, “Systems Engineering”, “Training” and “Communication”. Fig. 4.4 shows

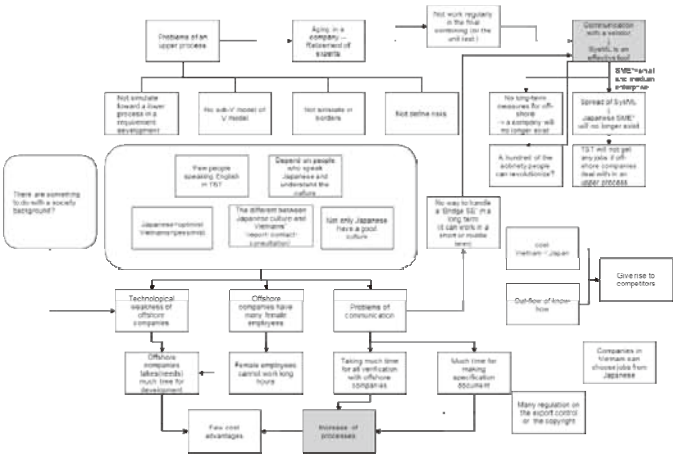


Fig. 4.3. First brainstorming.

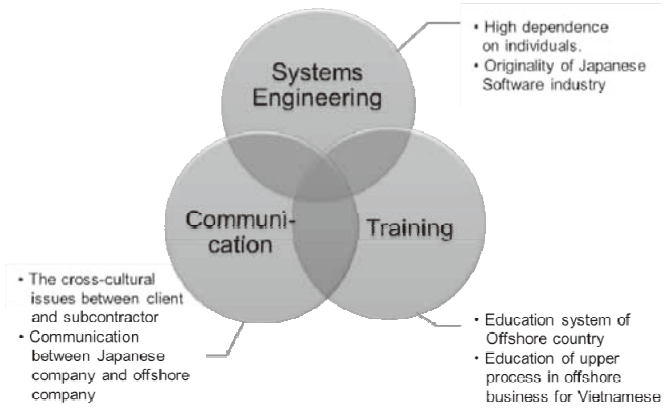


Fig. 4.4. Three keywords.

the keywords.

At the end of the project (before final presentation), we brainstormed to reconfirm the issues and to organize relationships among proposed subsystems and the issues.

4.3. Scenario Graph

The Scenario Graph is a tool for capturing the possible contexts in which a solution is offered.

After the Brainstorming, we used the Scenario Graph. Figure 4.5 shows the result of the Scenario Graph which we conducted at the beginning of the project. Unfortunately, because we used large components to the Scenario Graph, the result was void of concreteness. Therefore, we could not derive advantages from this tool.

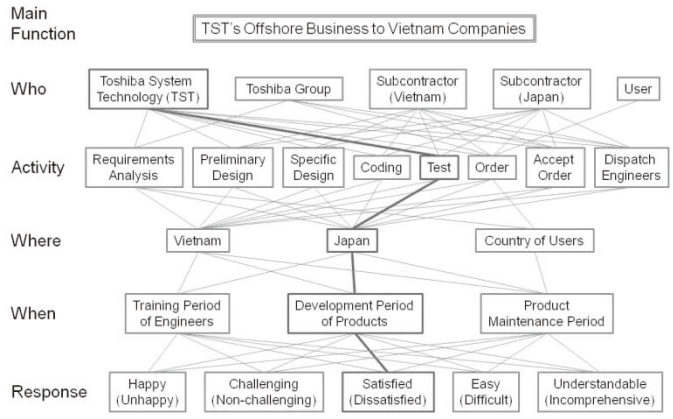


Fig. 4.5. The result of the Scenario Graph.

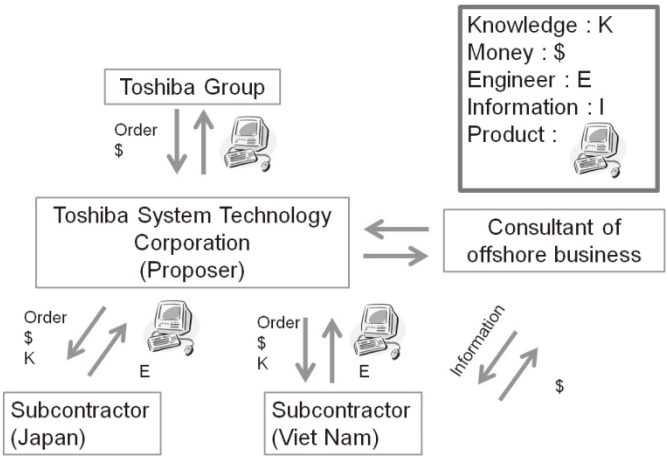


Fig. 4.7. Eventual CVCA.

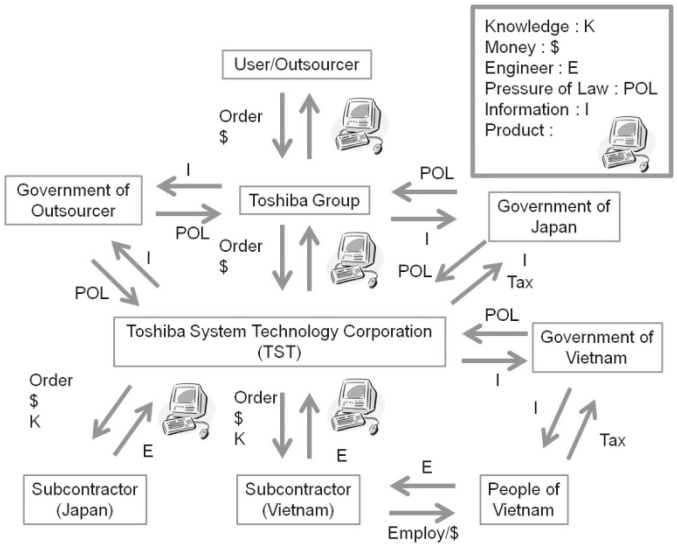


Fig. 4.6. CVCA at the beginning of the project.

Table 4.1. To_By_Using of the project

To	Craft symbiosis strategy in offshore business
By	Raising quality of communication
Using	Symbio-SYS-tem

4.4. CVCA

Customer Value Chain Analysis (CVCA) is a system analysis tool that captures the system stakeholders and their relationships in terms of money, information, material, complaints, and so on. We made CVCA about offshore business between Toshiba System Technology Corporation (our proposer company) and subcontractor companies in Vietnam. Figure 4.6 is the result of CVCA which conducted shortly after the beginning of the project. By this, we figured out the relationships among our proposer company and other stakeholders.

However, through interviews, we knew that there was little intervention by the governments and there were many orders which did not take from the Toshiba group. Consequently, we made the eventual result of CVCA of figure 4.7. By the tool, we figured out what the important relationships were and which needed improvement.

4.5. Goal Statement (To_By_Using)

The Goal Statement is used to clarify what the project do. In our project, all the results from Scenario Graph, CVCA, Brainstorming, etc. were integrated to set the To_By_Using. We set To_By_Using many times through the project. Eventually, we settled To_By_Using shown in Table 4.1. This tool helped us to tell the purpose and proposition clearly to audience in presentations.

4.6. Interview, Observation

The most important tool for us was "Interview, Observation". We conducted five interviews in the project.

1. Mr. Kawai : Former adviser of Toshiba System Technology (proposer)
   - To understand our theme
2. Mr. Yokohama, Mr. Higashiwaki and Ms. Hoan (Vietnamese) : TST's members who do offshore business
   - To know the actual condition of offshore business of embedded systems development
3. Mr. Seki : A member of Sony Corporation in charge of hardware systems development
   - To know the differences of hardware systems development and software systems development
4. Mr. Tamura and Mr. Koga : Members of IBM Corporation Japan
   - To know the actual condition of offshore business of large software companies
5. Mr. Takeda : Representative director of Astmilcorp Corporation (consulting corporation about offshore business to Vietnam)
   - To know common issues about offshore business to Vietnam

From these interviews, we received many comments and proposals for improvement of offshore business. We introduce some of these below.

- Effort to decrease misunderstanding about specifications or deliverables is needed. Avoidance for ambiguity of specifications or deliverables according to natural language and understanding upper processes or hardware's structure of embedded system are effective for decreasing misunderstanding.

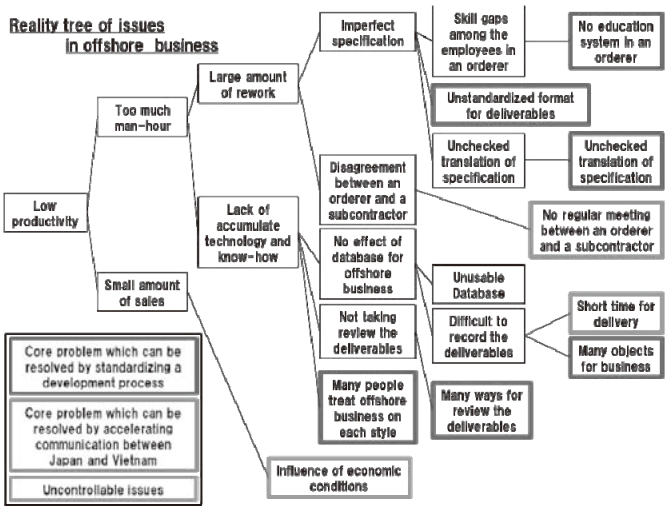


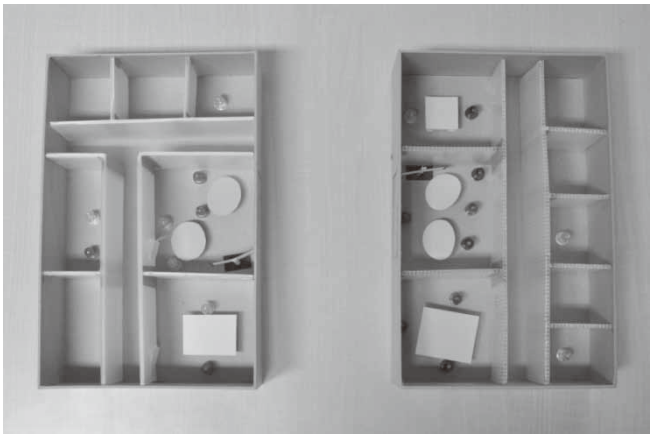
Fig. 4.8. Reality tree of issues in offshore business.

- For smoothing business with foreign countries, mutual understanding of each culture (including language) and personality of project members is important. Therefore, many companies take in an informal communication or face-to-face communication.
- Problems in offshore businesses attributable not only subcontractors in Vietnam but also outsourcers in Japan. Changing the mindset of Vietnamese and also Japanese is needed.

From interviews, we made a reality tree of issues in offshore business. Fig. 4.8 shows it.

4.7. Scenario prototyping rapidly

We made two prototypes in the project. First one was of the Teleconference room (Figure 4.9). Each box represents offices of the Japanese company and the Vietnamese company. By using a special display as large as the wall, these distant rooms seem as if one large room. When we showed the prototype to people from software companies, they showed good reaction and gave us advice, "If the system works anytime instead of only limited time, it is more effective to understand each other and decrease mistakes." So we added the function "anytime connection" to the teleconference room.



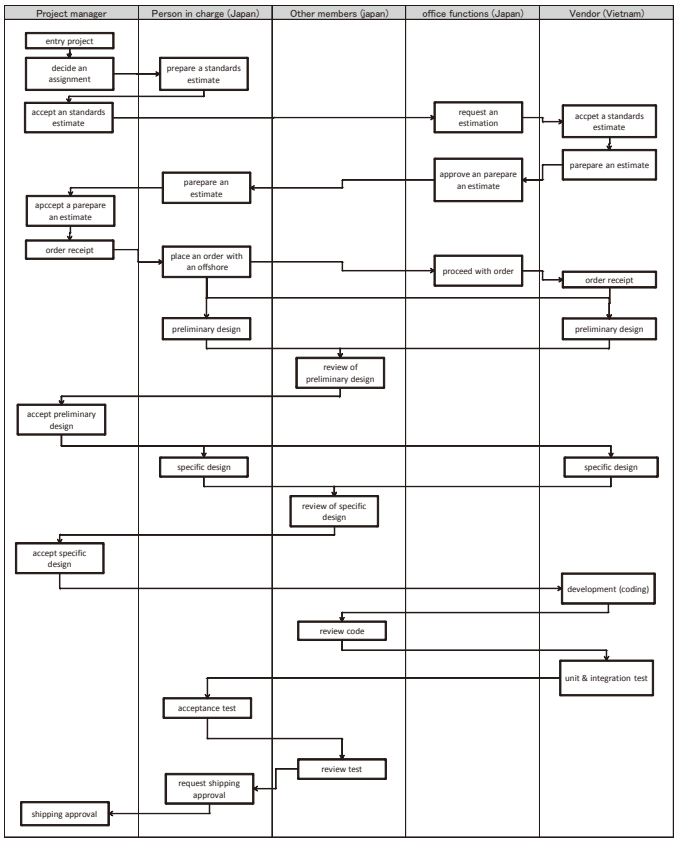
(a). Each office.

(b). Teleconference room.

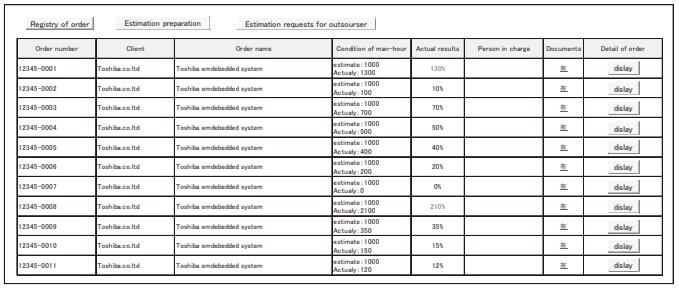
(c). Image of bleaking the walls.

Fig. 4.9. Prototype of the Teleconference room.

Second one was about standardization of development processes (Figure 4.9.1). When our proposers saw the prototype, they said “Although it is certainly important and right, it is very difficult because most of our businesses are small scale, quick delivery and highly changeable requirements.” Therefore, we rejected the idea from our proposal consequently.



(a). The flow of processes.



Order number	Client	Order name	Condition of man-hour	Actual results	Person in charge	Documents	Detail of order
12345-0001	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 1300	130%		表	dislay
12345-0002	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 100	10%		表	dislay
12345-0003	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 700	70%		表	dislay
12345-0004	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 500	50%		表	dislay
12345-0005	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 400	40%		表	dislay
12345-0006	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 200	20%		表	dislay
12345-0007	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 0	0%		表	dislay
12345-0008	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 2100	210%		表	dislay
12345-0009	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 350	35%		表	dislay
12345-0010	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 150	15%		表	dislay
12345-0011	Toshiba.co.ltd	Toshiba embebedded system	estimate : 1000 Actualy : 120	12%		表	dislay

(b) The system of management of orders.

Fig. 4.10. Prototypes of standardization of development processes.

4.8. Value graph

The Value graph is a brainstorming tool for clarifying the goals of a product. It is composed of upper part, “Why (user value, purpose of the system)”, and lower part, “What”, “How”,.

By using the Value Graph, the question “why the teleconference room is used” was become clear. Also, we knew that “Language”, “Topic”, “Time”, “Place” and “Interface” were required as the solution elements. Therefore, we considered how to satisfy the function requirements by defining these solution elements next.

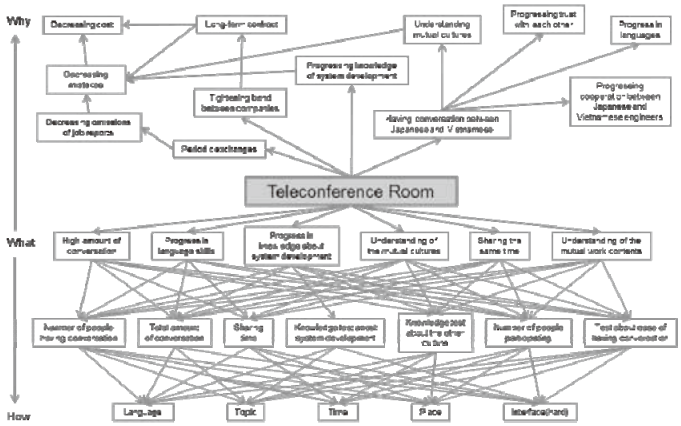
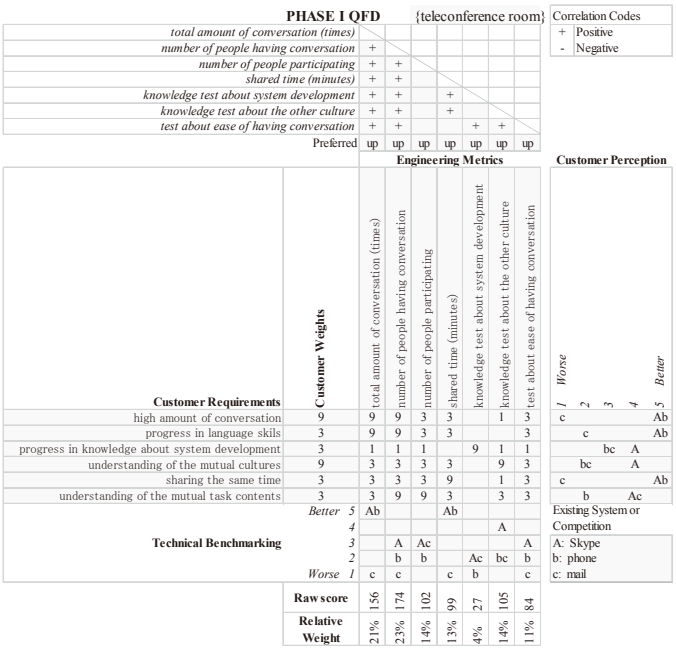


Fig. 4.11. Value Graph of Teleconference room.



PHASE I QFD {teleconference room}

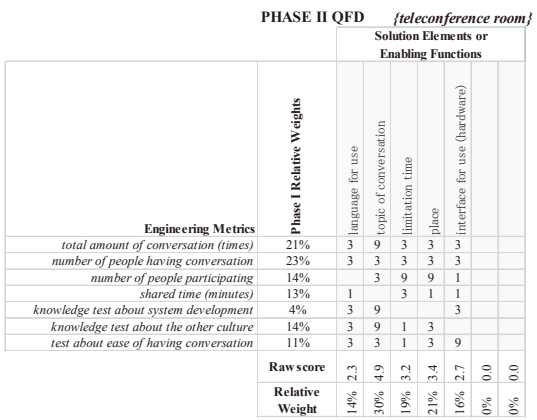
Correlation Codes	
+	Positive
-	Negative

total amount of conversation (times)	
number of people having conversation	+
number of people participating	+ +
shared time (minutes)	+ +
knowledge test about system development	+ + +
knowledge test about the other culture	+ + +
test about ease of having conversation	+ + + +
Preferred	up up up up up up up

Customer Requirements	Customer Weights	Engineering Metrics: total amount of conversation (times)	number of people having conversation	number of people participating	shared time (minutes)	knowledge test about system development	knowledge test about the other culture	test about ease of having conversation	Customer Perception: 1 Worse	2	3	4	5 Better
high amount of conversation	9	9	9	3	3		1	3	c				Ab
progress in language skils	3	9	9	3	3			3		c			Ab
progress in knowledge about system development	3	1	1	1		9	1	1			bc	A	
understanding of the mutual cultures	9	3	3	3	3		9	3			bc	A	
sharing the same time	3	3	3	3	9		1	3	c				Ab
understanding of the mutual task contents	3	3	9	9	3		3	3		b		Ac	
Technical Benchmarking: Better 5		Ab				Ab							
4							A						
3			A	Ac				A					
2			b	b		Ac	bc	b					
Worse 1		c	c		c	b		c					
Raw score		156	174	102	99	27	105	84					
Relative Weight		21%	23%	14%	13%	4%	14%	11%					

Existing System or Competition
A: Skype
b: phone
c: mail

Fig. 4.12. QFD I.



PHASE II QFD {teleconference room}

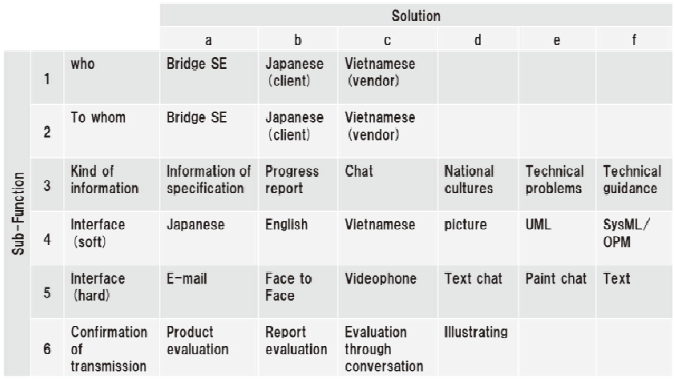
Engineering Metrics	Phase I Relative Weights	Solution Elements or Enabling Functions: language for use	topic of conversation	limitation time	place	interface for use (hardware)		
total amount of conversation (times)	21%	3	9	3	3	3		
number of people having conversation	23%	3	3	3	3	3		
number of people participating	14%		3	9	9	1		
shared time (minutes)	13%	1		3	1	1		
knowledge test about system development	4%	3	9			3		
knowledge test about the other culture	14%	3	9	1	3			
test about ease of having conversation	11%	3	3	1	3	9		
Raw score		2.3	4.9	3.2	3.4	2.7	0.0	0.0
Relative Weight		14%	30%	19%	21%	16%	0%	0%

Fig. 4.13. QFD II.

4.9. QFD I & II

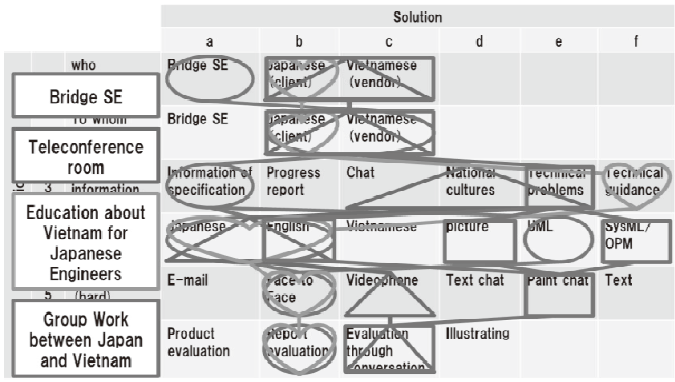
After conducting many interviews and the Value graph, we used QFD to figure out what kind of system will be required from the stakeholders.

The purpose of our project is to increase quality and frequency of communication between the outsourcer and the contractor. Therefore, we focused on communication of actual software development process. Fig. 4.12, 4.13 are the results of QFD I and II. As shown in these figures, the results had little to gain because it was difficult to measure the quality of communication. That is why we could not make good use of QFD I and II.



Sub-Function		Solution a	b	c	d	e	f
1	who	Bridge SE	Japanese (client)	Vietnamese (vendor)			
2	To whom	Bridge SE	Japanese (client)	Vietnamese (vendor)			
3	Kind of information	Information of specification	Progress report	Chat	National cultures	Technical problems	Technical guidance
4	Interface (soft)	Japanese	English	Vietnamese	picture	UML	SysML/ OPM
5	Interface (hard)	E-mail	Face to Face	Videophone	Text chat	Paint chat	Text
6	Confirmation of transmission	Product evaluation	Report evaluation	Evaluation through conversation	Illustrating		

(a). Chart of solution-subfunction.



(b). Four scenarios in Morphological Analysis.

Fig. 4.14. Result of Morphological Analysis.

4.10. Morphological Analysis

Using the Morphological Analysis, we tried to find the system to increase conversation between the companies in Japan and Vietnam. It made us generate many ideas and also made these ideas clear considering to the sub-functions, who, to whom, kind of information, soft-ware interface, hard-ware interface and the way for confirmation of transmission. Next, we selected the best solutions among these created ideas by Pugh Selection.

Concept				
Criteria	Bridge SE	Teleconference Room	Education about Vietnam for Japanese Engineers	Group Work between Japan and Vietnam
Low cost for introduction	DATUM	+	−	+
Low cost for maintenance		+	−	+
High motivation of participants		+	−	S
Much amount of conversation between Japanese and Vietnamese		+	S	+
Much amount of getting knowledge for the other culture		+	+	+
Short term for introduction		+	S	+
Small knowledge and skills for participants		+	+	+
High relevance to work		S	S	−
Σ of +		7	2	6
Σ of −		0	3	1
Σ of S		1	3	1
Overall		7	−1	5

Fig. 4.15. Pugh Selection Matrix's result

4.11. Pugh Selection

By the Pugh Selection Matrix, we discussed which concept was the best compared to the others. The concepts we mentioned were "Teleconference room", "Education about Vietnam for Japanese Engineers" and "Group Work between Japan and Vietnam" which came up from Morphological Analysis. We set the “Bridge SE” in DATUM and measured them by some criteria which are chosen by the views of “cost” “motivation of participants” “amount of conversation”.

According to the Pugh Selection Matrix's result, we selected "Teleconference room" as the best concept which is good in the views of “cost” “motivation of participants” “amount of conversation”.

4.12. Function Structure

First, we described the Function from Use Case analysis. After that, we developed the function as the Function structure map. Fig. 4.16 shows one example.

4.13. FMEA

This tool is useful to identify critical issues and risks of a system. However, we did not use the tool because this year ALPS did not cover the tool.

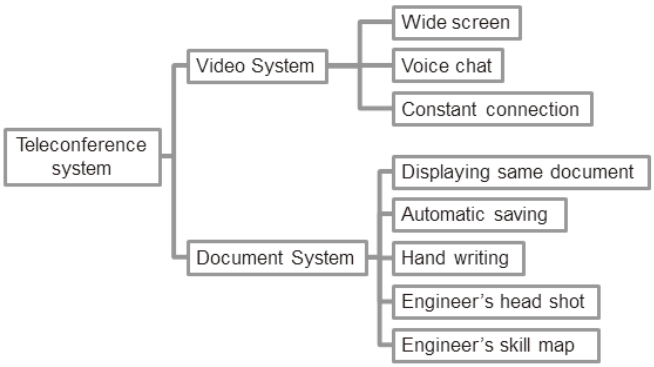


Fig. 4.16. Function Structure.

4.14. Quality Score-carding

The Quality Score-carding is a method for considering the factors that might influence a project model.

[1] Project Objective

- Productivity of TST on offshore business (Y)

[2] Objective Measures

- Amount of sales
- Man-hour
- Initial cost
- Gross margin

[3] Control Factors

- Amount of sales
  - Marketing efforts (X_1)
- Initial cost
  - Labor cost (X_2)
  - Communication cost (X_3)
  - etc.
- Man-hour
  - IT skill (X_4)
  - Level of standardized process (X_5)
  - Accuracy of communication (X_6)

[5] Noise

- Economic conditions (V_1)
- Competitor conditions (V_2)

[6] Transfer Function

$$Y = \frac{\text{gross profit}}{\text{production cost}}$$

$$= \frac{\text{amount of sales} - \text{initial cost}}{\text{man-hour}}$$

$$= \frac{\text{project size}(X_1, V_1, V_2) - (X_2 + X_3 + \text{etc})}{X_4 \times X_5 \times X_6}$$

4.15. Net present value

We mention this tool in our business model at Chapter 6, "Competitive Analysis".

4.16. Design of Experiment

We could not conduct experiments because of the economical and time constraints. To conduct experiments, we had to prepare the tools for our developed system such as wide screens and tablet computers as well as making the environment where a project of embedded systems development is carrying out between the Japanese company and the Vietnamese company.

4.17. Object-Process Methodology (OPM)

We did not use the Object-Process Methodology because of the feature of our developed system. The object and process of our developed system depends on the requirements of the people carrying out a project in embedded system development and the scene where the system is used. Thus, we used Use Case Diagram to visualize the functions of the system, instead.

4.18. Use Case Analysis

The Use Case Analysis is a method for capturing the user requirements of a system. We used this tool for confirming if our developed system works in actual work. We mention this tool in chapter 5.

Fig. 5.1. Prototype of Teleconference room.

5. DESIGN RECOMMENDATION

We propose a new system named "Symbio-SYS-tem" as a solution for our ALPS theme. The "Symbio-SYS-tem" consists of three subsystems:

- Teleconference room
- Internal SNS
- Model-Driven Development.

First is the Teleconference room. It has two prominent functions for "Visual information" and "Documents".

For "Visual information", it has two functions, "Wide screen" and "Constant connection". "Wide screen" is to display the picture of another room on the screen as large as the wall. "Constant connection" is to run the system constantly in order to communicate with each other whenever the engineers in Japanese company and Vietnamese company want. The aim of "Visual information" is to share the atmosphere of each room as if they get though the walls. Fig. 5.1 shows the prototype of the Teleconference room (Detailed explanation of prototypes are mentioned in Chapter5).

"Documents has three functions, "Displaying same documents", "Hand writing" and "Automatic saving at each room".

"Displaying same document" is to display the same document on tablet computers like iPad.

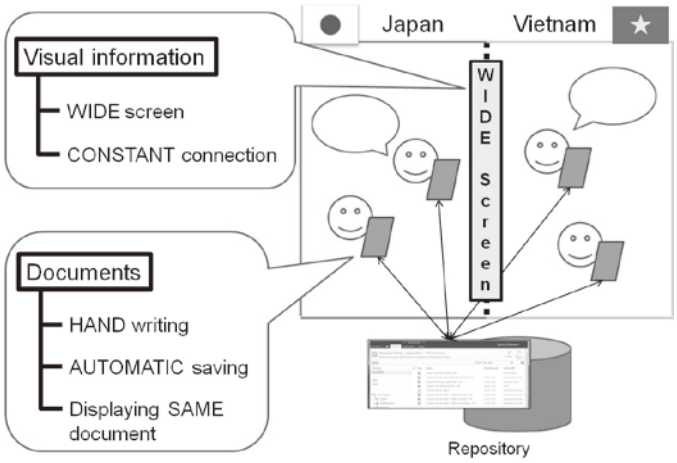


Fig. 5.2. Explanation drawing of Teleconference room.

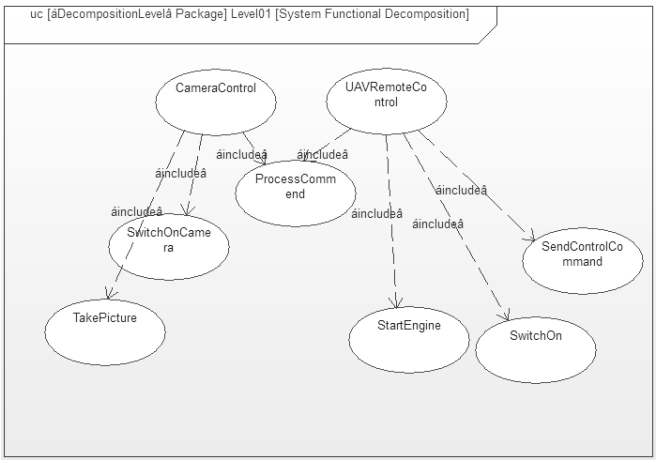


Fig. 5.4. An example of a use case diagram with SysML.

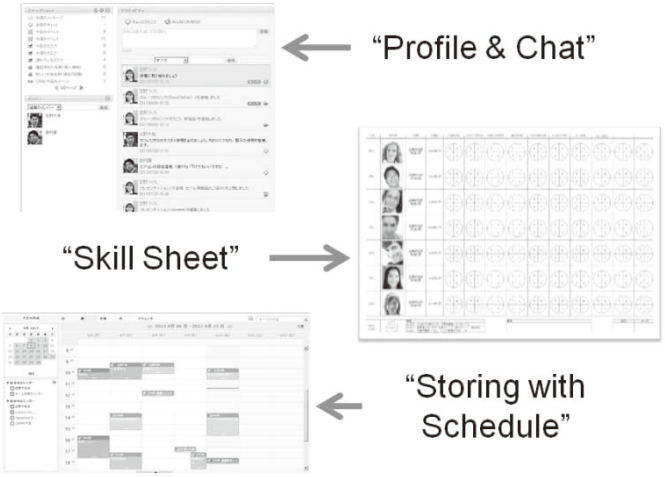


Fig. 5.3. Prototype of Internal SNS.

"Hand writing" is to write figures or texts in handwriting to the documents on tablet computers. "Automatic saving" is to save the documents automatically in the prescribed repository, like a server of a company. The aim of "Documents" is to communicate easily based on the same documents and trace the way of conversation.

Fig. 5.2 shows the explanation drawing of the Teleconference room.

Second is the Internal SNS. The functions of Internal SNS are divided by three main functions, "Profile & Chat", "Skill sheet", and "Sharing schedule and progress".

In "Profile & Chat", we can see head shots of project members and chat with the members on Internal SNS. We can communicate more easily by using it than by using E-mails and phones.

In "Skill sheet", we can see the skill map and visualized people-relation's map among engineers. So we can check the abilities and experiences of workers. It is useful to know each other among the project members and to know who has experiences of the work.

In "Sharing schedule and progress", we can share the schedule and progress of the project. And they can see the documents in the repository using the internal SNS. By it, we can check the schedule and the documents with date easily and frequently. The prototypes of the Internal SNS are shown in Fig. 5.3. We use pictures of some website on this prototype.

Third is the Model-Driven Development (MDD). The MDD is defined that "An approach to software development where extensive models are created before source codes are written (Scott W. Ambler, "Agile Model Driven Development")". In particular, engineers create models of product structure along the process with a modeling language like SysML or OPM. The prototype of MDD is shown in Fig. 5.4. We use a picture of SysML on this prototype.

Each subsystem shall be effective alone. However, it becomes more effective when we use the three subsystems in combination. We think that the

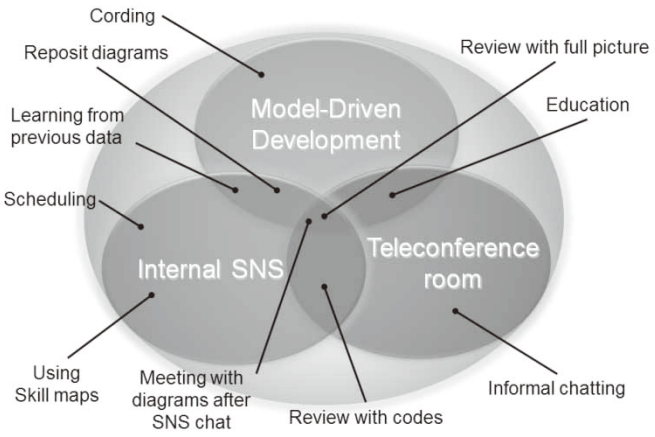


Fig. 5.5. Usage example of the Symbio-SYS-tem.

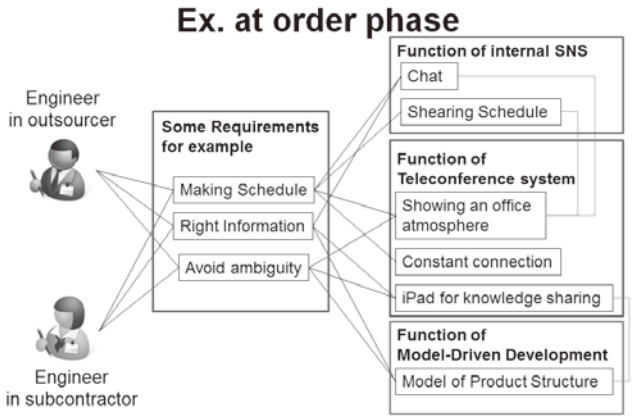


Fig. 5.7. Use case diagram at the order phase.

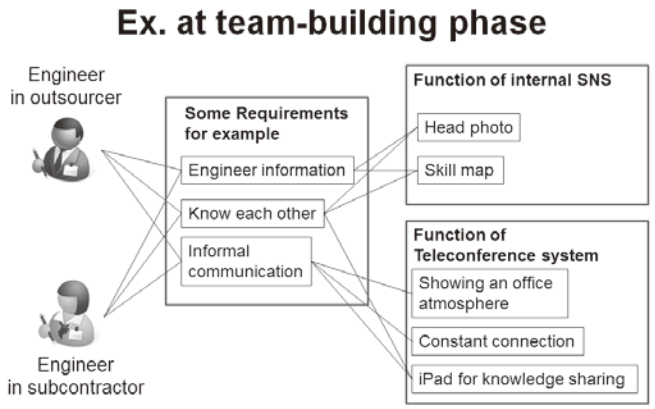


Fig. 5.6. Use case diagram at the team-building phase.

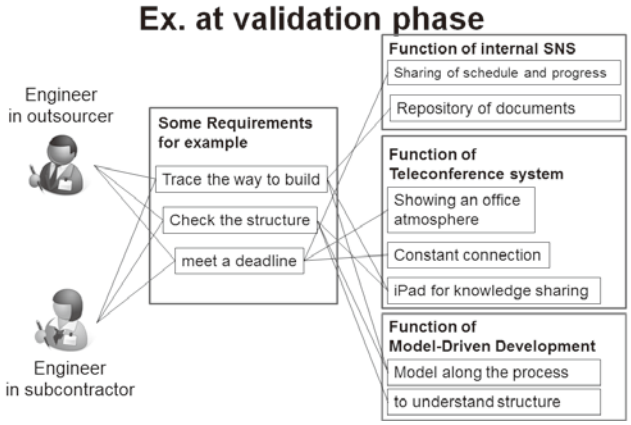


Fig. 5.8. Use case diagram at the validation phase.

three subsystems are collaborated in many cases. Fig5.5 shows many use cases.

For example, at coding phase, if they ask small questions frequently, they shall use the Internal SNS. If they ask big questions like something related to the whole process of their work, they communicate by talking face to face in Teleconference room and discuss with the models which are made of the MDD. Even if the language to communicate is natural languages, for instance Japanese and English, it would be much easier to share their recognition.

We think that three subsystems are collaborated in the other cases. From Figure 5.6 to 5.8 show the use cases of the Symbio-SYS-tem.

6. Competitive Analysis

By "Symbio-SYS-tem", we aim "sharing the recognition between outsourcers and subcontractors". If it is realized, "Symbio-SYS-tem" mainly allows them to prevent the rework by miscommunication.

We would now like to calculate the efficiency of the Symbio-SYS-tem.

6.1. Assumption and Definition

We assume offshore business between Japan and Vietnam. The number of Japanese engineers is 100 and one of Vietnamese engineers is 100. They work 200 man-months. The price of man-month of engineers is ¥1,000,000. The profit of Japanese company per one man-month of Japanese engineer is ¥320,000. The cost of man-month of Japanese engineer's work is also ¥320,000.

year	amount of rework	amount of engineers' work	factual amount of engineers work	Profit compared to present state on every year	Present Value on every year	NPV on every year with Initial Cost
	(man-month/person)	(man-month/person)	(man-month/person)	(million yen)	(million yen)	(million yen)
present state	0.3	12	9.23			
1	0.3	11.5	8.85	-42.95	-35.79	-40.74
2	0.25	11.5	9.20	-10.75	-7.47	-48.21
3	0.25	11.5	9.20	-10.75	-6.22	-54.43
4	0.25	11.7	9.36	3.81	1.84	-52.59
5	0.25	11.7	9.36	3.81	1.53	-51.06
6	0.22	11.7	9.59	24.75	8.29	-42.77
7	0.19	11.7	9.83	46.76	13.05	-29.72
8	0.16	11.7	10.09	69.89	16.26	-13.47
9	0.13	11.7	10.35	94.26	18.27	4.80
10	0.1	11.7	10.64	119.96	19.37	24.18
			Discount Rate: 0.2(20%)	Initial Cost: 4.95million yen		

Fig. 6.1. Calculation of NPV

The cost of man-month of Vietnamese engineer is 1/20 of Japanese engineer. We assume that the order cost of Vietnam company assume ¥50,000. Therefore, if Vietnamese engineer works one man-month, the added profit of Japanese company is ¥270,000(=320,000-50,000) per one man-month of Vietnamese engineer.

We found the data that amount of rework is over 30% of the work. Now we assume it is 30%. It means that time to complete the work of 1 man-month is 1.3 month. The actual amount of work of engineers is 12/1.3. Therefore, we calculate the profit of Japanese company is {320,000*100+(320,000+270,000)*100}*12/1.3=840 millions. We set it is base value. We defined that Cash Flow is the increase or decrease of Japanese company's profit from base value.

We calculate NPV for ten years. By the introduction of the Symbio-SYS-tem, engineers spend time on training and habituation of system. We assume that spent work is 0.5 man-month on from one year to three years and 0.3 man-month on from four years to ten years. By the introduction of the Internal SNS and the Teleconference room, we assume that the rate of rework will be improved to 25 % from one year to five years. And, according to MDD, from six year to ten years, the rate of rework will be improved to 3 % per year from six years to ten years.

We define the initial costs and running costs from actual services and software as the following.

- Internal SNS
  - Initial cost ¥400,000
  - Running cost ¥1,440,000 per year
- Teleconference room
  - Initial cost ¥1,870,000
  - Running cost ¥370,000 per year
- Model-Driven Development
  - Initial cost ¥2,680,000
  - Running cost ¥1,010,000 per year

Moreover, we assume that the cost of training for using the system and maintenance is ¥5,000,000, because the work of five man-months may be needed for teachers of using system and maintenance Company of this system.

Therefore, we assume that the Symbio-SYS-tem's initial cost is ¥4,950,000 and its running cost is ¥7,820,000 per year.

6.2. Calculation result

On the calculation of NPV, we define that Discount rate is 20 %. The NPV for ten years is about ¥24.2 million. This system is effective for the profit of Japanese company.

In this calculation, the maximum exposure is third year which it takes to improve for training and habituation of system. And Pay-back Period is 9th year. It may take long time for this system to be effective. For increase of profit, the time and

endurance of engineers will be used to use this system is important.

6.3. Future

According to technological progress each three factors of the Symbio-SYS-tem would be developed. There is high possibility to grow functions of each factor. However, as the factors change the functions, we must consider the interfaces among factors.

Additionally, as the Symbio-SYS-tem become popular, it causes decrease the cost.

6.4. Protection strategy

If an outsourcer has a work for modeling secret technology and order to subcontractors, the technology might be leaked to the other companies. It makes an outsourcer lose their advantages in market. In order to prevent the out flow of the technology, an outsourcer must distinguish the covert parts which they deal with from the other parts. If they model the covert parts on their files, they need to hide the structure of them. In some software, the function like this is implemented.

7. ALPS ROADMAP AND REFLECTIONS

The above is the graph which shows ALPS process and the maturity of the concept.

First, In order to find issues of the actual embedded system development, we determined the interviewees by CVCA. At this phase, we found out that there were many stakeholders related to the systems development. Therefore, we took time for determining interviewees. For this reason, this phase was set to “Oops”.

After interviewing with stakeholders, we grouped the acquired knowledge using the Mind Map and the KJ method. Thus we materialized the system which solves the critical issues using morphological analysis. From this interview, we thought that communication issue such as the

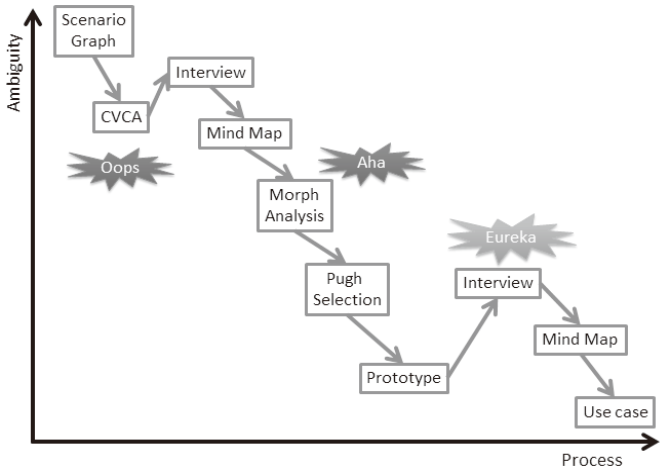


Fig. 7.1. Roadmap of an actual process.

differences in language was a critical issue, and devised the teleconference system. In this phase, since we embodied the system, we set this phase to “Aha”.

We interviewed with the stakeholders again after prototype preparation. From this interview, we obtained the positive feedback of the proto type. Moreover, we came up with the new system idea “Internal SNS” and “Model-driven architecture”. So, we set this phase to “Eureka”.

<Improvement>

- To listen deeply to customer’s voice in the selection stage of a concept
  - We were not able to hear deeply the customer's voice on account of time in concentration on idea phase. (using mind map and morphological analysis)
  - Therefore, we noticed the importance of the discarded idea at the final interview of a phase

8. CONCLUSION AND FUTURE WORK

8.1. Operation of Symbio-SYS-tem (Conclusion)

The time to master each subsystem is different. The time to apply the Internal SNS is the shortest because it is easy to understand the way to use the Internal SNS. We think that the time to apply the Teleconference room is medium because it is more difficult to understand the way to use it than the Internal SNS and less difficult than the MDD. The time to apply the MDD is the longest because the MDD is very difficult to understand to use.

Therefore, in order to make the most the "Symbio-SYS-tem", companies should use and maintain this system for a long time

8.2. Upcoming challenges of this system (Future Work)

In order to finish the "Symbio-SYS-tem" project, we need to solve three issues.

First, we should validate this system in actual work. We prepared use cases in chapter 6. So, we have to examine the effectiveness of our system and use cases. However, we got reviews and feedbacks about it from proposers and professors during ALPS workshop.

Second, we will have to integrate interfaces of three subsystems. Each subsystem has already used in many companies. But there are many efficiency issues. We proposed that they have to use three subsystems in combination for improvement in efficiency. So, we need to think more deeply about interfaces.

At the last, we did not mention information's security. If an outsourcer and subcontractors terminate a business contract, they must prevent from leaking the company's information.

9. Acknowledgments

First of all, we are deeply grateful to our proposers Mr. Yokohama, Mr. Kawai, Mr. Higashiwaki, Ms. Kawauchi and Ms. Hoan from Toshiba System Technology Corporation on the support of our project. They advised us appropriately throughout the ALPS lecture, and taught us kindly in several points of view, not only the attitude toward the project but also the idea making our discussion improve. Moreover, we would like to thank our mentor Prof. Nishimura, sub-mentor Mr. Murakami and all of other professors, teachers from the universities of Keio, MIT, Stanford and Delft. Finally, I appreciate all our colleagues on the active discussions and mental supports.

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11. APPENDIX

11.1. WCA

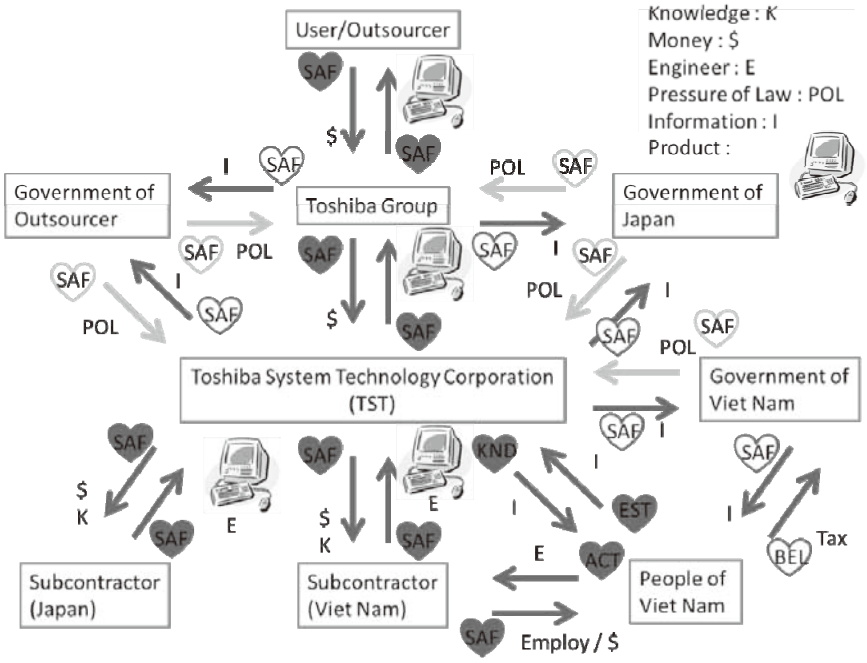


Fig. A.1. WCA.

11.2. Large figures

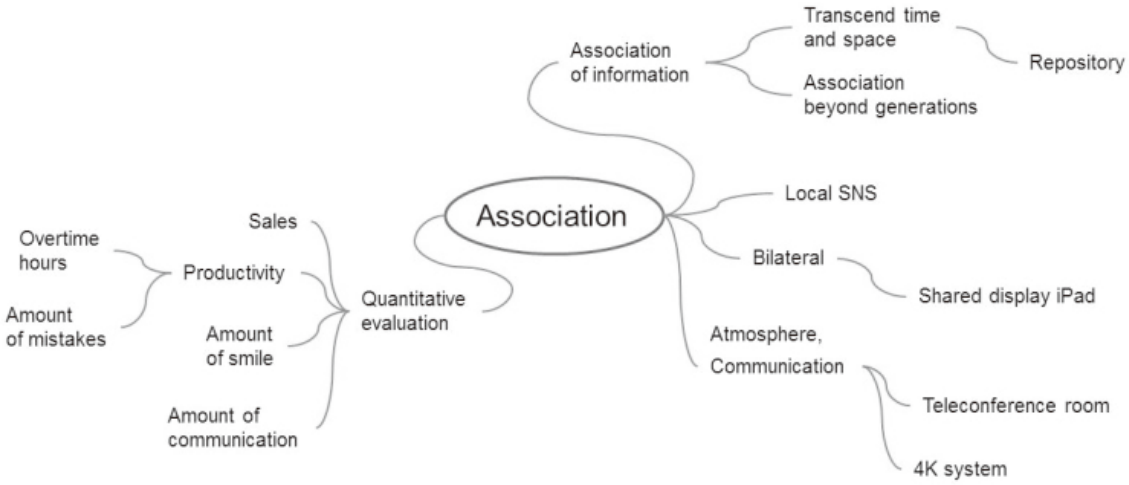


Fig. A.2. Mind Map about "Association" (large ver. of Fig. 4.1).

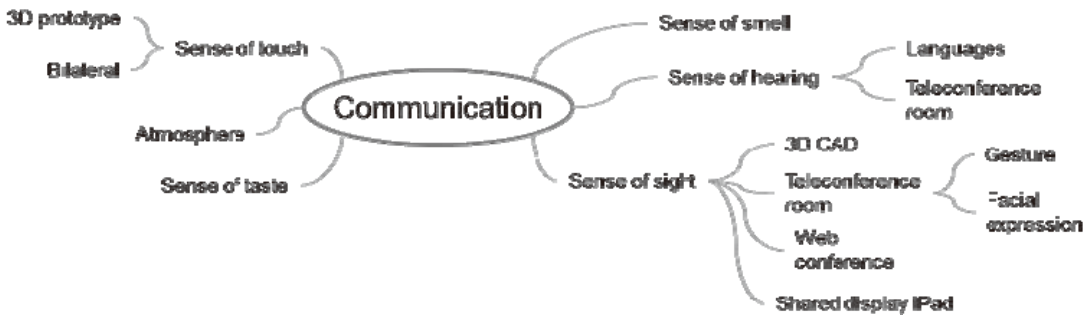


Fig. A.3. Mind Map about "Communication" (large ver. of Fig. 4.2).

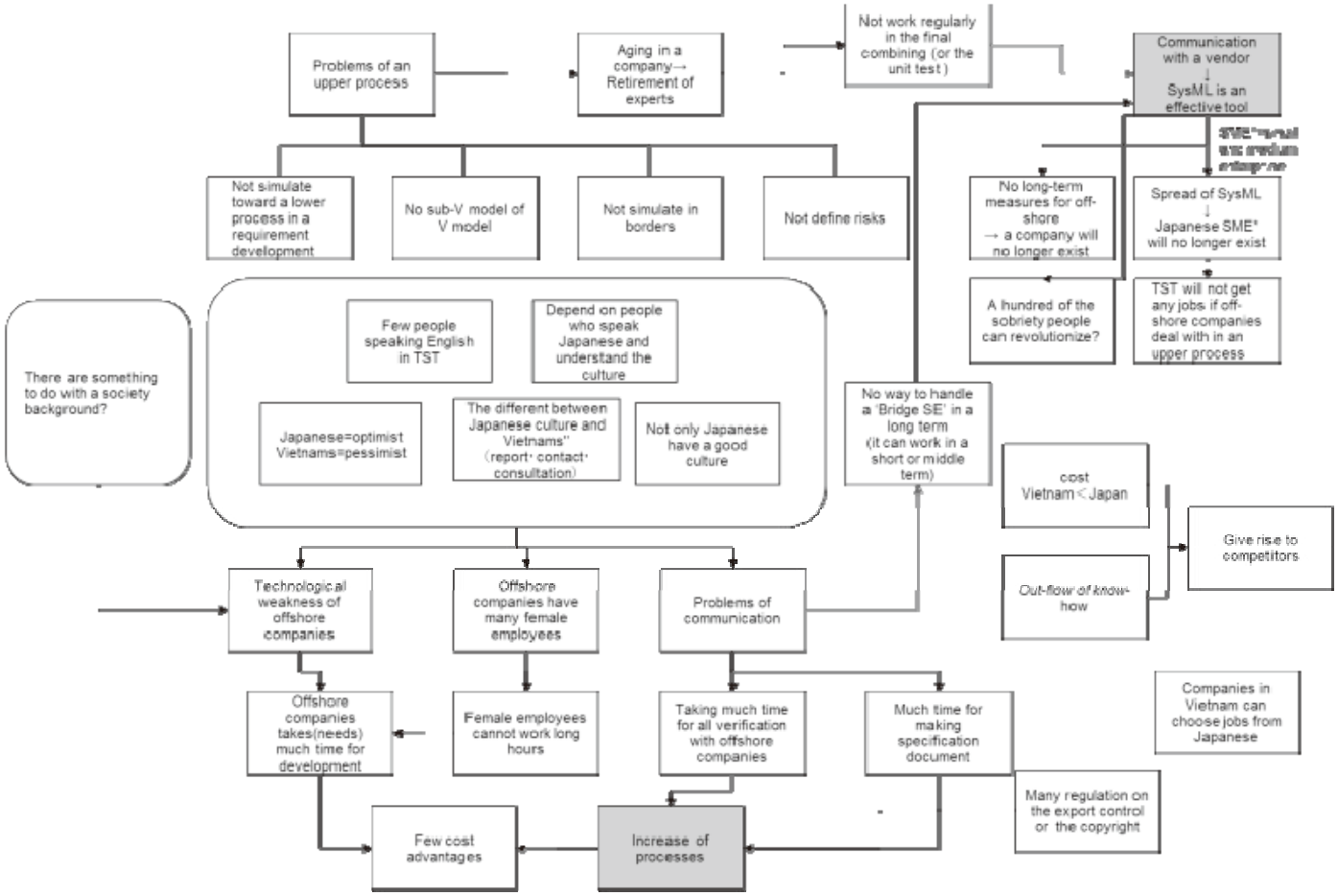


Fig. A.4. First brainstorming (large ver. of Fig. 4.3).

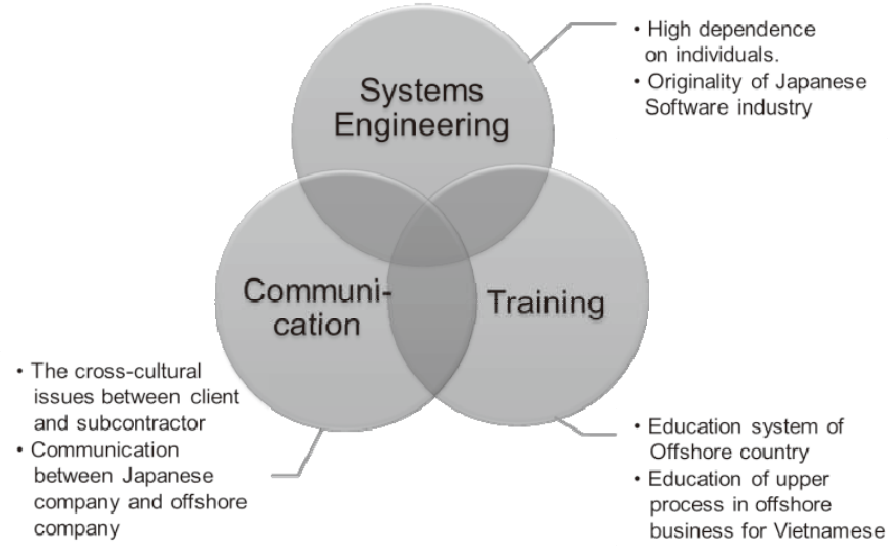


Fig. 4.4. Three keywords (large ver. of Fig. 4.4).

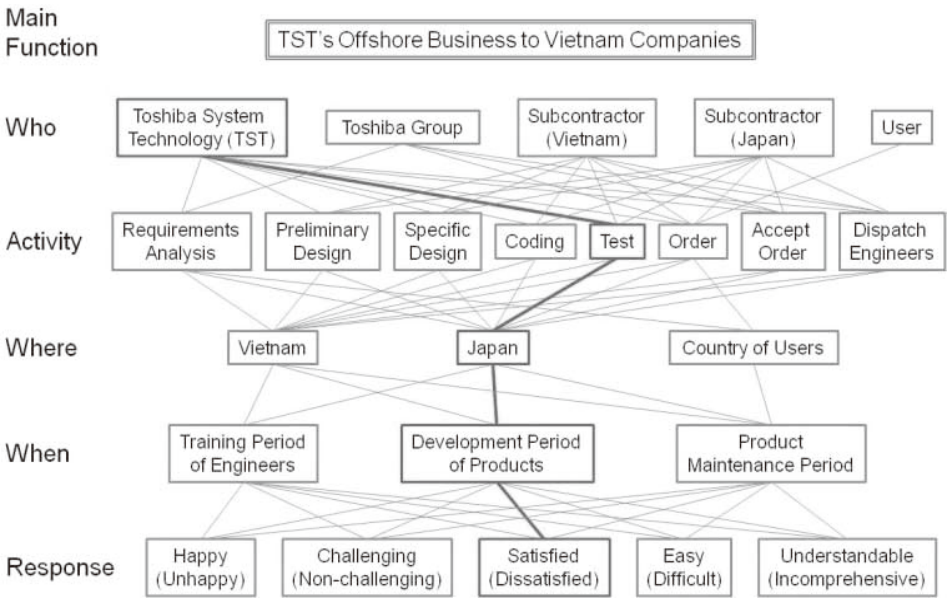


Fig. 4.5. The result of the Scenario Graph (large ver. of Fig. 4.5).

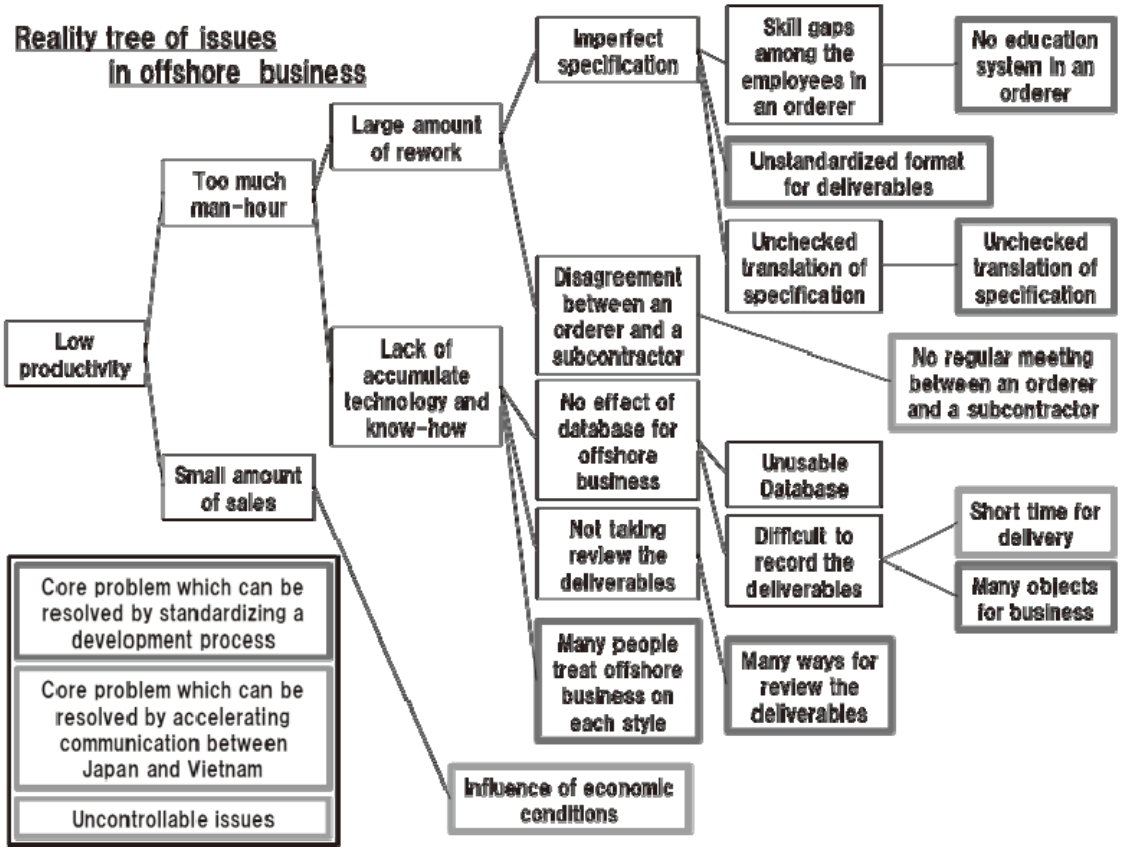


Fig. A.5. Reality tree of issues in offshore business (large ver. of Fig. 4.8).

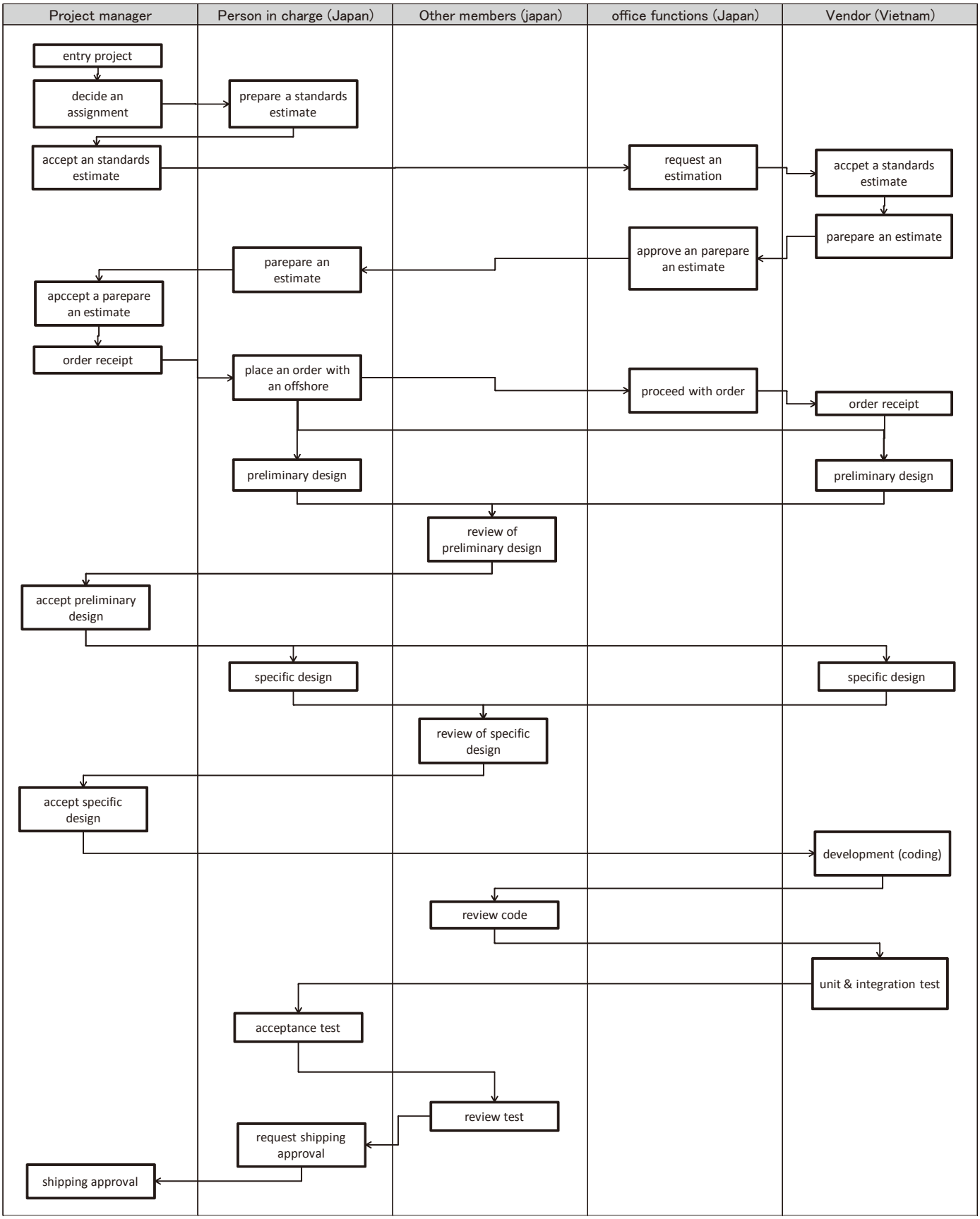


Fig. A.6. Prototype of the flow of processes (large ver. of Fig. 4.10 (a)).

Registry of order | Estimation preparation | Estimation requests for outsourser

Order number	Client	Order name	Condition of man-hour	Actual results	Person in charge	Documents	Detail of order
12345-0001	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 1300	130%		有	dislay
12345-0002	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 100	10%		有	dislay
12345-0003	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 700	70%		有	dislay
12345-0004	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 500	50%		有	dislay
12345-0005	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 400	40%		有	dislay
12345-0006	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 200	20%		有	dislay
12345-0007	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 0	0%		有	dislay
12345-0008	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 2100	210%		有	dislay
12345-0009	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 350	35%		有	dislay
12345-0010	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 150	15%		有	dislay
12345-0011	Toshiba.co.ltd	Toshiba emdebedded system	estimate : 1000 Actualy : 120	12%		有	dislay

Fig. A.7.Prototype of the system of management of orders (large ver. of Fig. 4.10 (b)).

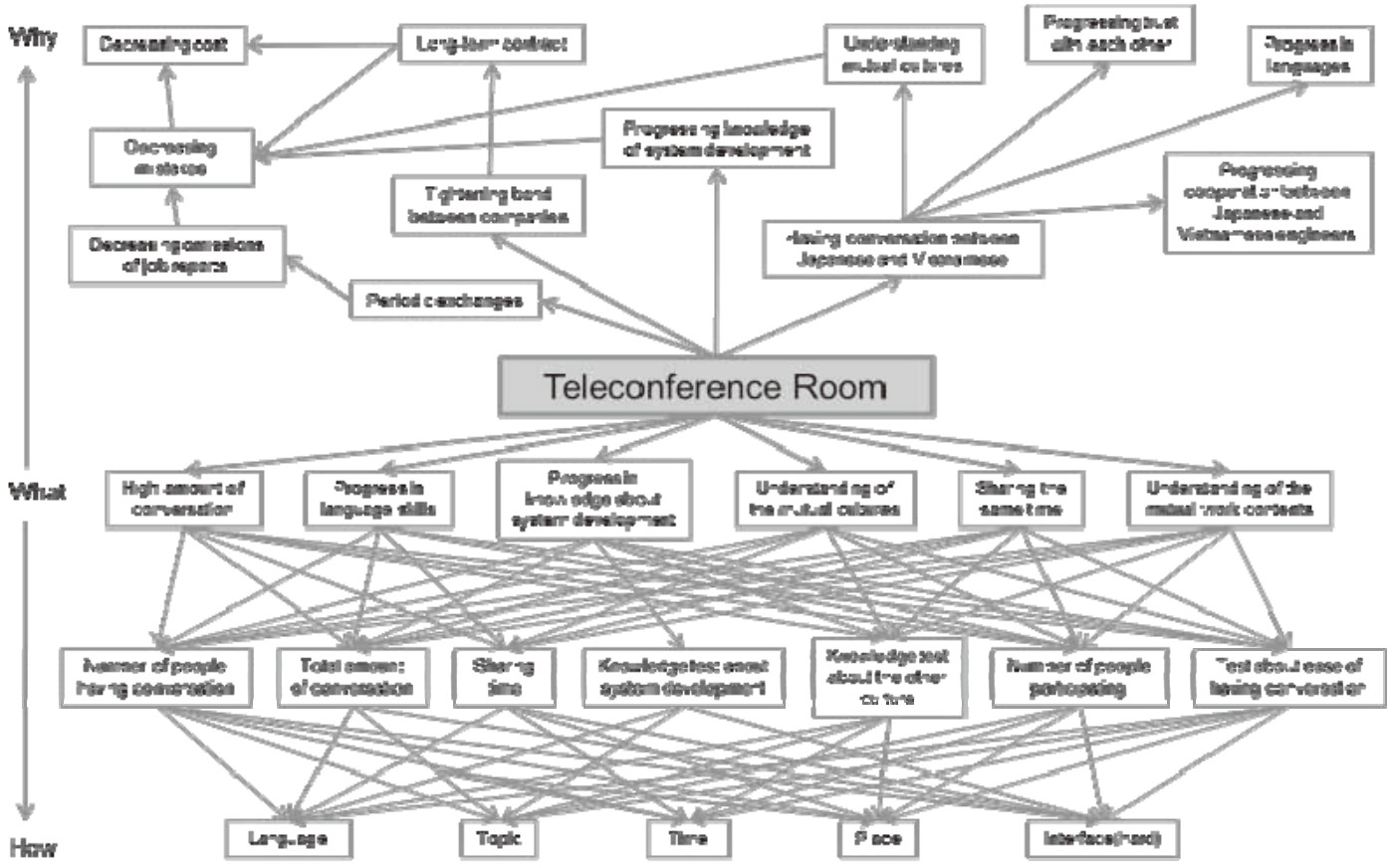


Fig. A.8. Value Graph of the Teleconference room (large ver. of Fig. 4.11).

PHASE I QFD {teleconference room}

Correlation Codes	
+	Positive
-	Negative

total amount of conversation (times)								
number of people having conversation	+							
number of people participating	+	+						
shared time (minutes)	+	+						
knowledge test about system development	+	+		+				
knowledge test about the other culture	+	+		+				
test about ease of having conversation	+	+			+	+		
Preferred	up	up	up	up	up	up	up	

		Engineering Metrics							Customer Perception					
Customer Requirements	**Customer Weights**	total amount of conversation (times)	number of people having conversation	number of people participating	shared time (minutes)	knowledge test about system development	knowledge test about the other culture	test about ease of having conversation	*1 Worse*	*2*	*3*	*4*	*5 Better*
high amount of conversation	9	9	9	3	3		1	3	c				Ab
progress in language skils	3	9	9	3	3			3		c			Ab
progress in knowledge about system development	3	1	1	1		9	1	1			bc	A	
understanding of the mutual cultures	9	3	3	3	3		9	3		bc		A	
sharing the same time	3	3	3	3	9		1	3	c				Ab
understanding of the mutual task contents	3	3	9	9	3		3	3		b		Ac	
Technical Benchmarking *Better 5*		Ab			Ab				Existing System or Competition					
4							A							
3			A	Ac				A	A: Skype					
2			b	b		Ac	bc	b	b: phone					
Worse 1		c	c		c	b		c	c: mail					
Raw score		156	174	102	99	27	105	84						
Relative Weight		21%	23%	14%	13%	4%	14%	11%						

Fig. A.9. QFD I (large ver. of Fig. 4.12).

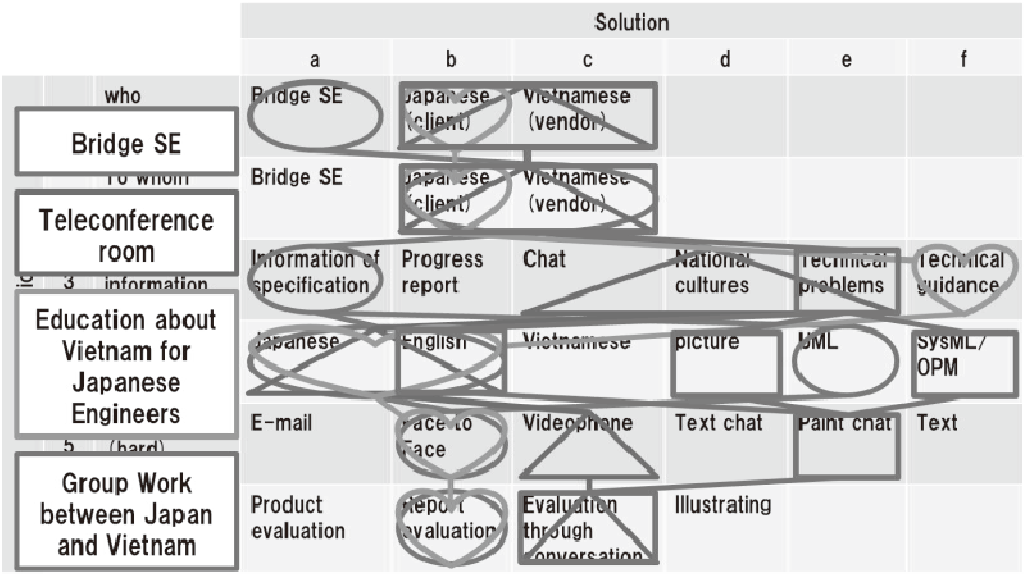
PHASE II QFD ***{teleconference room}***

		Solution Elements or Enabling Functions						
Engineering Metrics	**Phase I Relative Weights**	language for use	topic of conversation	limitation time	place	interface for use (hardware)		
total amount of conversation (times)	21%	3	9	3	3	3		
number of people having conversation	23%	3	3	3	3	3		
number of people participating	14%		3	9	9	1		
shared time (minutes)	13%	1		3	1	1		
knowledge test about system development	4%	3	9			3		
knowledge test about the other culture	14%	3	9	1	3			
test about ease of having conversation	11%	3	3	1	3	9		
Raw score		2.3	4.9	3.2	3.4	2.7	0.0	0.0
Relative Weight		14%	30%	19%	21%	16%	0%	0%

Fig. A.10. QFD II (large ver. of Fig. 4.13).

			Solution					
			a	b	c	d	e	f
Sub-Function	1	who	Bridge SE	Japanese (client)	Vietnamese (vendor)			
	2	To whom	Bridge SE	Japanese (client)	Vietnamese (vendor)			
	3	Kind of information	Information of specification	Progress report	Chat	National cultures	Technical problems	Technical guidance
	4	Interface (soft)	Japanese	English	Vietnamese	picture	UML	SysML/ OPM
	5	Interface (hard)	E-mail	Face to Face	Videophone	Text chat	Paint chat	Text
	6	Confirmation of transmission	Product evaluation	Report evaluation	Evaluation through conversation	Illustrating		

(a). Chart of solution-subfunction.



(b). Four scenarios in Morphological Analysis.

Fig. 4.14. Result of Morphological Analysis (large ver. of Fig. 4.14).

Concept				
Criteria	Bridge SE	Teleconference Room	Education about Vietnam for Japanese Engineers	Group Work between Japan and Vietnam
Low cost for introduction	DATUM	+	−	+
Low cost for maintenance		+	−	+
High motivation of participants		+	−	S
Much amount of conversation between Japanese and Vietnamese		+	S	+
Much amount of getting knowledge for the other culture		+	+	+
Short term for introduction		+	S	+
Small knowledge and skills for participants		+	+	+
High relevance to work		S	S	−
Σ of +		7	2	6
Σ of −		0	3	1
Σ of S		1	3	1
Overall		7	−1	5

Fig. 4.15. Pugh Selection Matrix's result (large ver. of Fig. 4.15).

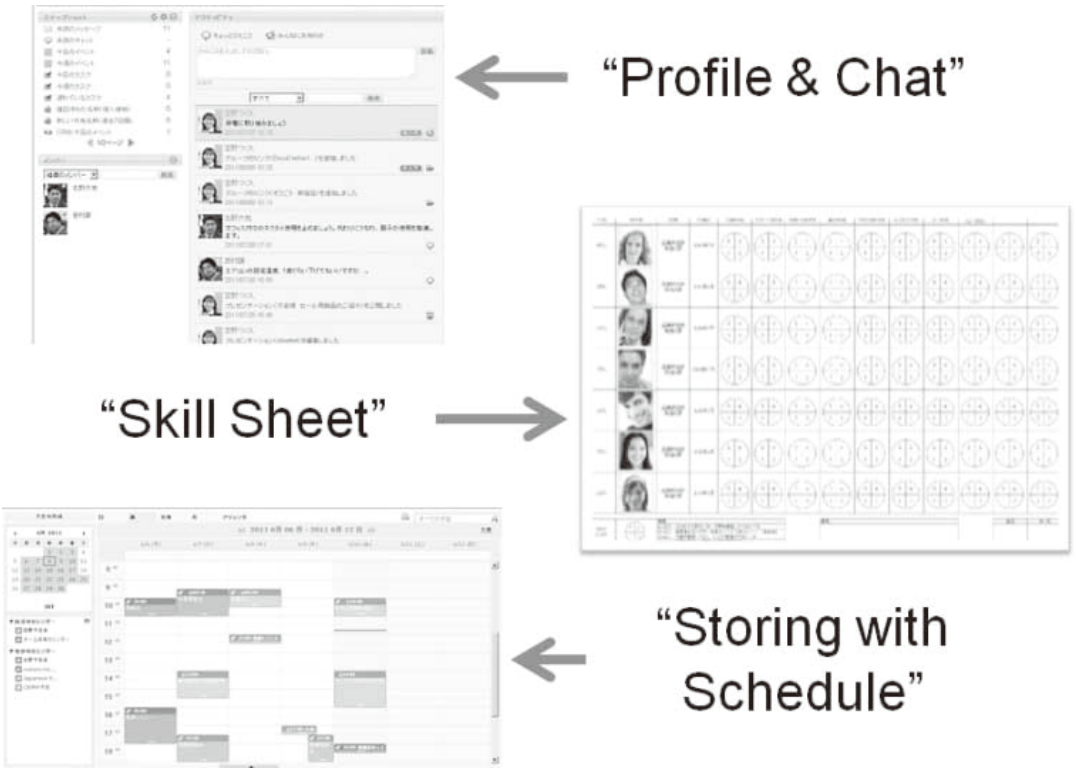


Fig. 5.3. Prototype of Internal SNS (large ver. of Fig. 5.3).

Group L's Final Presentation Slides

Symbiosis strategy of Embedded Systems Development

Between Japan and Vietnam

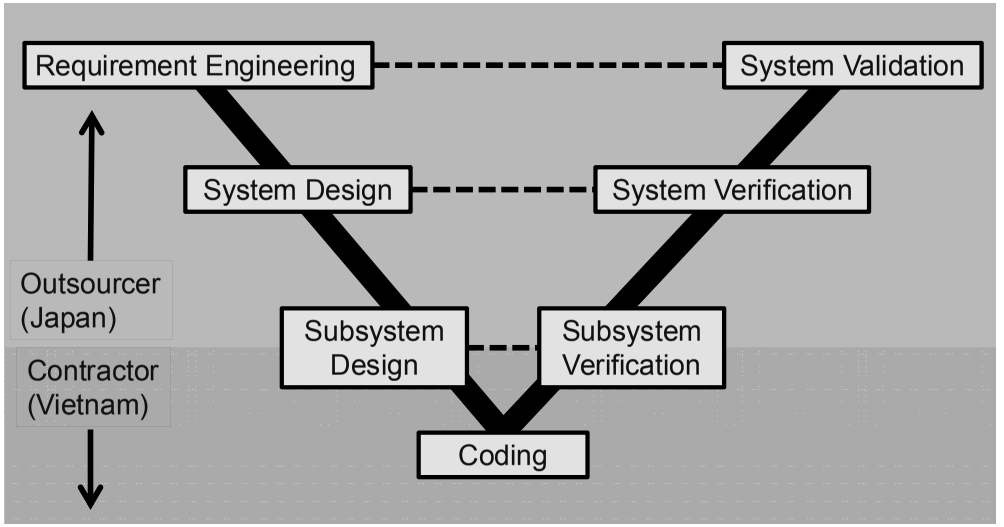
Beyond **Offshore Business**

TOSHIBA
Leading Innovation

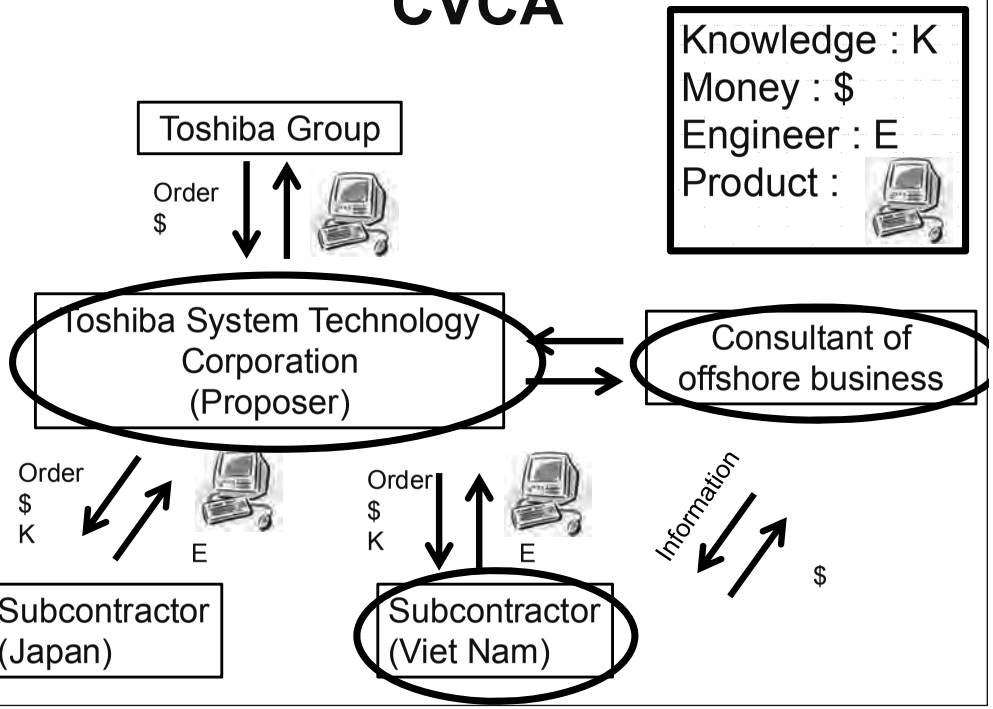
SDM
System Design and Management

ALPS Group L

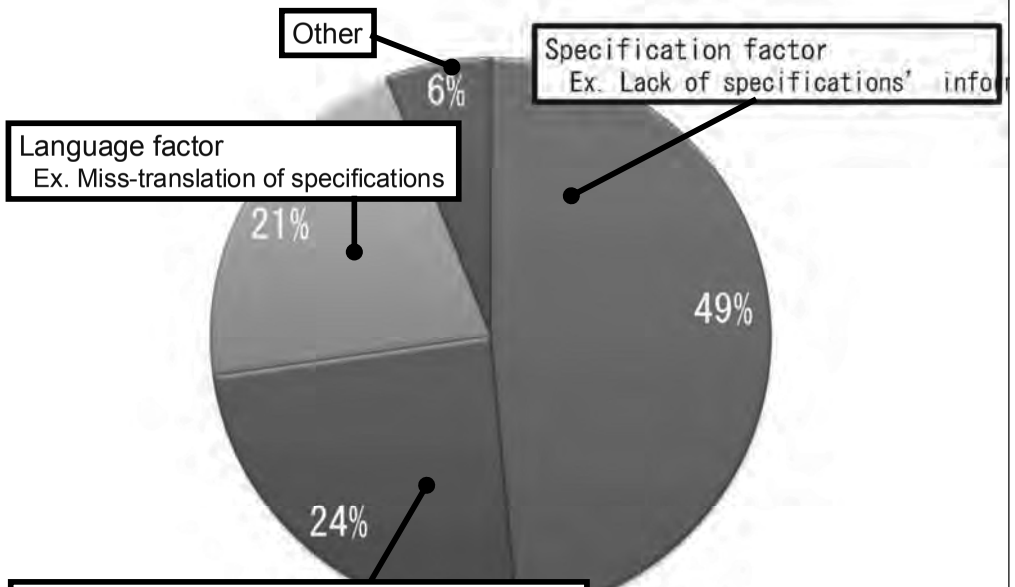
Vee Model
～Development of embedded systems～



CVCA



Defect factors of offshore development



Reference :
Defect rate at actual project

セロリ “Celery” by Masayoshi Yamazaki

Japanese lyrics

育ってきた環境が違うから　好き嫌いはイナメナイ
夏がダメだったり　セロリが好きだったりするのね
ましてや男と女だからすれ違いはしょうがない
妥協してみたり多くを求めたり　なっちゃうね

English lyrics

The environments where we grew up were different,
so of course we would have our likes and dislikes.

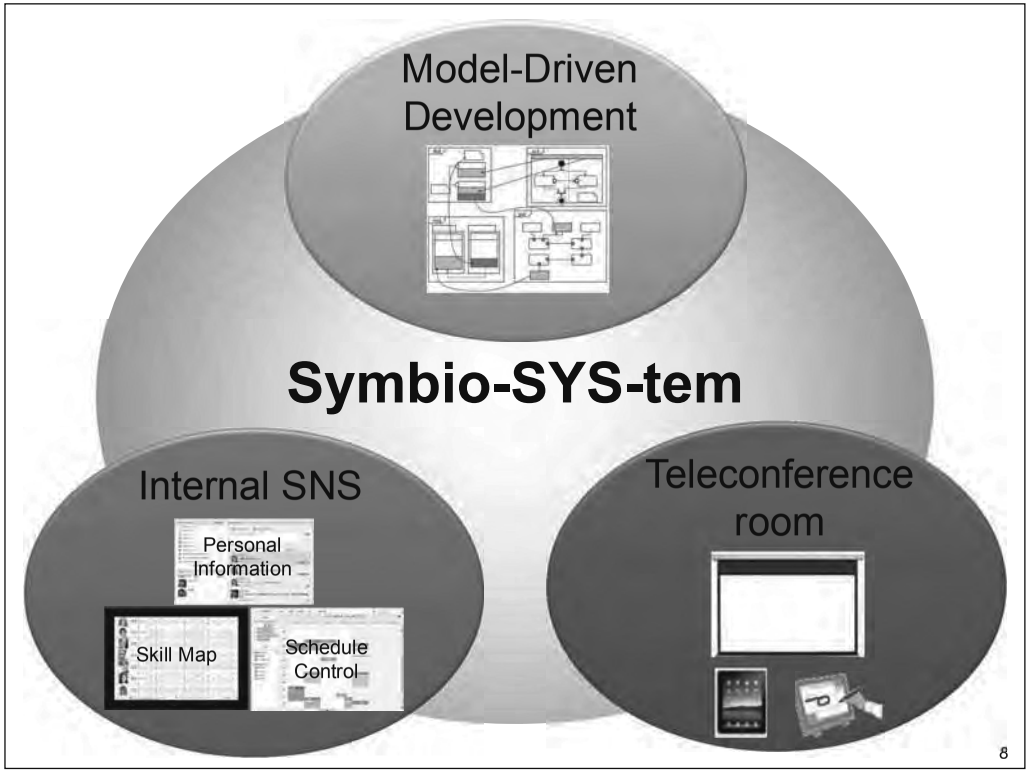
Like hating the summer or liking celery, isn't it like that.

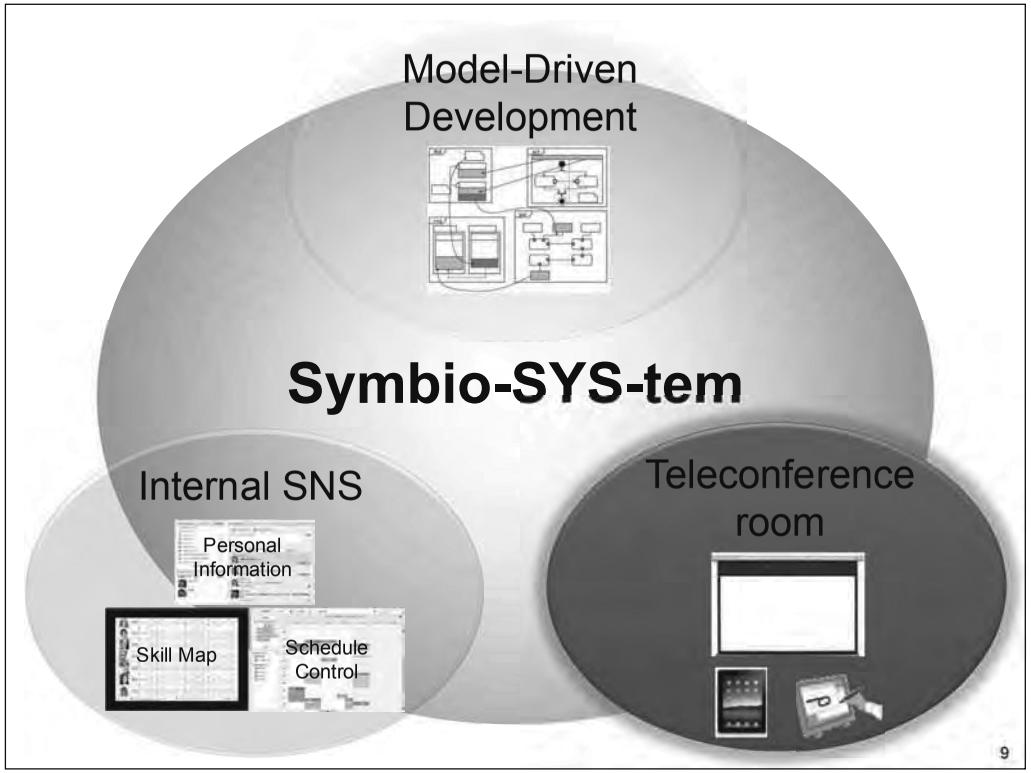
What's more we're a man and a woman,
of course our differences would be inevitable.

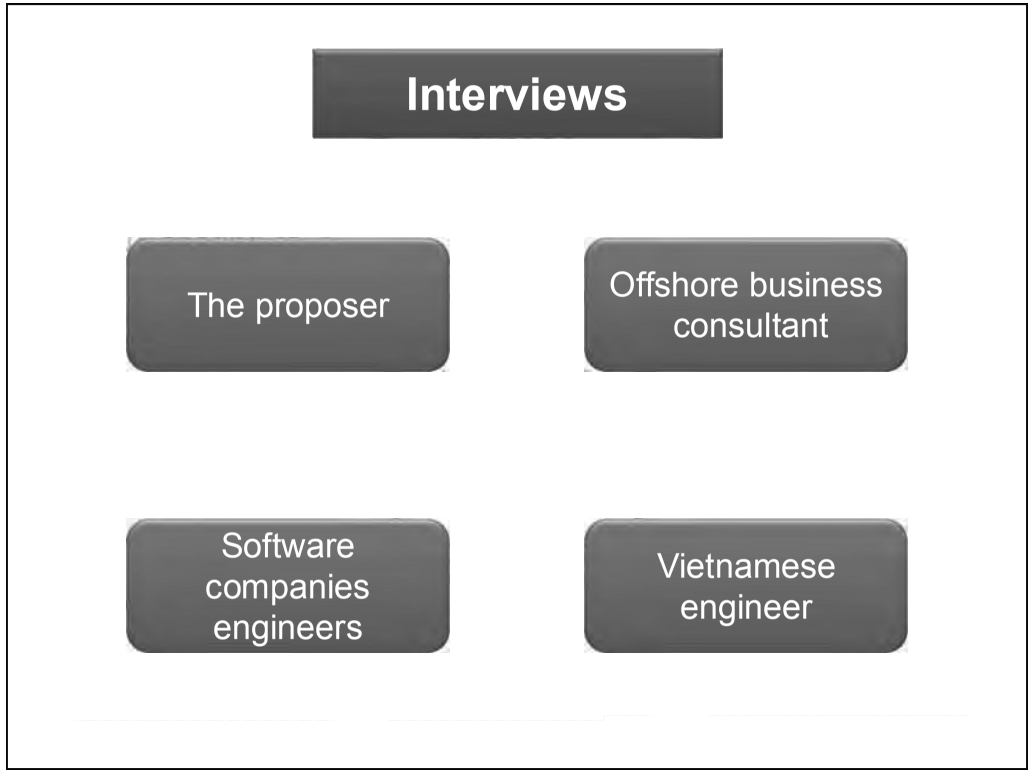
It leads to trying to compromise and wishing for too much.

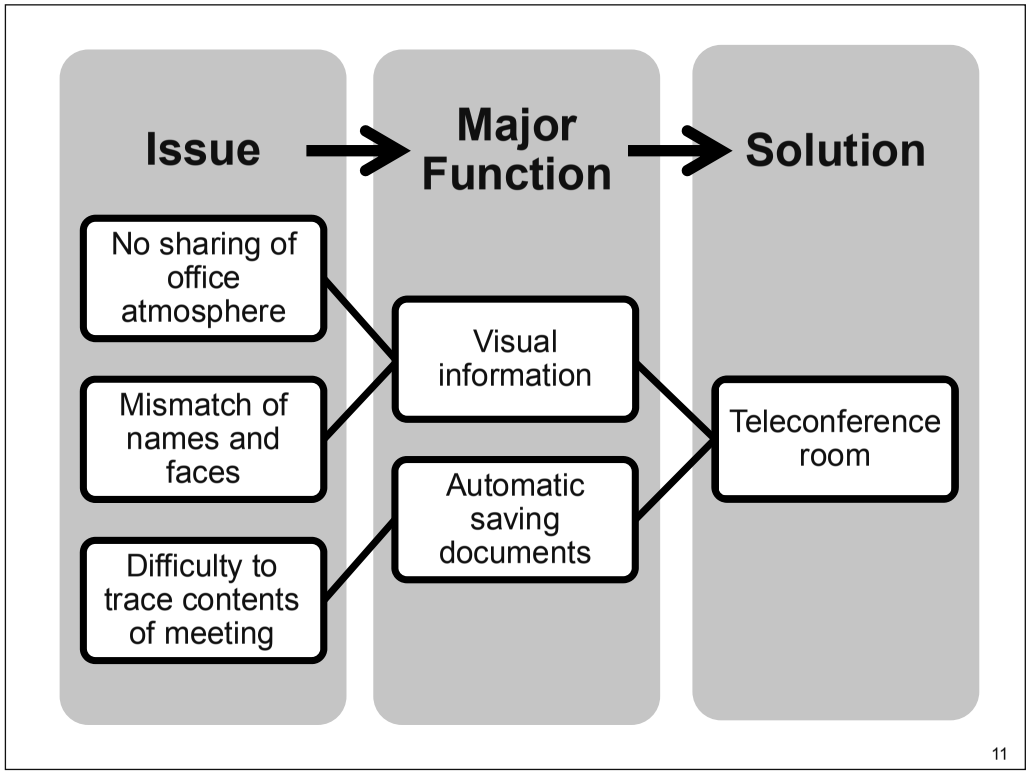
出典：http://ameblo.jp/aika070922/entry-10416388024.html

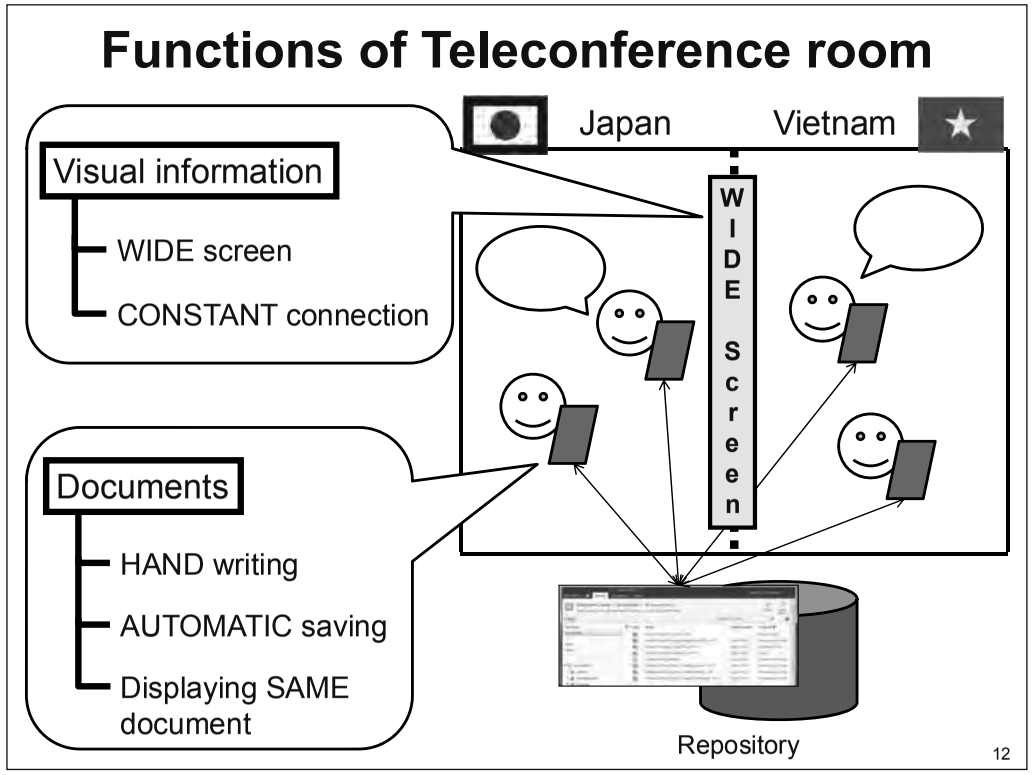
What is Symbio-SYS-tem?

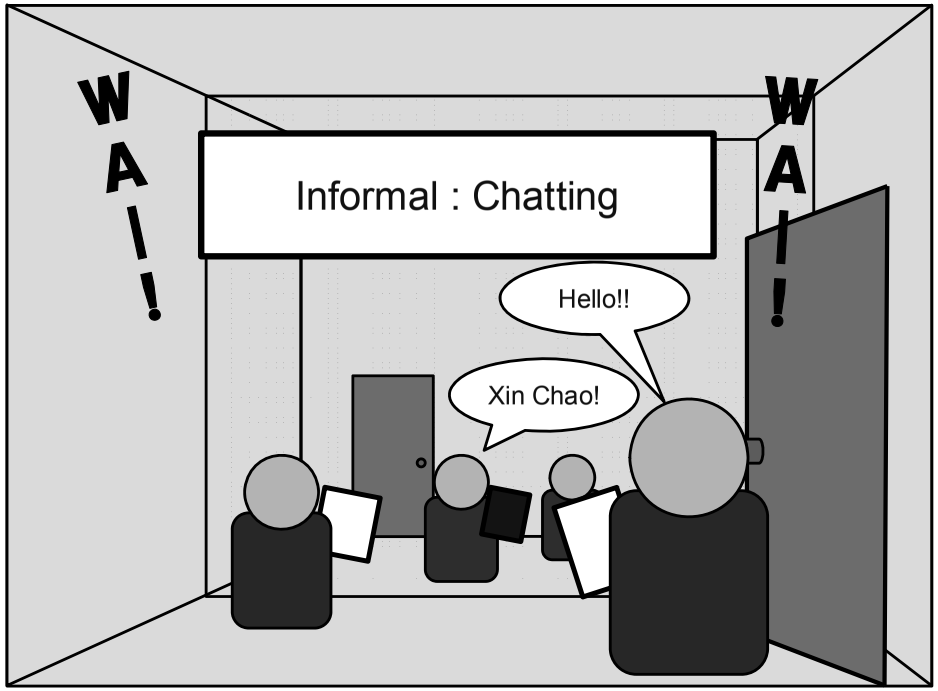



Model-Driven Development
Symbio-SYS-tem
Internal SNS
Personal Information
Skill Map
Schedule Control
Teleconference room
9

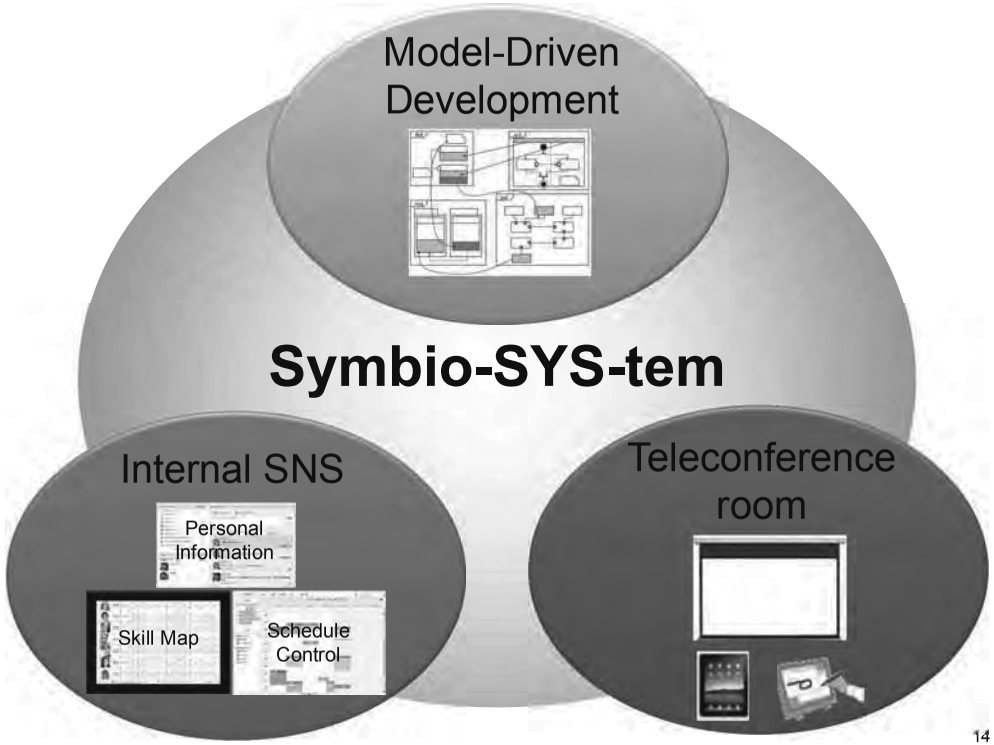

Interviews
The proposer
Offshore business consultant
Software companies engineers
Vietnamese engineer


Issue
Major Function
Solution
No sharing of office atmosphere
Mismatch of names and faces
Difficulty to trace contents of meeting
Visual information
Automatic saving documents
Teleconference room
11

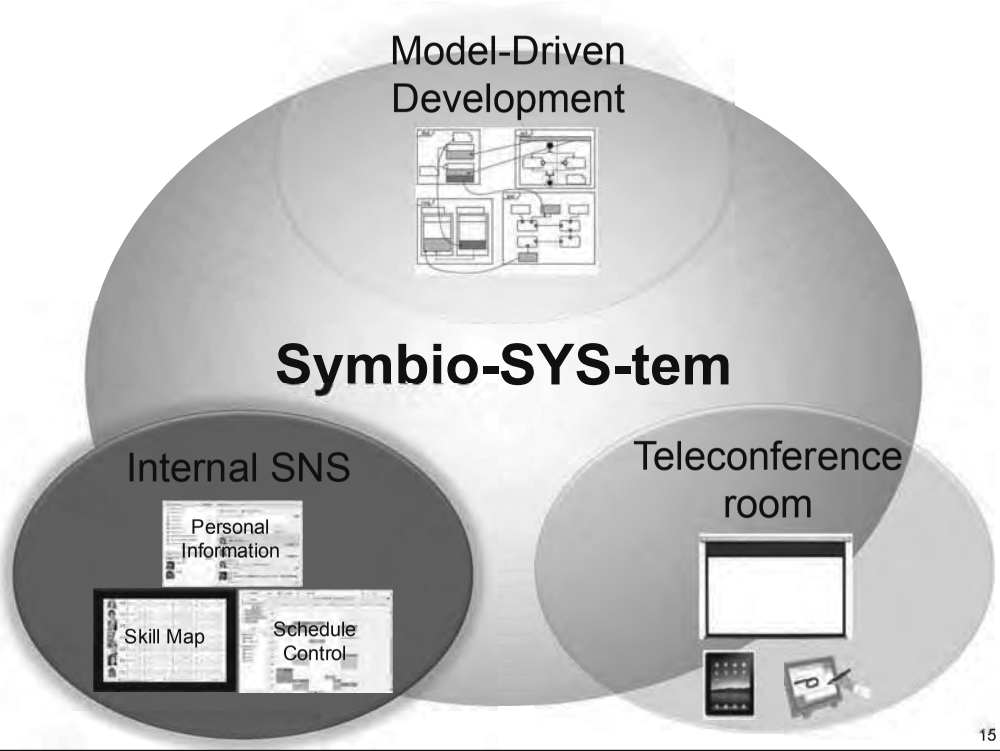

Functions of Teleconference room
Japan
Vietnam
Visual information
WIDE screen
CONSTANT connection
WIDE Screen
Documents
HAND writing
AUTOMATIC saving
Displaying SAME document
Repository
12


W
A
!
Informal : Chatting
W
A
!
Hello!!
Xin Chao!

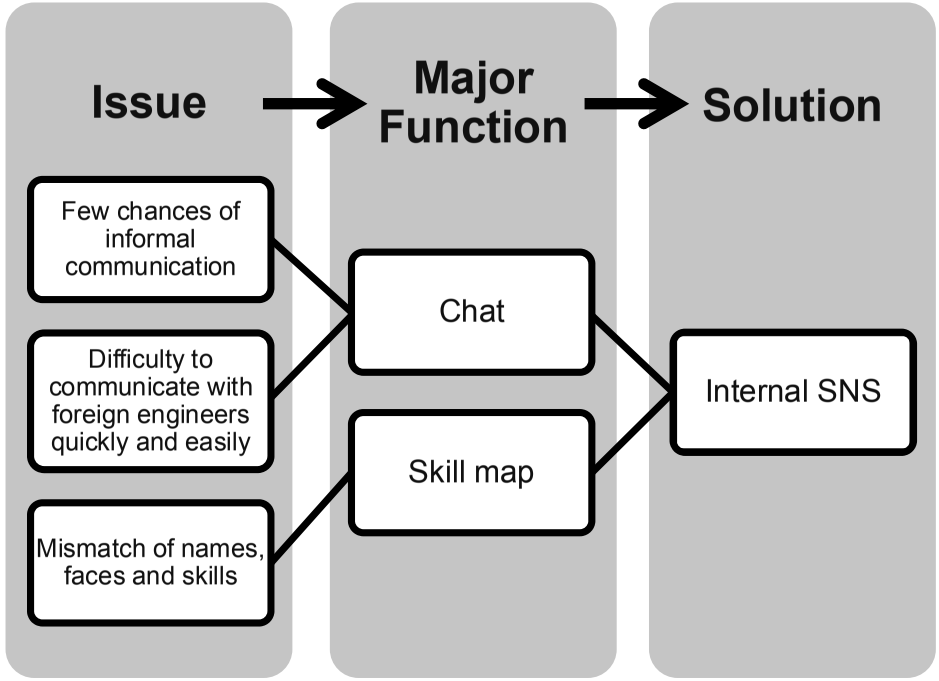
13


Model-Driven
Development
Symbio-SYS-tem
Internal SNS
Personal
Information
Skill Map
Schedule
Control
Teleconference
room

14


Model-Driven
Development
Symbio-SYS-tem
Internal SNS
Personal
Information
Skill Map
Schedule
Control
Teleconference
room

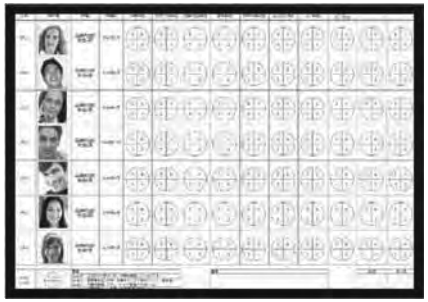
15


Issue
Major
Function
Solution
Few chances of
informal
communication
Difficulty to
communicate with
foreign engineers
quickly and easily
Mismatch of names,
faces and skills
Chat
Skill map
Internal SNS

16

Function of Internal SNS

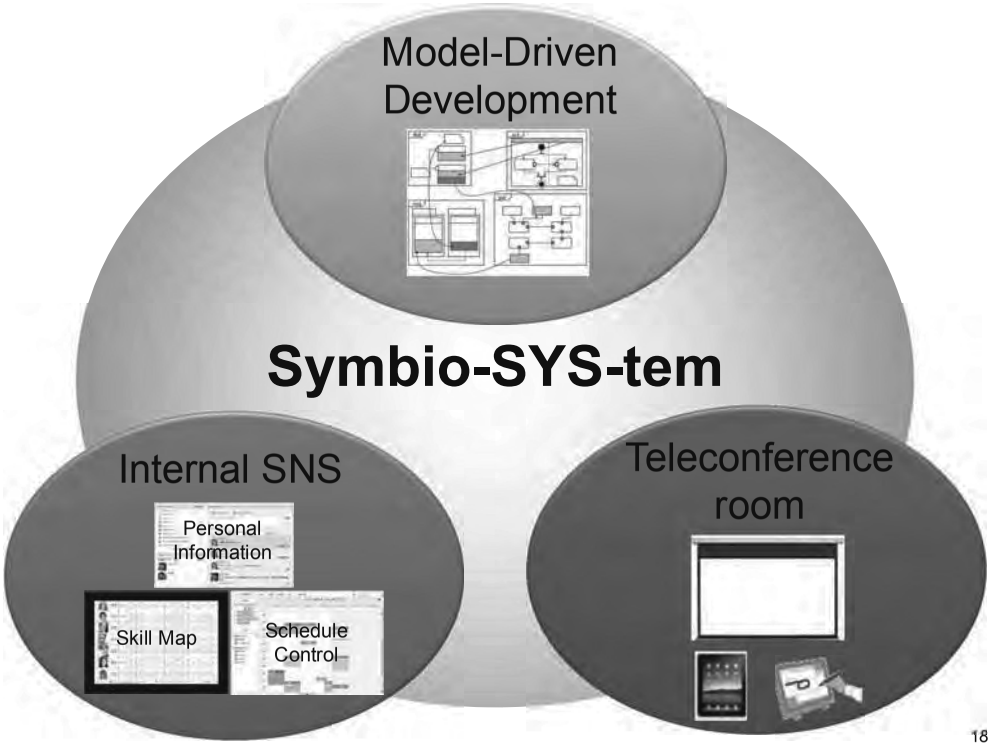
・Headshot
・Chat



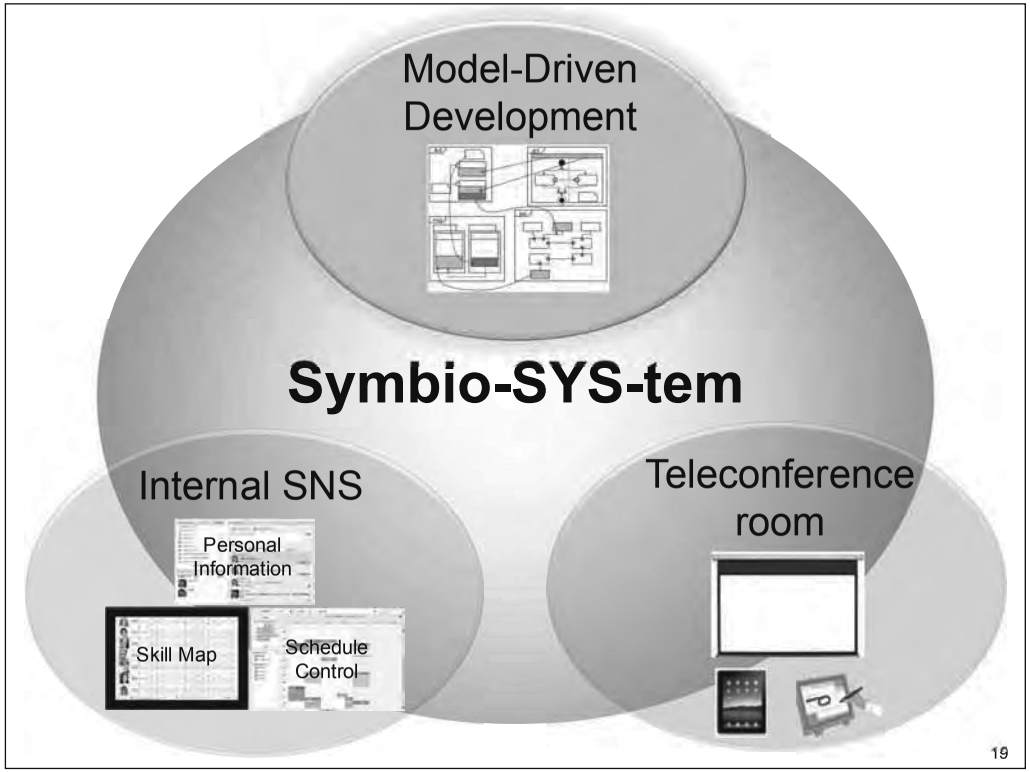
• Project member's skill map
• Visualizing the connection among engineers

• Sharing of schedule and progress
• Repository of documents

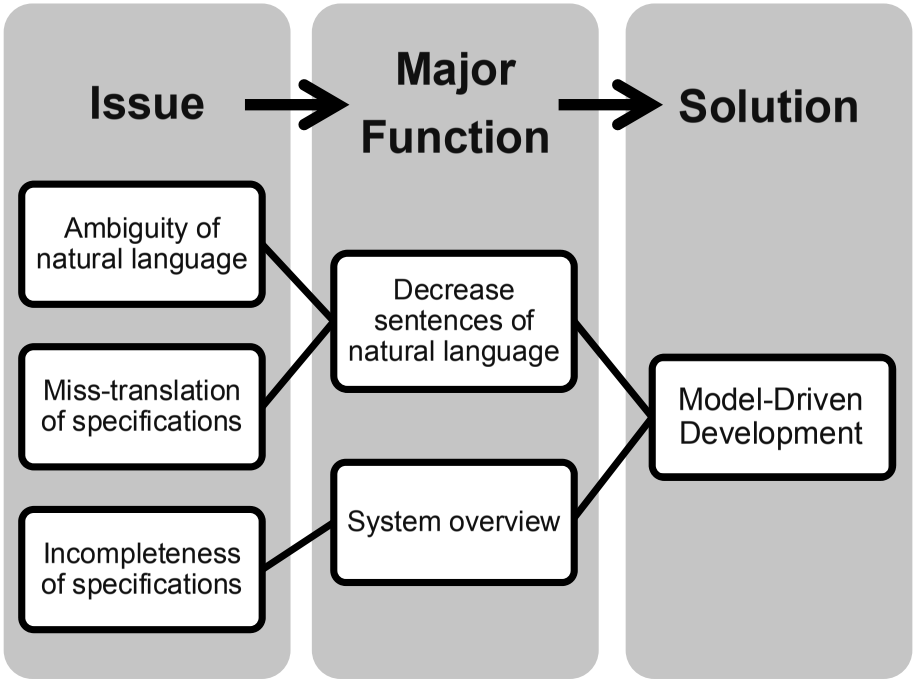
17



18



19



20

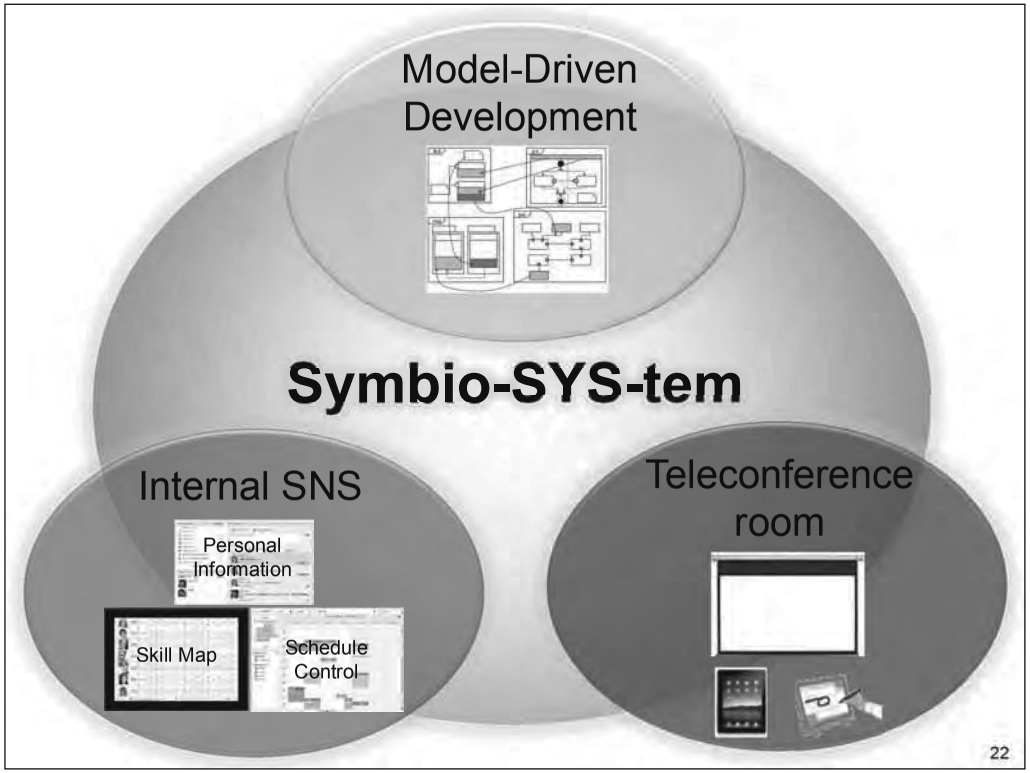
Function of Model-Driven Development

An approach to software development
where extensive models are created before source code is written.

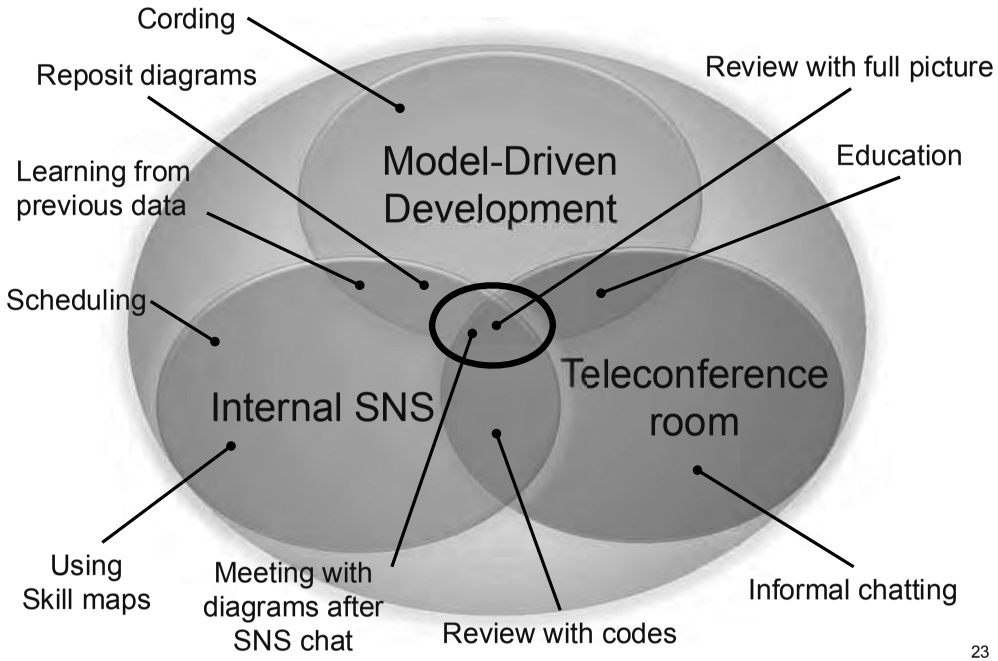
(Scott W. Ambler, "Agile Model Driven Development," http://www.agilemodeling.com/essays/amdd.htm)

- Creation of models of product structure along the process

- Usage of models to understand structure under development
- Reuse of models in many processes (Ex. education for newcomer)



Usage example of Symbio-SYS-tem



Video

Summary

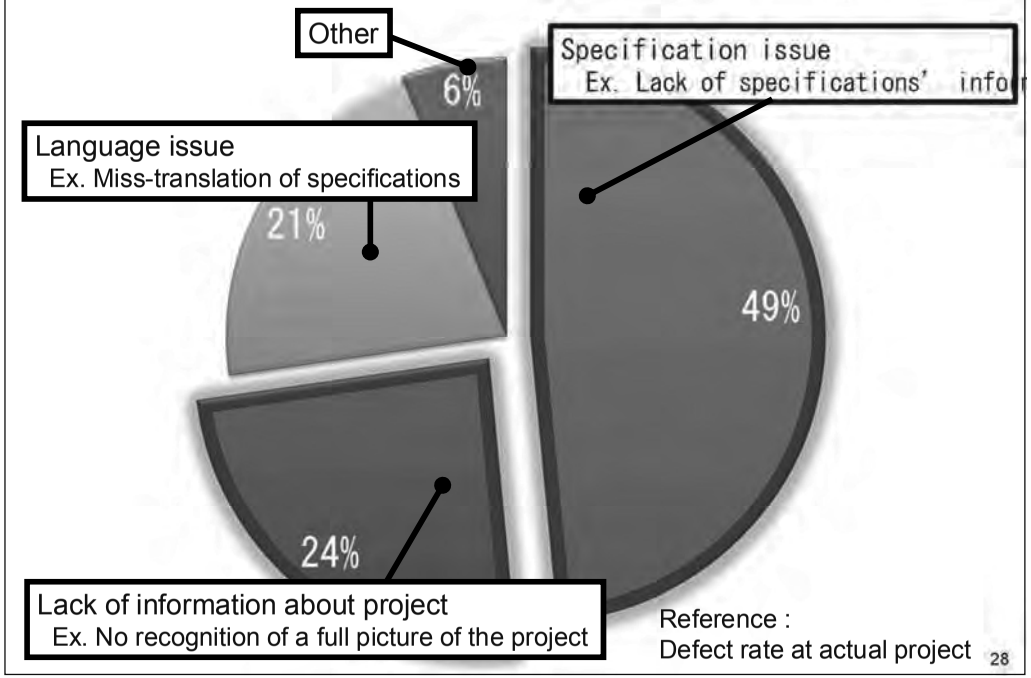
- Symbiosis & Synergy!!!

Future issues

1. TIME
   - Acquirement of skill of model-driven development needs much time
   - Building the teleconference room need much time
2. Cost-effectiveness
   - Difficulty of measurement of communication's effect and cost value
   - Dependence of person's ability to learn to use the system

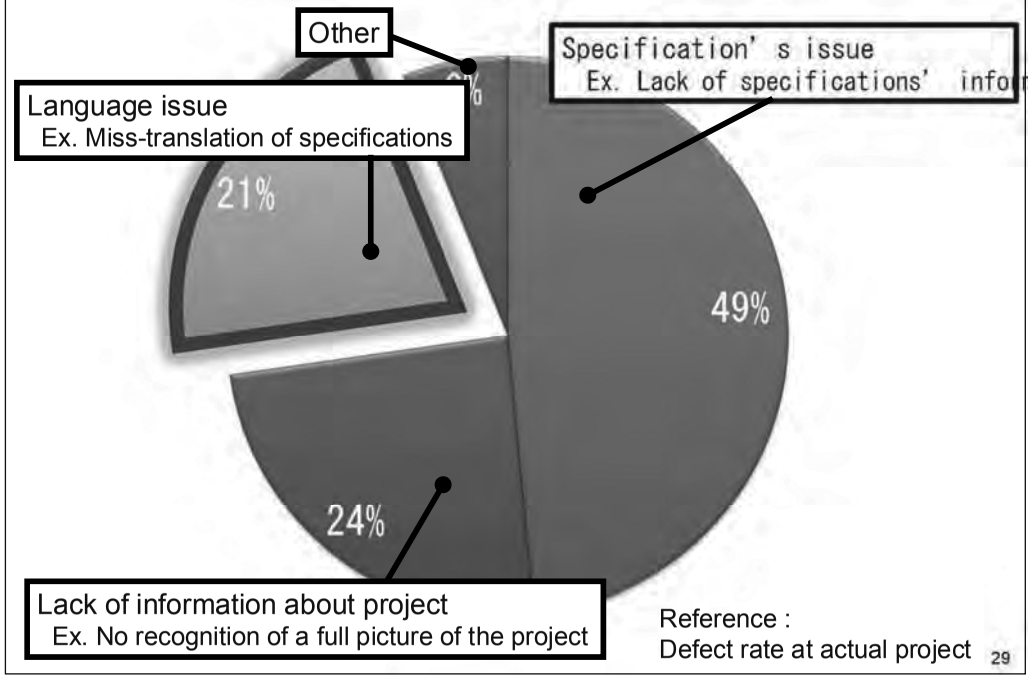
Appendix

Defect rate of offshore development



Reference :
Defect rate at actual project

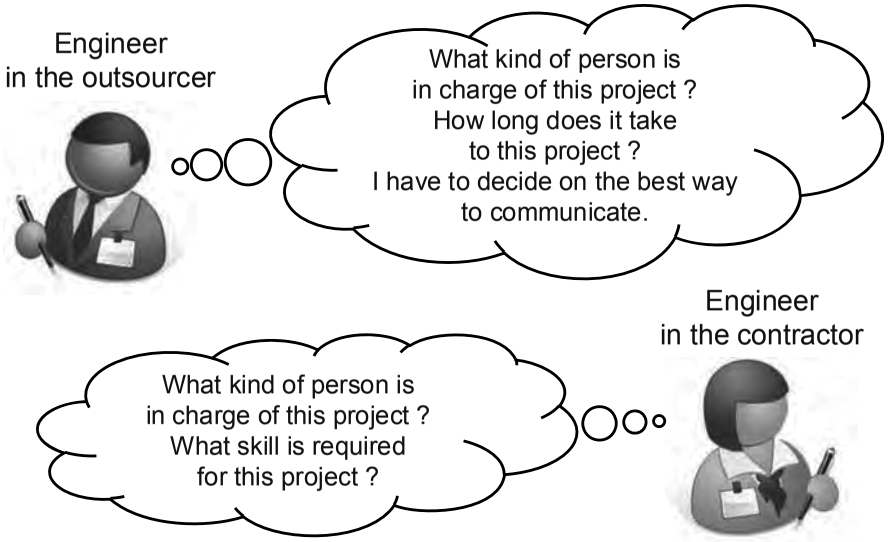
Defect rate of offshore development



Reference :
Defect rate at actual project

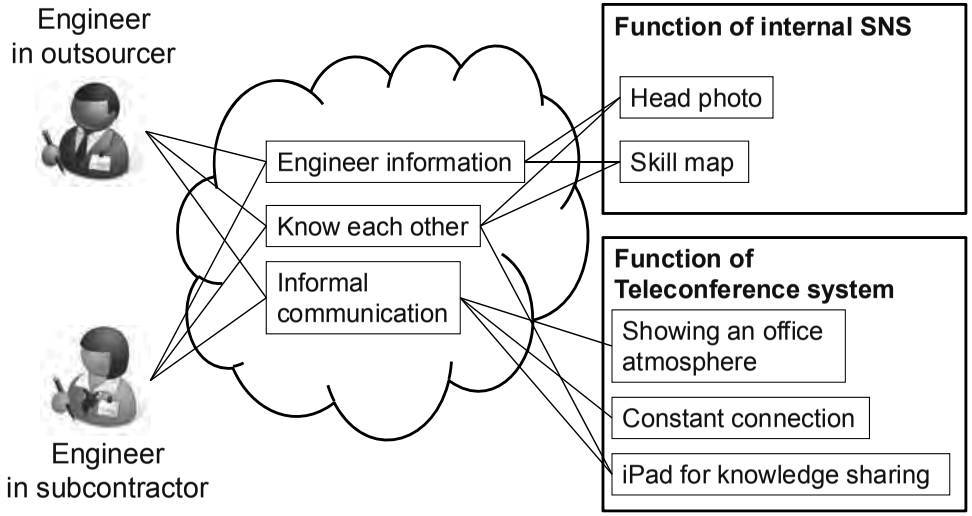
29

Use case
Ex. at team-building phase



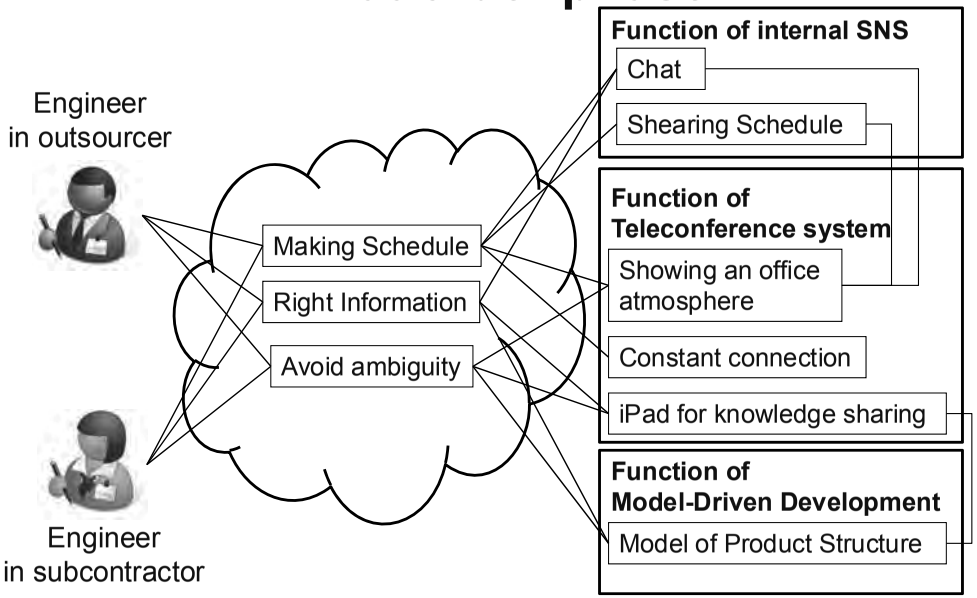
30

Use case
Ex. at team-building phase



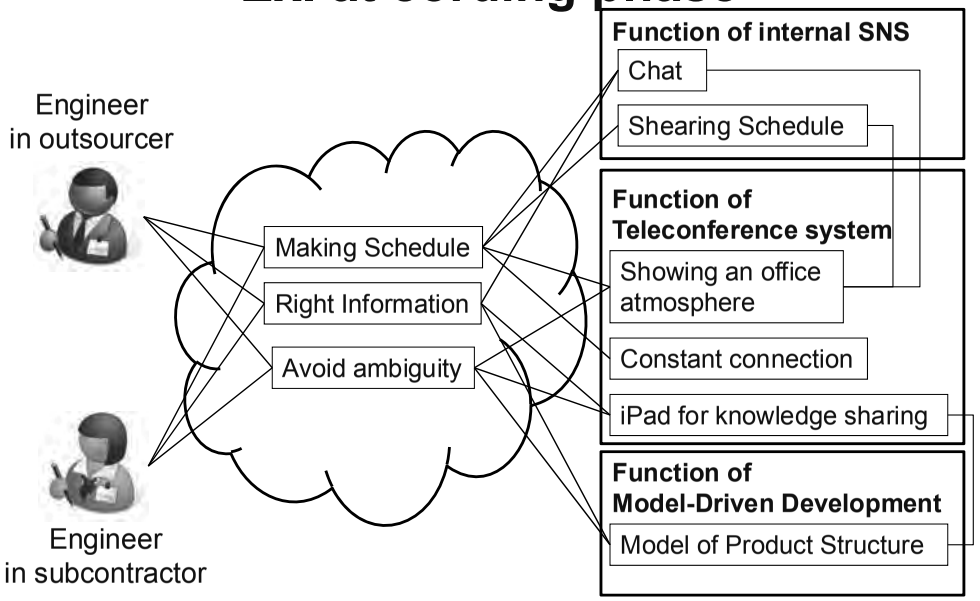
31

Use case
Ex. at order phase



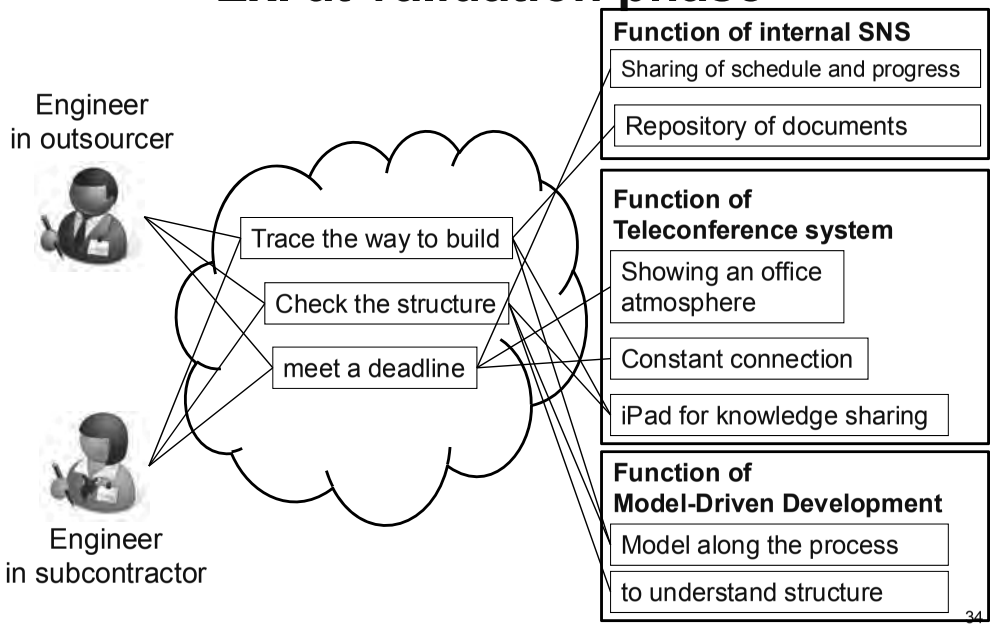
32

Use case
Ex. at cording phase



33

Use case
Ex. at validation phase



34

Internal SNS

- It's easy to introduce .
- It's easy to use because of the popularity.
- It's difficult to use in business situation .

Teleconference Room

- it has too much cost and time to manage the facilities.
- it exactly meets proposer's requirements.
- it has close affinity with Internal SNS and MDD.

Model-Driven Development

- it needs much time for education
- it needs to change the current method to the new method
- it needs to share the understanding.

Time

35

Business model