Customer Satisfaction Plays an Important Role: A Model to Improve Resiliency of ICT Service Maintainer

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Abstract. We propose a model of resilient response in ICT (Information Communication Technology) maintenance and address the importance of non-technical skill. ICT Services, such as the Internet, are socio-technical systems and must be repaired quickly after failures. These systems are so sophisticated that the ICT maintainers have to deal with a great variety of failure situations. Our response was to conduct an ethnographic study of ICT maintainers who troubleshoot home networks to find out how they achieved resilient response in the face of such variety. As a result, we found that customer satisfaction plays a key role in troubleshooting. When the customer is dissatisfied, the maintainer cannot get much information or even start repairs. The proposed model combines Situation awareness, Managing relationship, Repairs, Explanation, and Learn. In this model, Situation awareness and Managing relationship are the most important activities. To perform these activities, the maintainer needs not only technical skill for failure recovery but also non-technical skills to build good customer relationships.

1 INTRODUCTION

ICT Services, such as the Internet, are indispensable for society and for personal life, and so are called socio-technical systems. However, since their malfunction or failure can never be completely prevented, the maintenance service person (maintainer) must recover the ICT service quickly after a failure.

A key goal of maintainers is resilient response because they have to manage various failure situations and to satisfy the customers, as we discuss later. Poor customer satisfaction threatens the company's safe operation, and so is actually a business risk. Thus it is critical to ensure that all maintainers offer resilient response. The purpose of this study is to examine maintainer behaviour, identify the components of resilient response, and develop and model suitable for training.

2 PRECEDING STUDY

Repairing an ICT service, called troubleshooting, is a kind of problem solving and is common in daily life. Troubleshooting is defined as detecting the system malfunction and its cause, repairing it, and recovering the normal state from the abnormal state (Jonassen, 2000).

In the research field of troubleshooting, many studies have targeted the knowledge and the cognitive ability of maintainers (Morris Rouse, 1985) (Perez , 1991). Schaasfstal et al. analysed the maintainers' thinking process while troubleshooting military equipment by using protocol analysis (Schaasfstal et al., 2000). They found that the troubleshooting process can be divided into four subtasks. First, a maintainer must determine what is wrong and right with the system. (Formulate Problem Description). Second, they create hypotheses (Generate Cause). Third, they test all hypotheses (Test). Finally, they repair the malfunction and evaluate if the system works normally (Repair and Evaluate). With this categorization, they built an efficient training course.

In the field of Resilience Engineering (RE), there are four abilities that yield resiliency: Anticipation, Monitoring, Responding, and Learning (Hollangel, 2011). In troubleshooting, the maintainer needs a flexible and resilient response to cope with various problems and changes of the system's function to adjust to disturbances. To improve resilient ability, it is essential to create programs that teach resilient response.

The goal of this paper is to introduce an initial resilient response guide. To this end, we propose a resilient response model of maintenance and analyse the model to find out the key issues associated with resiliency.

3 FEATURES OF NETWORK MAINTENACE SERVICE

We conducted empirical research on maintainers who had to repair the Internet service used in home networks. They mainly manage metallic and photonic cables between the nearest telephone pole and the house, modems, ONU (Optical Network Unit), routers, and sometimes telephones and PCs and other electronic devices attached to the router.

The current troubleshooting approach to those networks and devices is as follows: First, when a network service experiences trouble, the customer calls the call centre and an operator tries to solve the problem. If it is difficult to solve the problem over the line, the operator dispatches a maintainer to the customer's home. The Maintainer detects and eliminates the malfunction by reviewing the failure history, interviewing the customer, and making some tests.

This network service has so many failure modes that the maintainer must respond with high flexibility. The difficulties posed by home network troubleshooting are detailed below.

3.1 Many Topologies

Connection technologies are becoming more sophisticated and diversified, such as Ethernet, Wireless LAN, and PLC (Power Line Communication). There are also many sophisticated devices in the house, such as home information appliances, STBs (Set-top Box), and Tablets. A home network is expected to handle this huge variety of technologies. This means that the home network maintainer has to deal with far more varieties of troubles than is true with other devices.

3.2 Affected by External Environment

A home network is constructed with and without physical cables, such as GE-PON (Gigabit Ethernet-Passive Optical Network), xDSL (x-Digital Subscriber Line), and Wireless LAN. These communication technologies are affected by environmental changes, such as temperature changes, and interference from other systems. This means that maintainer has to consider not only the devices and media forming the home network, but also the environment in which the system exists. This difficulty is only strengthened as the number of technologies in the home network increases.

In addition, the failures caused by environmental factors tend to have poor repeatability. They may not reoccur if even one environment condition differs from the set of conditions that triggered the failure. For example, on cold winter mornings, optical connectors can become temporarily disconnected due shrinkage of the optical fibre. This trouble may disappear before the maintainer arrives, since the temperature has increased. In this case, the failure situation is no longer available for the maintainer to inspect. S/he can only interview the customer and guess the cause with little information.

3.3 Best Effort Service

Different from a leased line, the home network service is often “a best effort service”. There is no strict service quality level, such as network speed or latency. To deal with a user’s complaint about network quality, the maintainer has to consider both the user’s demands and the facilities impacting the service level. S/he also must be extremely flexible in negotiating with and explaining the situation to the customer.

4 ETHNOGRAPHIC STUDY

To clarify how ICT service maintainers currently manage these difficulties, we conducted an ethnographic study. We accompanied several maintainers, noted what they did, and interviewed them.

From this study, we found three points. First, it is impossible to provide perfect recovery in some cases because of the intractability of legacy facilities. In these cases, the maintainer tries to repair with supportive care instead of making a complete recovery.

Second, the maintainer changes his/her troubleshooting approach according to not only device status, but also the customer relationship. For example, if the customer is cooperative, the maintainer seeks out the root cause and repairs the fault while offering the customer full support. On the other hand, if the customer is angry, the maintainer tends to go outside first to search for possible failure points, which may allow the customer to calm down.

Third, we found that the maintainer often continues troubleshooting until the customer is satisfied. Even if the failure cause is detected quickly, s/he sometimes checks other devices. Many maintainers noted that they continued troubleshooting until the customer was satisfied.

Summarizing these results, we found that the maintainer's goal was not just to eliminate the malfunction, as might be thought, but to sustain or improve customer satisfaction. Even if the maintainer effects a perfect technical recovery, the response is deemed a failure if the customer remains or becomes dissatisfied. Even partial service recovery (say 60%) can be deemed a success if the customer is satisfied with the maintainer's service behaviour. That is to say, the fault and the customer are equally important to the maintainer.

5 RESILIENT RESPONSE MODEL FOR MAINTENANCE SERVICE

Based on the study results, we developed a model to explain how the maintainer should behave to sustain or improve customer satisfaction. We categorized the maintainers' activities by their purpose, as is written below (see Fig. 1)

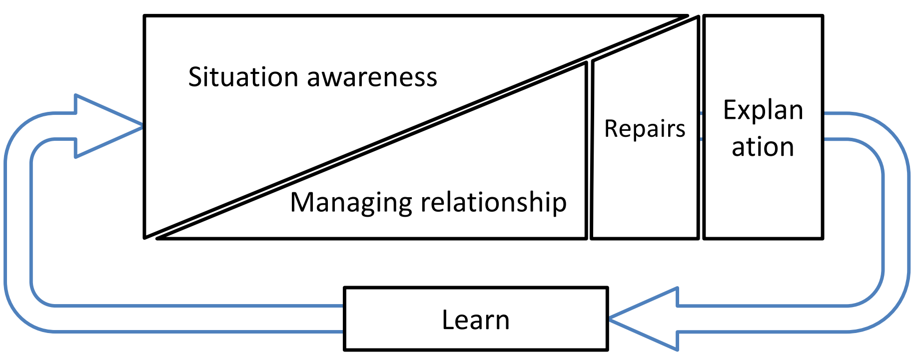

Fig.1 Resilient response model of ICT maintenance service.

5.1 Situation Awareness

The maintainer finds out not only the situation as regards the failure, but also the mood of the customer, which corresponds to Monitoring in RE. S/he understands the failure using information from logs of devices, system tests, and the attitude of the customer with regard to the failure history. The maintainer chats to discover the customer's personality. This overlaps the process of managing the relationship.

5.2 Managing Relationship

The maintainer manages the relationship with the customer, who is often irritated by the failure. A good relationship enhances the acquisition of information about the failure, and improves the effectiveness of the explanation. Most maintainers were careful about their appearance and were polite in conversation. Sometimes they examined devices not directly related to the fault so as to improve the relationship. This process and the following two correspond to Responding in RE.

5.3 Repairs

The maintainer identifies the failure cause from the information collected and rectifies the problem. Devices may be replaced or settings changed.

5.4 Explanation

The maintainer reassures the customer by explaining what the problem was and what corrections were made. The level of detail is changed to suit the level of ICT literacy or knowledge of the customer. Sometimes briefing material/notes were given to the customer so the customer could understand the failure and the maintenance result easily

5.5 Learn

The maintainer strengthens personal knowledge from the troubleshooting events. Sometimes maintainers will exchange their experiences and know-how if an unusual situation is encountered. This process matches the Learn ability in RE.

6 DISCUSSION

6.1 Interpretation of the Model

In our model, situation recognition, which includes understanding the customer, is the most important activity since it impacts the relationship created with the customer and repair efficiency. As there are great disparities in the situations encountered, the maintainer needs a lot of skill to recognize or diagnosis the situation correctly.

The second most important activity is managing the relationship. If the maintainer cannot build a good relationship with the customer, s/he cannot find out about the situation from the customer and may wastes time, or even makes the situation worse. As mentioned above, customer satisfaction is more dependent on good relationship than on technical skill.

This model fires after the maintainer gets a maintenance order. Because we focused on the activities after the dispatch, this model does not contain Anticipating in RE. However, the maintainers inherently have some anticipation before the dispatch. For example, they anticipate external connection troubles in the rainy season. After receiving an order, they anticipate the trouble type from the information of the failure history. This anticipation will guide them in monitoring the situation in the customer's home, making a diagnosis and repairing the fault. Likewise, they anticipate the customer type, confirm the type, and decide the response.

If they get the wrong failure history or encounter a new case, they cannot anticipate the trouble nor have good foresight in monitoring, and may fail to respond properly.

These trends have parallels in other activities, e.g. medical diagnoses. The physician may know of a specific flue that is currently active. S/he anticipates the disease through this prior information, monitors the patient, and decides the treatment options.

6.2 Data Collection Approach

To make guidelines that can improve the ability of resiliency, we must first tackle the issue of gathering information that permits identification of the key issues.

Since in our case satisfying the customer is the key goal, as is represented by Situation awareness, Managing relationship and Explanation in our model, we cannot be assured that semi-structured interviews and protocol analysis will gather sufficient information. This important point was found in our in-field study of on-site maintainers.

Our ethnographic study was critical to finding what was done and what was important in advancing their work. This approach is suitable for collect various cases and context data in natural settings (Stanton et al., 2005). In this study, we accompanied the maintainers and could directly gather their behaviour in the customer's house, which is impossible to reproduce in the laboratory.

On the other hand, the ethnographic approach cannot clarify cognitive processes, nor compare individual performance in the same context. These goals are best addressed by conducting semi-structured interviews and protocol analyses (Schaafstal et al., 1992).

We believe that it is important to identify the key points with ethnographical studies, and then clarify the practical knowledge with experiments in the laboratory or focused interviews.

7 CONCLUSION

The most important result of this study is that maintenance service personnel need not only technical skill to recover failures but also non-technical skills to build a good relationship with the customer. It is this latter point that we need to emphasize in training.

We conducted additional interviews of experts and focused on the non-technical skills. From these interviews, guidelines that will greatly improve the resilient response of novices are being made. We aim to raise the level of such skills and supress personal variation to create much better service.

This study will contribute to improving the methodology that enhances staff resiliency which is necessary in all service activities connected with human beings or customers, such as healthcare or medicine.

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