Abstract of Doctoral Thesis

Externalization of Skilled Workers' Tacit Knowledge into Explicit Knowledge
- Use of Industrial Management Technologies, AR and AI-

Doctoral Program in Technology Management
Graduate School of Technology Management
Ritsumeikan University

アカギ　コウイチ
AKAGI Koichi

In order to construct the new "*Genbaryoku* (problem-finding and solving capabilities at a manufacturing site)", conversion of skilled workers' tacit knowledge used for work improvement activities and skills to be transmitted into transmissible shared knowledge is required. In this study, the author proposes a method with following three techniques to convert skilled workers' tacit knowledge into explicit knowledge utilizing digital technologies by dividing into cognitive skills which are "preparation", motor skills which are "techniques" and perceptual skills which are "insights", focuses on the concept of Procedural Memory of neuropsychology.

The first technique is converting the knowledge used for work improvement into explicit knowledge by organizing and systematizing the work process information which is cognitive skill into 15 types of information based on the information used for IE, QC and VE, and 3 levels of information on Control of Human Behavior constructed by Rasmussen. It was verified in the manufacturing of heavy-duty gas turbines, and the effect of simultaneously improving the productivity and quality was confirmed by implementing standardization to lower the dependance degree level through organizational improvement activities using explicit knowledge.

The second technique is transmitting the workers' motion utilizing digital technology by creating explicit knowledge which is 3D holographic movement of workpieces from skilled workers' motion on the highly dependent motor skills and acquiring skills using AR to synchronize the unskilled worker's own motion with the movement of 3D hologram. This technique was tested in Tetris Block assembly work and it was confirmed that the average work time of block assembly was shorter and standard deviation was smaller than conventional technique in the control experiment.

The last technique is transmitting the recognition of workers' motion with digital technology by creating explicit knowledge of numerical datasets using skeleton-based action recognition and AI on highly dependent perceptual skills and recognizing workers' motion. Furthermore, in order to ensure the identification accuracy with fewer videos, an algorithm to improve the quality of datasets based on IE thinking and to evaluate the results identified by AI based on VE thinking is proposed. As a result of verification of this algorithm in the process "Form workpiece by grinding", it was confirmed that identification of 3 workers with different skill levels is possible by only two work videos for each worker.

Based on the research results describe above, the author proposes a method to convert skilled workers' tacit knowledge into explicit knowledge by utilizing management technology and digital technology, AR and AI.