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Example of Usability Evaluation Activities in Motorcycle Development

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Abstract

Unlike in the field of information devices, evaluations of usability are rarely conducted in the developmental stage for motorcycles. The reasons for this include that once the basic operations are learned, motorcycles can be used and enjoyed in accordance with the rider's level of skill, and that when learning to ride a motorcycle there is little of the sense of awkwardness that comes with entering a new field, since most people have experience riding a bicycle. However, if usability is reconsidered from the different viewpoints of functionality, safety, operability, cognitivity, and comfort/enjoyment, it is seen that the thinking behind usability is in fact already incorporated in the developmental stage for motorcycles.

1 INTRODUCTION

Recently there is a growing recognition of the importance of usability, and the number of companies incorporating usability evaluation and measures in product development is increasing. However, there is considerable difference in the zeal with which companies have taken this up. Some view usability as being critical for survival whereas for others do not feel a very great need for it. In general, it is not unusual to come across traditional companies that do not attach a particularly strong importance to usability.

The motorcycle industry may be placed with such companies, and one sees virtually none of the usability evaluations that are common in the development of products in the field of information devices. There remains a generally low awareness of usability within motorcycle companies. However the criteria for usability evaluations include functionality, safety, operability, cognitivity and comfort/enjoyment. If reconsidered from that viewpoint, we see that each element is in fact involved during the developmental process of motorcycle. The following will introduce an example of usability activities as they have been adopted in motorcycle development.

2 CONCEPTS OF MOTORCYCLE USABILITY

The kinds of textbook usability evaluations that are done with information devices and home electronics appliances are not generally performed with motorcycles. **Fig. 1** shows the steps in usability design. And the developmental process for motorcycles does in fact employ these techniques of usability design.

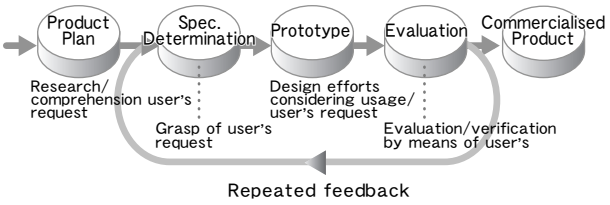

Fig. 1 Usability design method

Kurosu[1] presented the hierarchical structure shown in **Fig. 2** with regard to the criteria for the development of machines and mechanisms.

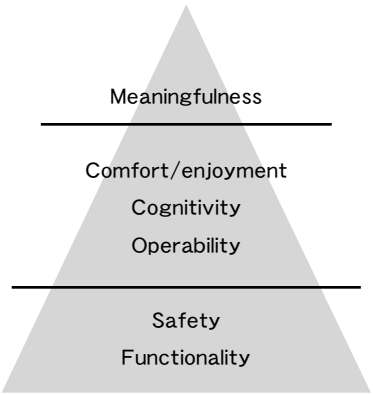

Fig. 2 Hierarchical system of machine development criteria

According to Kurosu, the criteria for machine development are divided into the three categories of operability, cognitivity, and comfort/enjoyment. To this he added the elements of functionality and safety proposed in Maslow's Hierarchy of Needs. Finally, meaningfulness is set as the ultimate criterion at the top.

Reexamining motorcycle development in the light of these criteria, we see that in fact each is built in to the steps of development.

In this sense, one can say that usability activities have in fact been conducted in the development of motorcycles.

3 USABILITY ACTIVITIES FOR EACH CRITERION

Of the criteria in **Fig. 2**, the ones of particular importance for motorcycles are functionality, safety, operability, and comfort/enjoyment.

3.1 Functionality

Functionality is the core aspect of motorcycles, but relatively few functionality items are directly related to the human user. Most functionality items are those such as durability or environment-related matters like fuel efficiency and exhaust gas. On the other hand, power output characteristics are important in establishing the distinctive character

of the motorcycle, and this is one of the items that receives the most attention during development. Since power output is something that users respond to most sensitively when a motorcycle is put on the market, it is important to realize output characteristics that match the product concept.

3.2 Safety

Safety is extremely important for transportation machinery, and the standards are well established. Since crash tests cannot be done with real human riders, safety is investigated through computer simulation or experiments using crash dummies.

Motorcycles have a large degree of freedom of movement at the moment of impact, and repeatability is poor in crash tests with real motorcycles. Therefore, computer simulation is used to supplement these tests (**Fig. 3**).

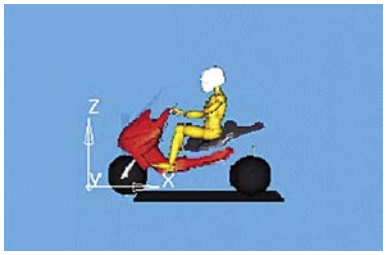

Fig. 3 Crash simulation (Studying moving images)

With brakes, it must first be confirmed that they conform to regulation standards, but an evaluation of brake feeling is also important. In particular, whether or not control is easy and a stable braking force is achieved is more important than the level of braking force itself. (**Fig. 4**).

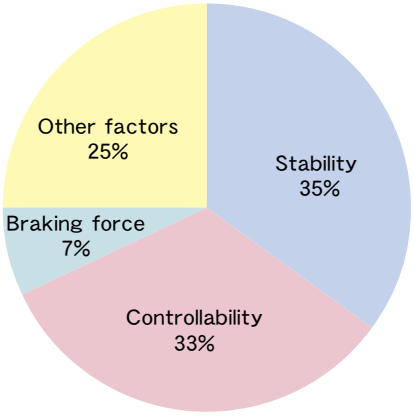

Fig. 4 The factors involved in brake feeling

Once safety factors have been cleared in evaluations by professional riders, virtually no problems will occur due to motorcycle function when used by the general rider. However, the possibility always remains of problems occurring due to the unrefined skills of the rider or rider negligence.

3.3 Operability

When riding a motorcycle there are many instances when a number of operations must be performed simultaneously. The hands must work to steer the motorcycle at all times. The hands must also work the accelerator, light switch, turn indicators, brakes, and clutch as needed.

The foot brake pedal and shift pedal must also be operated in parallel with the hand operations. The handlebars, accelerator, front brake, clutch, rear brake and gear shift must be operated simultaneously, especially when braking or speed control is necessary. In addition, since gloves are usually worn, particularly delicate operations are difficult. When such multiple operations are necessary, reliability and good operational feeling are demanded of the operations. To improve operability, compatibility between the human and machine is investigated from the viewpoint of ergonomics, and when a problem is found improvements are made. This process is done repeatedly. Specifically, evaluations are conducted from viewpoints such as the fit between human and motorcycle: whether the motorcycle fits the human shape and dimensions; whether the lever and pedal operating ranges are within the range possible by the human body, and whether they are positioned for most efficient operation.

Evaluations are also conducted from the viewpoints of the motorcycle for the human compatibility between physiological and sensory characteristics, efficiency of operations, reduction of rider fatigue, and the like. Then, based on these evaluations, improvements are made.

3.4 Cognitivity

There are few aspects of motorcycles today that are related to cognitivity; instrument visibility is about the only concern. However, there are many switches concentrated in the area around the handlebars in motorcycles (**Fig. 5**).

Fig. 5 Handlebar-mounted devices

Each of the devices involved in the handlebar assembly is simple and has just a single function. Still a certain amount of familiarization is needed by beginners. In addition, in terms of operability, as noted above, in many cases multiple operations must be performed at once, so that beginners may feel burdened when having to perform these simultaneous operations. For this reason, the level of cognitive engineering and ergonomic design incorporated is important. However, since there is not a hierarchical function structure, proficiency is quickly gained.

3.5 Comfort/enjoyment

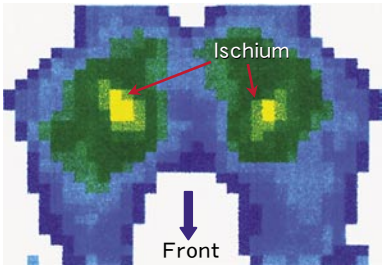

Fig. 6 Seating pressure distribution

Comfort and enjoyment are extremely important since motorcycles are often ridden for pleasure, and during development evaluations are conducted from the viewpoints of ergonomics and sensibility engineering. The riding feeling is important among the comfort/enjoyment items. Riding a motorcycle for long periods will always be accompanied by pain in the buttocks. To produce a comfortable seat that reduces this pain, a wide range of evaluations are conducted during development, such as whether the pressure distribution when a rider sits on the seat is ergonomically appropriate, the pressure distribution and height of the backrest on motorcycles that have them, and whether there are adverse effects from the backrest when encountering sudden turbulence (**Fig. 6**).

Noise is another important item in terms of motorcycle comfort/enjoyment. Great effort is put into suppressing the noise level, but recently attention is focusing on the tone quality as well.

Vibration also affects comfort. The structure of motorcycle frames is relatively simple, and the great structural design restrictions make it difficult to adopt a vibration absorbing structure. To reduce vibration, simulations are used in design and motorcycles with a comfortable vibration feeling are developed and assessed based on physical evaluations and sensory evaluations by people when riding.

3.6 Meaningfulness

Professor Kurosu has defined meaningfulness as "the ultimate criterion in machine development."

That meaning is determined by the ultimate goal in developing the machine.

For motorcycles, the level to which they contribute to self-fulfillment or a richer lifestyle is important, and ideally users should desire the motorcycle itself as a presence in their lives and society. Usability activities are necessary to realize this.

4 CONCLUSIONS

Usability is thought to be only loosely related to motorcycles. However, from the standpoint of the user, incorporating the idea of usability is essential in development. A review based on the developmental criteria advocated by Kurosu for usability evaluation activities reveals that the idea of usability is, in fact, incorporated in various aspects during the developmental process for motorcycles.

However, in view of a number of points to be considered, in the future it will be necessary to devise optimum evaluation methods from the standpoint of usability best suited to motorcycles. This may also lead to an increased range of users including the elderly and women.

■ REFERENCES

1) Masaaki Kurosu. (1996). Human Interface, The Structure of the Usability Concept (Vol.11 N&R 351-356)

■ AUTHORS

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