

# Using Fieldwork to Hand Down Skills of Expert Systems Engineers

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*(Manuscript received November 7, 2008)*

Various efforts are being made to hand down the skills of expert systems engineers (SEs) to younger SEs but none are considered to be the ultimate solution. The main problem here is that young SEs treat the information given them as generalities and never develop a deep understanding of the skills themselves. Fujitsu's Social Science Center has been developing fieldwork techniques for some time based on a human-centered, fact-based approach and has applied this approach to the development of a new service called "handing down expert SE skills". This service involves the three processes of visualizing skills, systematizing them, and sharing them based on human-centered design that focuses on human behavior to extract skills in actual practice. The service has been provided since 2007 as one solution to the problem of off-the-job-training for work in the field—which has not been solved by traditional human-skills training—by incorporating realistic skills visualization and supporting skill analysis by holding joint study meetings.

## 1. Introduction

Although it was a highly publicized problem as recently as 2007, concern over the lack of skilled systems engineers (SEs) has recently died down as companies decide to reemploy veteran SEs or postpone their retirement. Of course, these are only stop-gap measures that serve to create a "danger past, God forgotten" scenario without providing a fundamental solution to the problem. These veteran SEs, who have helped to extinguish the crisis for the time being, will surely leave their companies once and for all someday, so it is only a matter of time before a serious problem reappears. A survey conducted by the Ministry of Economy, Trade and Industry found that "in many companies, knowledge and skills are not being systematized and shared—they are being developed and held only on an individual level."<sup>1)</sup>

Fujitsu's Social Science Center, where the solutions business is practiced through fieldwork,

promotes the handing down of expert SE skills through the visualization and sharing of those skills using fieldwork based on ethnography and a human-centered, fact-based approach.

## 2. Problems and new approach

### 2.1 Veteran SE skills

Before we consider a solution to the problems of handing down SE skills, let us first attempt to define "veteran SE skills". This expression strongly connotes equipment and technique, but skills in this case can also carry the nuance of "people" and "action". For this reason, we refer to veteran SE skills as "expert SE skills" in the following discussions. In particular, the Social Science Center considers experts SE skills to combine "human behavior" such as practicality and communication skills and "specialized knowledge and technical expertise" in relation to work, applications, etc. (**Figure 1**). This is because an extensive knowledge of work or advanced appli-

cation technology is not sufficient in itself. Such specialized knowledge and technical expertise begin to have value only when they can be put to use. For example, in systems integration services, where the overall ability of a team is crucial, work-related knowledge can be expanded to team know-how through people skills like the ability to communicate. This can produce significant results that can be felt on a day-to-day basis.

## 2.2 Current state of handing down skills

The handing down of skills, whether in Fujitsu or another company, can be viewed in terms of visualizing and sharing skills.

First, with regard to visualizing skills, individual companies will often attempt to document expert SE knowledge in the form of textbooks or other educational materials or to store SE-related data in the form of knowledge to facilitate its common use. At the same time, there has been a significant increase in how-to books and magazines related to SE, and the Internet has made it even easier to access SE-related information.

Next, in regard to sharing skills, both “human behavior” and “specialized knowledge and technical expertise”, the constituent elements of expert SE skills, have traditionally been learned simultaneously through on-the-job training in the field (**Figure 2**). Nowadays, however, a decrease in opportunities means that only skills associated with specialized knowledge and technical expertise are being handed down by training and other

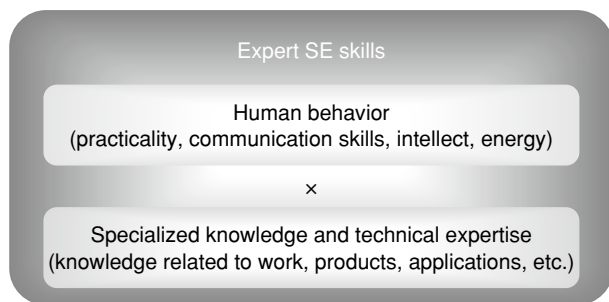


Figure 1  
Expert SE skills.

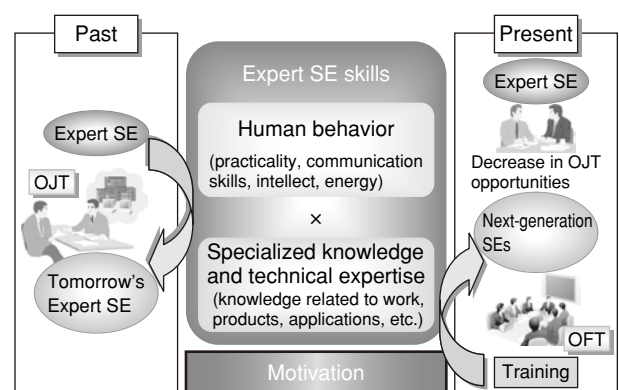
forms of off-the-job training.

## 2.3 Problems in handing down skills

Why then is the passing of skills to young SEs not going so well?

First, in terms of visualizing skills, information is not being provided in a way that makes a deep impression on the recipient. Documents that collect the knowledge of experts in the company tend to contain advanced content while general SE-related books are often criticized for having examples that are not very realistic. Thus, while information may be understood in general terms, it is not being shared in the form of realistic examples. This leads to skills not being fully understood by the recipient of that information. In short, the level at which skills are used as a conditioned reflex based on one’s own empirical rules has not yet been reached, despite the fact that the information (example) in question may even be presented under the same conditions as found in the field. Since the area of human behavior is a collection of implicit knowledge, the realistic visualization of skills holds the key to providing information in a way that makes a deep impression on the recipient.

Second, skills are not being shared in a form that can be readily used in field work. Although



OJT: On-the-job training  
OFT: Off-the-job training

Figure 2  
Acquisition of expert SE skills.

diverse forms of in-house human-skills training such as negotiation can be provided, such training is usually provided in a piece-wise fashion one skill at a time with no connection to work in the field. This has led even members of the executive team to comment that “it is hard to achieve the desired results by just attending training courses”. It is therefore important that off-the-job training be based on content with a direct connection to work in the field so that skills can be shared in a form that is ready for use in field work.

## 2.4 Our new approach

Fieldwork can be an effective approach to solving the problem of how best to visualize and share expert SE skills. Based on the method of shadowing (close observation), fieldwork can be thought of as an observation and survey technique that includes an ethnographic interview to induce natural conversation by asking open (non-leading) questions at appropriate times. The fieldwork described in this article is likewise based on ethnography. In the field of cultural anthropology, ethnography is a technique developed in field surveys of different cultures and lifestyles.<sup>2),3)</sup> A major feature of ethnography is that it attempts to extract human-centered events exactly as they are. This “human-centered, fact-based approach” of fieldwork can express information in a direct, unadulterated manner that can deeply impress the recipient and instill deep understanding of an event. In other words, this approach has the potential to create a new model for visualizing and handing down information. Fieldwork based on ethnography can be an effective technique for visualizing expert SE skills through human-centered design.

## 3. Human-centered, fact-based approach for handing down skills

### 3.1 Skill visualization by a human-centered, fact-based approach

Fieldwork based on ethnography is a human-

centered, fact-based approach. It excludes preconceived notions and bias to extract specific SE skills just the way they are. It also represents the background and context of individual projects in which expert SE skills are demonstrated to convey those skills to concerned personnel in a very realistic manner. At the same time, it cannot be denied that information unique to individual projects may be foreign to personnel outside the department in question; however, considering that Fujitsu projects are often large in scale with many members, even visualization that targets only those people sharing a unique context should have a great effect.

### 3.2 Co-creation of insights

Takayuki Shiose of Kyoto University (Graduate School of Informatics, Department of Systems Science) is involved in activities involving “persons with visual disabilities and art appreciation through words” and has presented examples of how a person with normal sight who explains art can obtain various insights from persons with visual disabilities.<sup>4)</sup>

When asked about Jean-Francois Millet’s famous painting “The Gleaners”, most art-lovers say something like “Oh yes. I know it well.” But if they are asked by a person with a visual disability such questions as “What kind of clothes are the figures in the painting wearing?” and “Are their facial expressions sad?” most of them cannot respond without having to think twice about the picture. This phenomenon in which a person who thinks he or she knows something very well nevertheless gains insights when asked various questions about that thing is very common. In the words of Takayuki Shiose, “The words of a hundred people describing a work of art present a hundred ways of viewing that work.”<sup>5)</sup> When transforming implicit knowledge into formal knowledge, “co-creation”, in which two parties both obtain new insights by asking each other questions, can be very effective.

### 3.3 Skill systematization and sharing by a fact-based approach

Skill-related information obtained from visualization is qualitative information as opposed to quantitative information based on numeric data. In general, it is not easy for those concerned to reach a unanimous decision when analyzing qualitative information. A human-centered, fact-based approach, however, is beneficial not only in the observation stage but also in the analysis stage. When an event is being examined, a human-centered approach makes it possible to resolve questions about the behavior of persons under observation by dealing directly with those persons, while a fact-based approach leaves little room for imagination in analysis, making divergence difficult. That is to say, a human-centered, fact-based approach enables qualitative analysis that can suppress the discrepancies and divergence that tend to occur when a hypothesis is being developed. This feature can be used to systematize and organize diverse skills in a manner that is easy for trainees to understand and enables the creation of a new sharable model, that is, a new learning mechanism, that exploits the convincing nature of a fact-based approach.

An actual example of this new approach to handing down expert SE skills is introduced in the next section.

## 4. Activities for handing down expert SE skills

### 4.1 Overview

Activities for handing down expert SE skills using fieldwork consist of three processes: visualizing, systematizing, and sharing skills. Specifically, they begin with the visualizing of expert SE skills through fieldwork (visualizing skills), continue with the systematizing of many visualized skills into multiple groups (systematizing the skills), and conclude with the holding of briefings and training seminars on the skills system to deepen understanding and encourage reflection with respect to those skills (sharing the skills).

These processes are described in more detail below in the workflow order.

### 4.2 Visualizing skills

In this process, field notes are prepared during first-hand observations of an expert SE participating in design reviews as part of a certain project. Field notes reveal that the expert SE will interrupt a design-review presenter who omits explanations to ask questions and clear up vague or confusing areas. On learning about this activity, most people would probably say “So what?” But to those concerned, this context can help them picture the scene and appreciate the valuable skills of expert SEs in a realistic setting. A weak point here, however, is that some of those concerned, while thinking that they will readily understand the skills in question from such context, may actually fail to obtain a deep understanding on the basis of only this process.

### 4.3 Transforming skills into formal knowledge by co-creation of insights

Co-creation plays an important role in compensating for this drawback of failing to obtain a deep understanding of expert skills through the above process. Co-creation of insights occurs by uncovering implicit knowledge through an ethnographic interview. The following presents a conversation that occurred during an interview with an expert SE with the underlined sections corresponding to co-creation.

“What I pointed out is that, while everyone seems to be well aware of the problem in question, it was not properly documented. If it is not written down, the problem may lose its visibility and become nonexistent in the eyes of the people concerned. I think this could be done better here. Everyone should look out for any ambiguity in the difference between listing an item as a problem or not.”

“A reviewer should also conduct a review with the same kind of analysis. At present, re-

views have essentially become a formality or a ritual. A reviewer who doesn't take it upon himself to check for omissions or questionable points is not doing his job."

As a result of co-creating through conversations with an expert SE as described above or holding data sessions among members of the fieldwork team, the following insight was extracted and implicit knowledge possessed by an expert SE was formalized.

Insight:  
Stop presenters from leaving out important information and clarify vague sections.

In the above way, the fieldwork team records fact-based field notes and accumulates insights of all kinds.

#### 4.4 Systematizing the skills

Skills that have been visualized through

fieldwork can be said to have been filtered of discrepancies and divergence, but because they consist of qualitative information, a variety of systems could still be created by different analysts each from a different point of view. Thus, in the skills systemization stage, common features of expert SEs are extracted and a meaningful summary prepared while the facts collected by fieldwork are objectively checked through joint data sessions attended by the fieldwork team and concerned personnel.

The visualized skills of expert SEs are described vividly and in detail. The observed events and insight described in the example above are given in the "Events Observed in Fieldwork" document shown at the top of **Figure 3**.

The skill shown here as the heading of this document (stop presenters from leaving without clarifying vague sections) and other skills documented on other pages (e.g., "determine the facts about a problem occurrence directly on the floor and assess conditions as quickly as possible") are

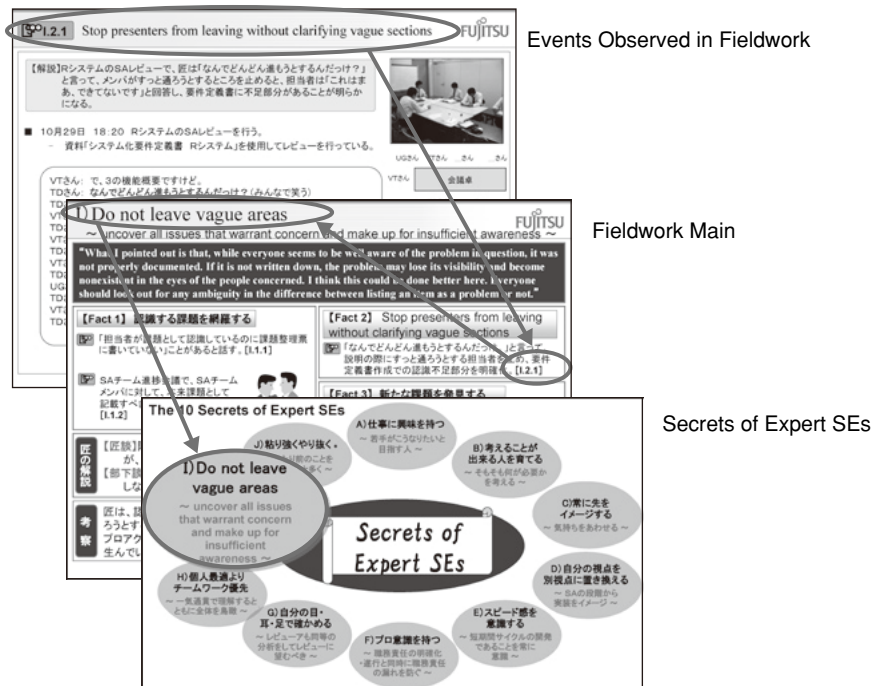


Figure 3 Relationships among fieldwork-output documents.

grouped under the same “secret of expert SEs” called “do not leave vague areas (uncover all issues that warrant concern and make up for insufficient awareness)”. This grouping is indicated in the “Fieldwork Main” material shown in the middle of Figure 3. The “Secrets of Expert SEs” document, which summarizes the various skills extracted by the fieldwork in question, is shown at the bottom of Figure 3.

For the trainee, this information provides a reference of real skills and helps in obtaining a systematic understanding in the next “sharing of skills” process.

## 4.5 Sharing the skills

### 4.5.1 Effect of holding a joint study meeting

The purpose of sharing skills is to help others obtain a deeper understanding of those skills and to enable others to use them in the field. Originally, students of SE skills would study and practice those skills on their own, but SE trainees are now expected to develop those skills as fast as possible before expert SEs leave. Great urgency is also being attached to having expert SEs themselves hand down skills. There is therefore a need to assemble a large number of young SEs in a single room to deepen their understanding of expert SE skills. However, an explanation of skills is not sufficient in itself. To enable those skills to be used in practice, young SEs must also develop a real appreciation of their importance.

As a solution to this need, we established a training forum that we call a “joint study meeting” targeting young SEs to actively convey the content of expert SE skills. We have found from trials of this joint study meeting that young SEs will generally become more conscious of the importance of skills. The following presents an example of such a change in consciousness.

A joint study meeting held with 12 young SEs consisted of the six steps shown in **Figure 4**. These steps are summarized below.

In step 1), the young SEs were presented with expert SE skills in the form of ten “secrets of

expert SEs” such as “do not leave vague areas”. In step 3), participants were divided into groups to discuss what they thought were important skills while referring to the realistic examples found in the Events Observed in Fieldwork and Fieldwork Main documents. In step 4), the reasons these skills are used (origin) and the effects of using them (effects) were discussed and the results of that discussion were presented. Finally, in step 6) an expert SE offered feedback on the results presented.

Furthermore, to see if there was any change in consciousness of the importance of skills, we designed a pre-questionnaire and post-questionnaire for steps 2) and 5), before and after the analysis steps. In these questionnaires, each of the young SEs was asked to rank the importance of each of the ten “secrets” on a scale of 1 to 4 with 4 being highest.

On examining the post-questionnaire results, we found that awareness of skill importance generally rose compared with the pre-questionnaire results. A high increase in scores was especially observed for the secrets of expert SEs taken up in steps 3) and 4). This outcome indicates that holding a joint study meeting makes young SEs more aware of the importance of skills and that

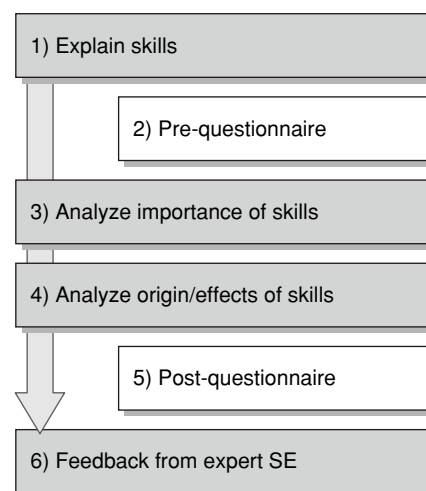


Figure 4  
Six steps of joint study meeting.

the meeting can produce highly effective results.

#### 4.5.2 Reason for rise in awareness of skill importance

Why is it that young SEs become more aware of the importance of skills through such analysis? The reason for this, we feel, is two elements that have been added by the Social Science Center to the analysis steps described above.

The first element is showing realistic examples of skills in action in step 1). These examples reflect the fieldwork feature of “excluding preconceived notions and bias and extracting specific SE skills just the way they are”. Fact-based, detailed examples make the context in which skills are practiced more real to the student.

The second element is having the young SEs themselves analyze the importance and effectiveness of skills in steps 3) and 4). Specifically, we established a forum in which young SEs of the same level could analyze and hypothesize about why a particular skill had come to be used, why its use is effective, and what negative effects would result from it not being used. Members of the Social Science Center will also facilitate these analysis activities by promoting mutual understanding and cooperation among young SEs. Moreover, the materials used for analysis describe expert SE behavior familiar to young SEs. Providing off-the-job training having content with a direct connection to work in the field solves the problem of unrealistic training that had hindered the sharing of skills in the past. These analysis activities provide young SEs with optimal conditions for thinking deeply about skills and developing greater awareness of their importance.

## 5. Conclusion

The approach described in this article for handing down expert SE skills achieved three main results.

1) The human-centered, fact-based approach of fieldwork and the co-creation of insights enabled the creation of documents that en-

able expert SE skills—and implicit human behavior in particular—to be visualized in a realistic manner.

- 2) The objective checking of facts and the co-creation of insights in data sessions made for qualitative analysis that suppresses discrepancies and divergence and a system of expert SE skills that is easy to understand regardless of the level of the reader.
- 3) Allowing young SEs to analyze skills themselves in a joint study meeting helped to raise their awareness of the importance of skills, and providing analysis materials that describe familiar expert SE behavior provided one solution for off-the-job training of work in the field. Greater work motivation was also achieved as a secondary effect.

As described above, we have developed a new technique for handing down expert SE skills by exploiting the advantages of a human-centered, fact-based approach in fieldwork. Looking forward, we plan to expand the practitioners of this approach beyond the Social Science Center to promote the handing down of expert SE skills.

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