

1 Introduction

Despite the fact that the importance of User Centered Design (UCD) has been recognized over the years, many engineers have remained deeply absorbed in the efforts to lower costs and enhancing functions to reinforce the product.

In order to disseminate the concept of UCD, it is desirable to present engineers with clear goals that they can actively participate in. For this reason, we focused on the measurement of usability that can easily be accepted by the engineers by providing an objective (quantitative) measure.

As is pointed by Norman, the usability problems may arise from the discrepancy between the designer(engineer)'s model and the user's mental model (Fig.1).

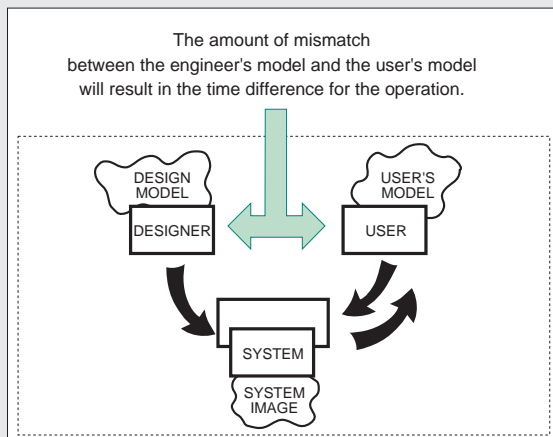


Fig. 1 Three Aspects of Mental Models.(From Norman ,1986)

4 Task Performance Analysis

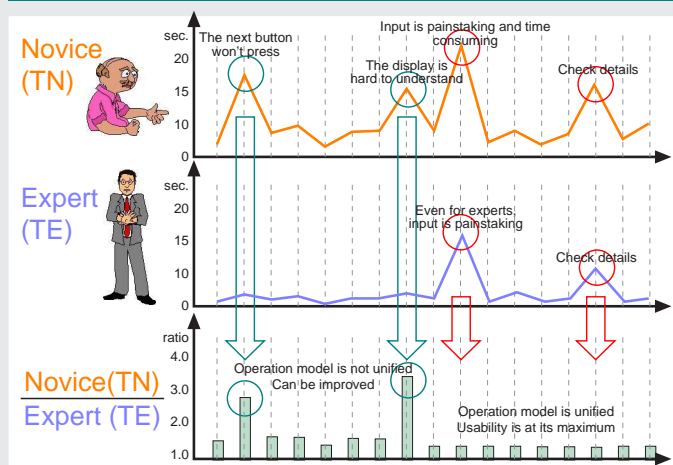
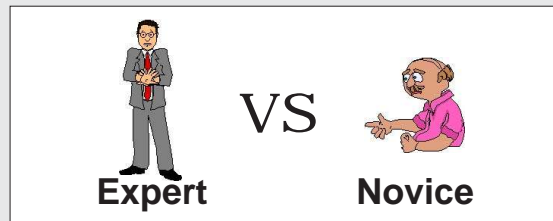


Fig. 3 Electronic bank transfer procedures

2 Hypothesis



$$NE \text{ ratio} = \frac{\text{Novice(TN)}}{\text{Expert (TE)}}$$

Fig. 2 NEratio

The time required for the operation by the engineer (in other word, an expert user) should be the minimum and the time for the general user (in other word, a novice user) may vary depending on the difficulty of operation.

It should be noticed that the absolute value of time is not important in considering the time difference. There may be a case in which even an expert user may take much time to accomplish a specific operational

Thus we focused on the difference of time required to two different types of users, i.e. an expert user and a novice user. But because the meaning of the time difference itself may vary depending on its absolute value, we decided to take the ratio of two time measures. **This value is what we call the NE (Novice/Expert) ratio (Fig. 2).**

In order to obtain the time measures for both types of users, the usability

5 Task Performance Measure

In order to summarize the NE ratio obtained from the usability testing data, we also proposed the measure for the task performance as shown in Fig. 4. This is a percentage of operational steps with low NE ratio, i.e. good usability.

At the moment, the criterion ratio value to differentiate the high NE ratio and the low NE ratio is determined arbitrarily.

$$\text{Task Performance} = \frac{S - NEh}{S}$$

NEh=Num. of task steps with high NE ratio
S=Num. of total task steps

Fig. 4 Task Performance

6 Conclusion

Improvements over previous evaluation methods
-Designers themselves can participate in the creation of base evaluation data
-Very effective for increasing designer interest in the topic of UCD

3 Characteristics Of This Method

1) Technical aspect: it can be applied to almost every kind of devices and systems to which the usability testing can be applied.

2) Practical aspect: it can be used not only by the usability specialists but even by the engineers because it does not require the identification and the content analysis of the user's error from the usability testing data.

It only requires the objective time measurement.

In the case where engineers have little time to participate in the usability testing, the estimates calculated by the Keystroke Level Model (KLM) can be used instead of the data obtained from the expert user. The estimates calculated by the KLM also represent the minimum time required for the specific operation.

7 Further development

We have not yet decided at which level of NE ratio the criterion should be positioned in order to identify the crucial usability problems. Our further research will focus on to determine the critical value of NE ratio.

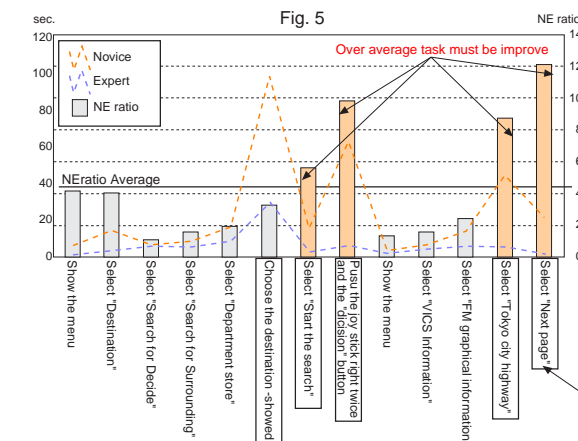
8 Support Tools Currently Under Development

To increase evaluation efficiency:
-Automated time measurement tools
-External systems: measurement tools & VTR log-in tools

To increase evaluation accuracy:
-A data analysis system
-Data warehouse (DWH) technology for easy management

-DWH data processing technology can be used for real-time processing and analysis of large quantities of task performance time data.

Application of the method (Case 1 : Car Navigation System)



By applying this method to the evaluation of the car navigation system, it was confirmed that this method is quite useful in identifying the procedural step that has a usability problem.

Following is an overview of this evaluation method applied to the car

The data was collected from 34 subjects including 4 expert users and

The task given to the subjects was to locate a destination point on the map and to let the system determine the optimum route to the destination, and to let display the traffic condition on the highway.

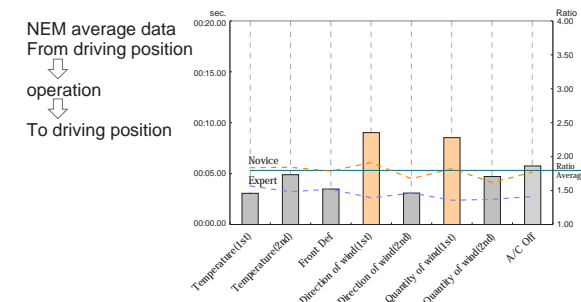
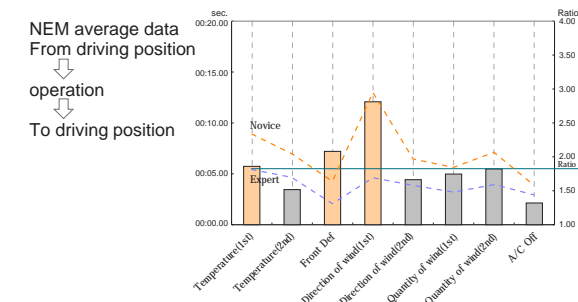
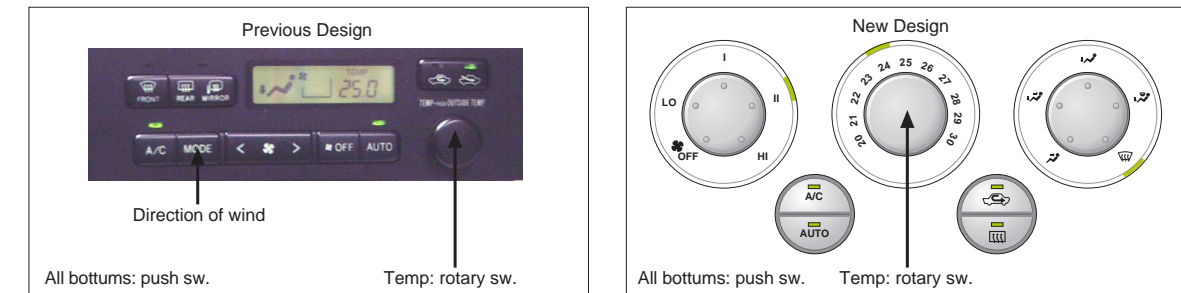
In Fig. 5, two line-graphs show the average values of time required for the novice user (orange line) and the expert user (blue line), and the bar graph represents the NE ratio. The boxed items are the operational steps that were diagnosed to have usability problems by the usability specialists. As shown in this figure, most of the boxed items have high NE ratios, thus is proving the validity of the NE method.



The boxed items are the operational steps that were diagnosed to have usability problems by the usability specialists.

Application of the method (Case 2 : Car Air Conditioner)

Compare operability of previous design and new design



The data was collected from 18 subjects including 2 expert users and 16 novice users. The task given to the subjects was to increase a temperature and to decrease a temperature, to change the direction of wind, to increase/decrease

This research was supported by **DENSO**

Getting designers on board

- Provide objective analysis of a myriad of task performance data
- Increase the reliability of evaluation results (indicating operability problems)

Let's make the UCD as the Standard!

Getting consumers on board

- Offer usability comparison specs to clarify how easy a product is to use
- Increase consumer awareness of usability as one tool for evaluating electronics products. Make "usability" a household word.