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The effect of resonance between the different specialized field engineers:

A case study on the division of labor between circuit design engineers and board design engineers

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The purpose of this research is to clarify the mutual aid design behavior among engineers in division of labor. In this research, we call ‘resonance’ a state where mutual aid design is performed between engineers of different special fields in division of labor between different companies.

According to previous studies, the following aspects have been clarified.

- Division of labor is a concept for economic growth.
- Companies around the world are shifting towards acquiring key technologies increasingly from outside the company.
- Modularization of electronic parts has progressed in recent years. At the same time, it has been pointed out that a problem of modularization is to hinder creations of added value in the modern Japanese electrical and information appliance industry.

While engineers making excessive use of modularized products, there was concern that they would gain insufficient designing experience, decreasing their design capability. On the other hand, it was considered that this concern could be addressed by establishing a

relationship among various engineers which would allow them to recognize ‘identity’ of engineer’s design philosophy to help achieve more creative design.

Therefore, this study was carried out by focusing on a set of engineers who specialized in different areas and were carrying out tasks given based on division of labor within current development process of consumer electronics appliances, and who also had a relation to access each other's boundary objects (design drawings etc.). In particular, circuit design and board design engineers were selected as subject.

Since the companies the engineers worked for were different, it was difficult for them to fully understand the other party's design philosophy. However, it was assumed that engineers would perceive each other's design philosophy, and the study attempted to call and recognize this state as ‘resonance’. In order to recognize ‘resonance’, a qualitative study was carried out on boundary objects used by the engineers and characteristics of dialogues exchanged when they received these objects.

As a result, it was found that boundary objects did not directly pass clear information on to the other party or indicate a clear instruction to enable design automation.

In addition, the study revealed feelings among the engineers who were subject of the study that ‘their design philosophy would never be completely materialized because of the existence of the other party’. However, the engineers acted to seek understanding of other’s design philosophy and incorporate them into their own design philosophy through observation of boundary objects and dialogues. Their energy to make these actions was the ‘resonance’, and the following factors were found to have promoted it.

- Foster a sense of secured feelings while having a dialogue by talking about ‘hobbies’ and ‘private life’
- Boundary objects that are perceived to be ‘beautiful’ and ‘interpretation of design philosophy by others’
- Reflective practice
- Dialogues to identify engineer’s ‘preferences’ and ‘style’
- Making quick judgments to solve a design problem

With the above, resonance among engineers occurred and while it continued, the following effects were produced.

- Promotes to make mutual understanding with engineers in different specialized field
- Improvement of currently developing design
- Start of learning process which leads to design improvement

As a conclusion of this research, a model to achieve a creative design using resonance was presented.