Intercultural Collaboration and Support Systems: A Brief History

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Abstract. At the beginning of the new millennium, we proposed the concept of *intercultural collaboration* where participants with different cultures and languages work together towards shared goals. Because intercultural collaboration is a new area with scarce data, it was necessary to execute parallel experiments in both in real fields as well as in research laboratories. In 2002, we conducted a one-year experiment with Japanese, Chinese, Korean and Malaysian colleagues and students to develop open-source software oriented towards machine translation. From this experiment, we understood the necessity of a language infrastructure on the Internet that could create customized multilingual environments for various situations. In 2006, we launched *the Language Grid* project to realize a federated operation of servers for language services. Using the Language Grid, we worked with a nongovernmental organization since 2011 to support knowledge communications between agricultural experts in Japan and farmers in Vietnam via their children. We observed that a large community emerged to utilize these nonmature machine translation technologies. During these experiences, by facing different types of difficulties, we gradually came to understand the nature of intercultural collaboration. Problems are *wicked* and not easily defined because of their nested and open networked origin. Fortunately, multiagent technologies can be applied to model and simulate intercultural collaboration so as to predict the difficulties and to prepare a better support systems. In this paper, we provide a brief history of the research and practice as regards intercultural collaboration and support systems.

1 Intercultural Collaboration

Immediately after September 11 in 2001, we started research on *intercultural collaboration*.[1] We were strongly motivated to utilize technologies to enhance communications among people in different cultures. While the Internet allows people to be linked together regardless of location, language remains the biggest barrier: only 25.9 % of the Internet population speaks English. The remainder is divided between other European and Asian

[1] There was no such concept at that time. We created the word "intercultural collaboration" by adding *goals* to *intercultural communication*, so that researchers in computer science can participate to advance methodologies and technologies to support multi-language and multicultural communities.

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languages.[2] However, it is not possible for anyone to learn the languages needed to access all possible information on the Internet. In particular, Asian people are not taught neighboring languages. Only a small portion of the Japanese population understand Chinese or Korean and vice versa. People learn English to collaborate, but often cannot think in English: serious barriers to intercultural collaboration exist, because the collaboration often requires the elaboration of new ideas. Therefore, communication in real intercultural situations is rather complex. For example, conversations between Chinese and Japanese are often done in English with the aid of written Chinese characters. As there is no simple way to solve this problem directly, it is necessary to combine different approaches. Learning English as a second language is one way, but learning other languages and respecting different cultures are also important. Since one cannot master all languages, the use of machine translation and other existing technologies on the Internet is a viable solution.

Intercultural collaboration is a goal-directed group activity. The research target emphasizes collaboration rather than communication. Therefore, we can clearly identify research objectives. Goal-directed group activities can be evaluated both qualitatively and quantitatively, and thus attract researchers with both socio-cultural and technological backgrounds. Culture and its effects on human cognition and behaviors have been intensively studied in sociology [7], psychology [17, 22] and linguistics [2]. Some of their research findings are confirmed in collaboration environments by laboratory experiments [24, 32]. Various technologies to bridge cultural and language gaps have been tried out and their effectiveness and limitations have been analyzed, e.g., pictogram communication to avoid language communications [1, 26], and machine translation to cope with language barriers [34, 35]. We can combine findings and ideas including social psychological analyses, collaboration support technologies, and case studies by field workers.

The research area of intercultural collaboration will become essential in a world in which physical borders disappear rapidly and people and cultures are more and more on the move and in contact. To understand how humans manage language and cultural issues, researchers should join and observe intercultural activities. However, sites related to intercultural activities are often far from research laboratories (both geographically and mentally). Workshops and conferences have been started for mutual learning between researchers and field workers [3, 10].

2 ICE2002: Getting Started with Machine Translation

We conducted *Intercultural Collaboration Experiment* in 2002 (ICE2002) among Asian universities.[3] Since the experiment pursued collaboration among heterogeneous groups across country borders, participants never saw each other and communicated only in

[2] Internet World Users by Language - Top 10 Languages, Internet World Stats, Miniwatts Marketing Group, 30 June 2015, retrieved from http://www.internetworldstats.com/stats7.htm.

[3] In this project, 32 students from Kyoto University (Japan), Shanghai Jiaotong University (China), Seoul National University and Handong University (South Korea), and University of Malaya (Malaysia) jointly developed software over the Internet.

their mother languages supported by machine translation. Given the dramatic Internet penetration in Asian countries, an intercultural collaboration support system that overcomes the language differences had to be developed. Differing from face-to-face communications, machine translation services can be easily applied to computer mediated communications. This approach drastically increases the potential for intercultural collaboration by lowering the language barrier.

Although natural language processing researchers had rigorously studied machine translation for years, translation quality was not adequate for wide application to actual worksites. The preceding studies evaluated the machine translation of written documents, and do not take into account the interaction factor for refining translation quality. We, on the other hand, applied machine translation to human-to-human collaboration, and tried to analyze the interactive translation refinement procedures implemented among humans and machines.

Figure 1 shows the participants of ICE2002. In this trial, multilingual discussions were established among the participants. These tools incorporate translation services for Chinese, Japanese, Korean, Malay, and English; a multilingual bulletin board system was utilized as a daily discussion space, and a multilingual Web browser enabled participants to share documents in their own languages. To explore the possibilities and limitations of machine translation technologies, communications during the experiment were restricted to just those tools.

Fig. 1. ICE2002 participants

The experiment had two tracks. The first track was conducted from May to July, and the second one from October to December. To synchronize software developments in different countries, each track was divided into two 4-week-phases. In *Software Design Phase*, collaboration software was designed. The goal of this phase was to submit a system design proposal to implement software. In *Software Implementation Phase*, software based on the design proposal was to be implemented. The goal of this phase was to complete and release a collaboration tool.

In ICE2002, collaboration software consisting of Web-based email, SMS, search engine, was proposed the outcome of the multinational teams. We observed how participants achieved the goal with communications in a noisy media. To analyze translation-mediated collaboration on multilingual tools, conversation and content analyses were conducted. We soon realized that users were adapting to the machine translators. Students tried to repair their input sentences so that the machine translators would produce better translations. Though the students exhibited significant flexibility in adapting to the machines, since the mental models of the machine translators were basically unavailable to the students, the students' behavior was sometimes humorous.[4] By investigating the interaction among users and machine translators, we confirmed two repair patterns as follows [23].

- *Self-initiated repair* or *user adaptation to machine translation*: People adapt themselves to machine translation capability to convey remarks properly to other team members. Before posting a message, the poster would repeated alter the input text to improve the translation results.
- *Other-initiated repair* or *collaborative translation*: Even if a translation was imperfect, people worked out the intentions of other members' remarks. The collaborative repair process is initiated by a message receiver's reaction.

During the experiment, we confirmed the above *repair patterns* in the process of eliminating translation errors. In particular, we explored other-initiated repair, and establish protocols for collaborative translation by monolinguals with machine translators [20]. We also realized that machine translation indeed supported intercultural collaborative works. We decided to further explore the approach to use machine translation in the context of collaboration. At the same time, we understood how difficult it is to create a comprehensive intercultural collaboration environment. The next section explains our attempts to develop a language infrastructure for intercultural collaboration.

3 The Language Grid: Building a Language Service Infrastructure

3.1 From Language Resources to Language Services

To increase the accessibility and usability of language resources (dictionaries, parallel texts, part-of-speech taggers, machine translators, etc.), we proposed the *Language Grid*,[5] which wraps existing language resources as atomic services and enables users to compose new services by combining the atomic services. We believe that *fragmentation*

[4] Japanese students input Japanese sentences with many personal pronouns such as "I" and "you" so that the machine translators would generate better results, though Japanese do not often use personal pronouns in their conversations.

[5] The concept was first presented in a keynote speech at SAINT 2006 [9], and later in a book published in 2011 [12].

and recombination[6] is the key to creating a full range of customized language environments for different types of user communities.

Our slogan is "from language resources to language services." To allow users to create their own language services that can be combined with other services, we take the service-oriented approach, where each language resource is wrapped as a language service. For example, data like multilingual dictionaries and parallel texts can be wrapped to form atomic language services that can translate words or sentences. However, those atomic services are not restricted to just a simple retrieval function: a parallel text service can return the translation of a sentence that is similar to the input sentence. Wrapping software like machine translators is straightforward, but even human interpreters can be wrapped as translation services. Users do not have to distinguish machines from human translation services other than by their quality of services: machine translators can provide faster services while human interpreters return higher quality translations.

The next step is to combine atomic language services to create new services. Figure 2 illustrates the process of combining a variety of atomic services for Japanese agricultural experts to translate their knowledge for Vietnamese farmers. To translate Japanese sentences into Vietnamese, we first need to cascade Japanese-English and English-Vietnamese translators, because there is no direct translator handling Japanese to Vietnamese. To replace words output by machine translators with the words in multilingual dictionaries specific to agriculture, part-of-speech taggers are necessary to divide the input sentences into parts. We can train *example-based machine translators* with

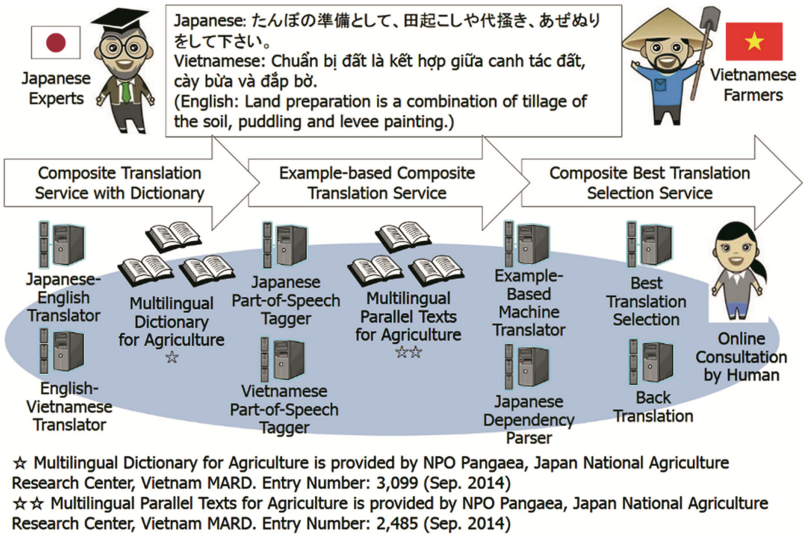

Fig. 2. Language service composition

[6] The concept *fragmentation and recombination* appeared in *e-topia* written by William J. Mitchell.

Japanese-Vietnamese parallel texts. We then have different types of translators and face the problem of determining which one is the best: example-based machine translators can create high quality translation only when they trained with similar sentences. We may use back-translation, say Japanese-Vietnamese-Japanese translation, to compare original and back-translated Japanese sentences, and select the translator that can produce back-translated sentences most similar to the original ones. In spite of all these efforts, if the quality of translation is still insufficient, the Japanese experts may use human translation services.

3.2 Service Grid Architecture

A variety of language resources already exist online. However, difficulties often arise when people try to use those language resources in their intercultural activities; the confusing web of complex contracts, intellectual property rights, and non-standard application interfaces make it difficult for users to create customized language services that support intercultural activities. Since many language resources have usage restrictions, it is difficult for users to negotiate with every language resource provider when combining several resources for their purpose. To improve the accessibility and usability of existing language resources, the Language Grid illustrated in Fig. 3 reduces the negotiation costs related to intellectual property rights.

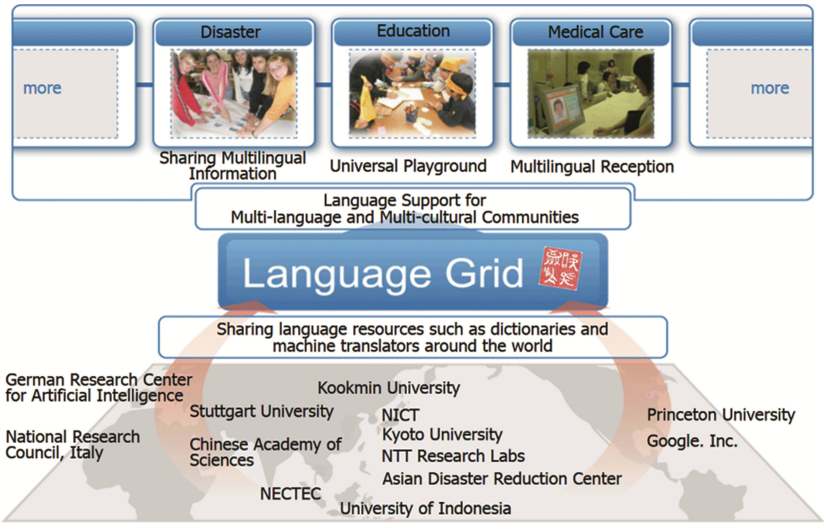

Fig. 3. The Language Grid

We need to allow users to easily create new language services by combining existing ones. The Language Grid[7] allows users to register services and share them. Let us define the infrastructure that supports the formation of service-oriented collective intelligence, the *service grid*.[8] Major stakeholders fall into three categories: *service providers*, *service users,* and *service grid operators*. Service providers provide language services such as machine translators, part-of-speech taggers, dependency parsers, dictionaries, and parallel texts. Service users invoke registered language services as needed for their intercultural activities. Service grid operators manage and control language resources and services. For institutional design, we considered the following issues of the stakeholders:

- How to protect the intellectual property rights of service providers and to motivate them to provide services to the service grid. To this end, service providers should be allowed to define for what purposes their services can be used and the usage rights.
- How to encourage a wide variety of activities of service users to increase their satisfaction. To this end, service users should be allowed to run application systems that employ the services permitted for such use.
- How to reduce the load on service grid operators while allowing them to globally extend their service grids. To this end, *federated operation* is to be facilitated, where several operators collaboratively operate their service grids by connecting them in a peer-to-peer fashion.

We organized this project based on collaboration between researchers in various universities and research institutes and potential users in nonprofit and nongovernmental organizations. Participatory design and action research methodologies are being employed during the project. Software development, applications in real communities, and institutional design for federated operation are all related, and thus performed in parallel.[9] It has become one of the most advanced service infrastructures for intercultural collaboration.

Various service computing technologies have been developed to enable the collaboration needed among language services. *Language service ontology* is a technology to define standard language service interfaces in a hierarchical way so that end users are provided with simple interfaces while professionals can access more complex interfaces [6]. *Horizontal service composition* was invented to select the best atomic service from a set of atomic services to instantiate a desired workflow.[10] We apply constraint optimization algorithms to select the appropriate services and thus satisfy quality of service (QoS) requirements [4]. *Context-aware service composition* was proposed to coordinate

[7] The word *grid* is defined as "a system or structure for combining distributed resources; an open standard protocol is generally used to create high quality services." Our approach, applying the grid concept to ensure the collaboration of language services, has not been tried before.

[8] Service grid is a generic term meaning a framework where "services are composed to meet the requirements of a user community within constraints specified by the resource provider [14]."

[9] As a result, we took only two years to start its operation. Around 30 organizations joined in December 2007 to share language resources.

[10] Contrary, *vertical service composition* generates workflows based on AI planning technologies.

multiple translations to determine the meanings of words consistently [18, 28]. *Service supervision*, on the other hand, is a runtime technology to monitor and modify the processes of composite services [27]. Furthermore, by monitoring existing language services, a *policy-aware parallel execution method* of atomic services was invented for users to adapt to the operation policies of service providers [31].

Table 1. Language service list

Service category	Service type	Number of services
Translation	Translation Service	32
	Domain-Specific Translation Service	5
	Multilingual Mixed Document Translation Service*	0
	Back Translation Service	3
	Multi-hop Translation Service	2
	Translation Selection Service	1
Paraphrase	Paraphrasing Service*	0
	Transliteration Service*	0
Dictionary	Multilingual Dictionary Service	17
	Multilingual Dictionary Service with Longest Match	34
	Concept Dictionary Service	19
	Pictogram Dictionary Service	2
	Multimedia Dictionary Service*	0
	Multilingual Glossary Service*	0
	Dictionary Creation Support Service*	0
Corpus	Parallel Corpus Service	40
	Dialog Parallel Corpus Service	1
	Template Parallel Corpus Service	5
Analysis	Morphological Analysis Service	19
	Named Entity Tagging Service	1
	Dependency Parsing Service	4
	Morphemese Dependency Parsing Service	1
	Similarity Calculation Service	6
	Quality Estimation Service	1
	Language Identification Service	5
	Text Summarization Service	2
	Keyphrase Extraction Service	4
Speech	Text To Speech Service	4
	Speech Recognition Service	2
Other	Structural Alignment Creation Service*	0
Meta Service	Service Management Service	1

(Service types marked * are currently under development.)

As of February 2015, 170 groups in 22 countries had joined to share more than 200 language services as listed in Table 1. However, we still need to collect language resources

for so called *low resource languages*. Automatic generation algorithms have been studied to create dictionaries between minor languages from existing dictionaries [33].[11]

3.3 Federated Operation

The operation model we designed reflects the intentions of user groups around the world like research institutes and nonprofit and nongovernmental organizations. Nonprofit and nongovernmental organizations and public sectors became the major users, but universities are using the Language Grid more intensively; researchers and students who are working on services computing, text analysis, computer-supported cooperative work, and multilingual communication are using language services to attain their research goals.

From our operation experience over several years, we have gained many insights. Because the operation center in Kyoto cannot reach local organizations in other countries, over 70 % of participating organizations are local. Since we need global collaboration to solve language issues in local communities, this imbalance should be rectified: the operators need to be dispersed into different organizations globally and to collaborate with each other. The *federated operation model* [21] was invented to realize such collaboration. Reasons to drive federated operation include not only the limited number of users that a single operator can handle, but also the locality caused by geographical conditions and application domains.

There are two types of federated operation. One is *centralized affiliation*, where the operators form a federal association to control the terms of affiliation based on mutual agreement. This yields flexibility in deciding affiliation style, but incurs high cost in maintaining the federal association. The other is *decentralized affiliation*, which allows a service grid user to create and become the operator of a new service grid that reuses the agreements set by the first service grid.[12] This type of operation promotes the formation of peer-to-peer networks by operators. Since the formation of peer-to-peer networks by the operators is flexible and maintenance costs are avoided, we adopted the decentralized affiliation since it suits research organizations like universities and research institutes.

Using the Language Grid, various kinds of intercultural activities have been implemented at hospital reception desks, local schools, shopping streets, and so on. To enable each multi-cultural community to develop its own multi-language environment, we take the participatory design approach, where collaboration among humans and technologies is the key for creating customized multi-language environments [15]. In other words, we could develop customized language environments for intercultural collaboration by

[11] For example, the algorithm enables users to create a Uyghur-Kazakh dictionary from Uyghur-Chinese and Kazakh-Chinese dictionaries.

[12] Sometimes it is impossible for different service grids to use exactly the same agreements. A typical problem is the governing law. For international affiliation, a possible idea is to adopt a common law like New York State law, but operators may wish to adopt the governing law of their own locations.

mirroring the approach taken by humans in creating and diffusing domain specific words and dictionaries.

Another important aspect of the Language Grid is to encourage the collaboration of widely separated people. The joint research conducted with Tsinghua University's smart classroom is a typical achievement [25]. We rebuilt the smart classroom as a collection of pervasive computing services to allow easier connection of the smart classrooms. The Language Grid then quickly realized the *open smart classroom*, which connects classrooms in different countries.

The *service grid server software* has been released as open source software. Using this source code, universities and research institutes can operate any kind of service grid not only for language services but also for services in other domains. We are now in the process of creating a network of operation centers to cover Asian languages. The Bangkok operation center in Thailand opened in October 2010 to provide a collection of atomic services including a Thai-English dictionary and machine translator, Thai text-to-speech tagger, and morphological analysis utilities. Those services can be accessed by users of the Kyoto operation center.[13] The service grid software has been selected as a basis of *Open Language Grid*, where Asian, US and EU projects are going to share open-source language resources.[14]

4 YMC-Viet: Forming a Community to Utilize Nonmature Technologies

We have been participating in an agriculture support project in Vietnam with rice harvesting experts since 2011. The project aims at designing new services for multi-language knowledge communication via the Internet. The goal is to transfer agriculture knowledge from Japanese experts to Vietnamese farmers in rural areas with low literacy rate, to increase rice productivity, and to decrease the environmental burdens caused by excess use of agrichemicals. The motivation of Japanese experts, who work for the Japan International Cooperation Agency to support developing countries, in using information technology is that they cannot physically travel to all rural areas that need their advice.[15]

There exists a huge gap between Japanese experts and Vietnamese farmers, not only in agricultural knowledge but also language and culture. Furthermore, the farmers have difficulties in using computers and indeed in reading/writing messages. Therefore, as shown in Fig. 4, a *youth-mediated communication (YMC) model* was proposed and applied to bridge the gaps in knowledge, language, and cultures [19]. In the YMC model,

[13] Jakarta and Urumqi operation centers have just started at the University of Indonesia and Xinjiang University.

[14] The Language Application Grid (LAPPS Grid) project in the US adopts the service grid server software described in this section.

[15] The project consists of our team in Kyoto University for providing the multilingual collaboration environment, NPO Pangaea for educating children and conducting experiments, University of Tokyo and Mie University for providing agricultural knowledge, Vietnam National University for local arrangements, and MARD/DARD for planning and controlling the whole process of the project.

the children received training at a local community center, and then acted as mediators between the Vietnamese farmers (parents) and the Japanese experts. The YMC model is a breakthrough idea for gap bridging, but it exposes another difficulty in communication: the computer literacy and background knowledge of children determine the boundaries of agricultural knowledge communication. To cope with all the problems, we formed a project with a variety of stakeholders: agricultural experts and language processing experts in universities, farmers and their children, nongovernmental organizations targeting the education of children in developing countries, and Vietnamese national and local ministries.

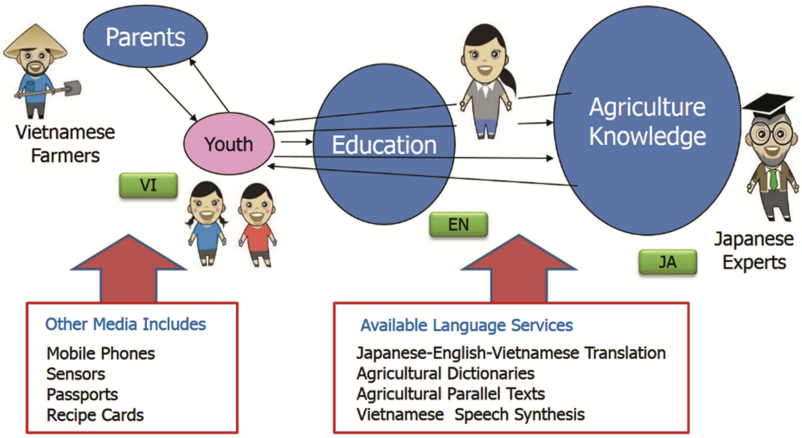

Fig. 4. Youth mediated communication

At the beginning, we designed services for knowledge transfer from Japanese experts to Vietnamese children, where the experts are service providers and the children are customers. Multi-language knowledge communication services were developed and managed in the project [13]. These services were realized based on the different motivations of various stakeholders. The nongovernmental organization staff working in the field were motivated to educate the children. Soon after the project started, however, we observed that the experts became more and more motivated by obtaining field data from the children: a complementary service was added where the children are service providers and the experts are customers. Meanwhile, the local government highly praised the project because they found that it became easier for them to form communities in low literacy areas. Figure 5(a) shows a child collecting field data, and Fig. 5(b) shows the local government officers involved in helping the children to read the experts' advice.

(a) (b)

Fig. 5. Collecting field data/reading expert's advice

The YMC project has been well recognized and supported by Vietnamese national and regional governments. It has resulted in community formation with local stakeholders and researchers, among which staffs from the local government are in charge of working with the nongovernmental organizations to train children. To increase the quality of machine translation, human bridgers joined our community. They are typically students of agriculture departments, having strong motivation to assist this project and also to acquire professional knowledge. The reason we need their help is that the quality of machine translation is not good enough, especially when translators are cascaded.[16] In this way, the community has grown continuously even though the machine translation technologies are rudimentary. Figure 6 shows one of the new communities which includes various stakeholders.

We conducted one trial a year for four years.[17] During the successful project, however, we recognized the difficulties in understanding the relationships among newly created services and existing services. Here is one episode.

> *One of the goals of this project is to reduce the amount of agrichemicals by enhancing knowledge communication among agricultural experts and farmers. Employees of the local government became heavily involved in the project by helping farmers' children to learn information technology. However it was found that local government workers usually work part-time, and they normally have second jobs, such as selling agrichemicals and fertilizers to farmers.*

Moreover, it is also difficult to estimate the effects of services. Here is another episode.

> *This project aims at increasing the yield of rice. One project member, an agricultural expert, recognized the lack of nitrogen in this particular rice field, and suggested the use of a little more*

[16] For Japanese-Vietnamese translation, two translators, Japanese-English and English-Vietnamese, are cascaded using English as a pivot, because there is not enough data to create a direct translator between Japanese and Vietnamese. Since machine translators expect correct input, human bridgers are requested to post-edit translated sentences in the pivot language.

[17] We conducted experiments 2011/02–2011/03, 2012/10–2013/01 and 2013/09–2014/01 in Thien My, Vinlong Province, and 2013/09–2014/01 and 2014/02–2014/03 in Dong Thanh, Vinlong Province. Both villages are located near Can Tho City in the Mekong Delta.

fertilizer. The farmers did not follow this advice, since they believe bugs would gather from neighboring fields, if they increased the amount of fertilizer.

These episodes shows how difficult it is to shape the problem and design services in a single project. We need a new methodology to deal with the unexpected interdependency of problems and services by widening the scope of stakeholders and forming a sustainable problem-solving organization that will continue the process of service design.

5 Modeling and Simulation: Predicting Difficulties in Intercultural Collaboration

We have been modeling intercultural collaboration based on the findings acquired through field activities. Culture itself has been modeled in various ways. Hofstede proposed *cultural dimensions* based on a large scale survey [7]. Agent models to simulate cultures has been proposed [8]. This section, describes a model for service design to support practical activities in intercultural collaboration.

Service can be seen as the fundamental basis of exchange; t*he organizations, markets and society are concerned with the exchange of service* [16]. We think this view can be effectively modeled using multiagent systems. We first introduce a role playing game and a participatory simulation, in which humans and software agents are connected. We then propose a gaming simulation, which applies participatory simulation to role playing games.

Fig. 6. Various stakeholders in YMC

Role playing games (RPGs) are a well-known multiagent approach, where stakeholders participate in a game and mutually confirm their decisions on a game board. There are several ways to utilize RPG:

- For consensus building, RPG enables stakeholders to compromise and reach an optimal decision for the community by representing and sharing individual decisions on a game board.
- For system design, team members can learn the requirements and environments of the systems to be designed by simulating the decision processes of various stakeholders.
- For field analysis, a more accurate model of the decision processes of the community can be obtained by observing stakeholder decisions during RPG sessions.

Let us illustrate the process of modeling players' decision making. An initial model is created from relevant literature and surveys. RPG sessions are conducted using a board game that represents the players' environment. The decision making process can be understood based on the logs obtained during the game. The reasons behind the decisions made in the RPG are exposed by interviewing the players after the game. Finally, the decision making model is refined by analyzing the RPG log data and the interviews. Running the RPG several times can improve the obtained models [30].

Multiagent simulations are getting popular as a method of micro simulation in various research areas. In multiagent simulations, agent behaviors are determined by scenarios, which can either be described by programming languages or scenario description languages with embedded decision-making models. The scenario processor interprets agent scenarios and requests agents in a virtual space to perform sensing and acting functions. *Participatory simulations* have been invented as an extension of multiagent simulations. We can easily extend multiagent simulations to yield participatory simulations by replacing some of the scenario-guided agents with human-controlled avatars [11]. A participatory simulation consists of (1) *agents* for modeling users, (2) *avatars* to represent human subjects, (3) *scenario*s for modeling interactions, (4) *human subjects* to control avatars, (5) *virtual space* to represent real space, and (6) a *monitor* to visualize simulations underway in the virtual space. In this situation, human subjects and agents can cooperate in performing a simulation. Just as with video games, human subjects can join the simulation by controlling avatars via joy sticks, mice, or other input devices. To analyze simulation results, we monitor the entire process of the simulation by visualizing the virtual space. Recording human behavior is useful for analyzing the simulation results and for improving the agent decision making models.

Gaming simulation can be conducted by fusing participatory simulation with RPG [29]. Although RPG requires all the stakeholders to participate in the game, this not always practical in design processes. It is more efficient if a small design team conducts the simulations to understand the nature of problems and services at the early stage of design. We actually tried a gaming simulation to predict difficulties in YMC-Viet (described in the previous section). Since we can execute only one field experiment a year, problems in support systems should be detected as much as possible in advance. One of the advantages of gaming simulations is that they provide seamless design activities from a design team to all stakeholders. Moreover, it is easy to deal with situations

where additional services are required or conflicts occur among new and existing services. Those advantages come from the fact that multiagent simulations are a type of micro simulation [5].

Let us summarize an approach to design support systems for intercultural collaboration. Especially in the early stage of design, it is necessary to understand the problems in the community, and propose services that can solve the problems. However, designing services in the field is always difficult due to the interdependency between problems and their evolution over time. Therefore, developing a continuous problem solving process is as important as solving currently known problems. In other words, the key to support intercultural collaboration is to provide a design process and form a flexible team that can support the process. In this context, we propose a multiagent approach including role playing games, participatory simulations and gaming simulations as a basis of experiments for designing support systems with various stakeholders. In intercultural collaboration, designers cannot always completely understand the complex relations and behaviors of stakeholders. The purpose of running gaming simulations is to design services for intercultural collaboration by understanding the interdependencies of existing services, and to reach agreement on the design of future services. We have to be careful, however, when interpreting the results of gaming simulations. We should be sensitive to what is important and what is not in the results from simulations. Since simulation results depend on participating stakeholders and agent models, result validity should be confirmed both in the field and theoretically.

To end this paper, we suggest the next step to model agents that can not only support a specific culture, but also recognize the differences among cultures, and differences among the understanding of cultural differences. There exists work that clarifies the asymmetry among the recognition of cultural differences. For example, paper reported how people in the US, Japan and China feel about the cultural differences in punctuality.[18] In terms of how Japanese perceive the approach of Americans and Chinese to punctuality, 67.0 % of the Japanese in the US perceive the cultural difference to be significant, while 72.2 % of those in China claim the same feeling. In contrast, 50.3 % of Americans perceive the cultural difference to significant, while only 29.3 % of Chinese say the same. The results reveal that most Japanese feel there are strong cultural differences in the approaches to punctuality, much more than Americans or Chinese, and more importantly there exists a difference in recognizing the cultural differences.

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[18] There are many interesting examples listed in Hiroko Nishida's book on *intercultural communication friction in Japanese companies operating in the US and Chinese market*, published in 2007. The book is written in Japanese.

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