Human-Integrated Assist Systems for Intelligence Operators

Hirohisa Sakai
Toyota Motor Corporation, Japan

Kakuro Amasaka
Aoyama Gakuin University, Japan

INTRODUCTION

The Japanese manufacturing industry is now developing global production by establishing production sites in various countries. High quality assurance is regarded as the strong point of manufacturing in Japan (Abegglen, 1958). However, this situation is under threat (Hunt, 1992). The authors consider it vital to make production operators more independent and creative in addition to their engineering capabilities and skills so as to become an *intelligence operator.* In view of the need to develop a new, creative, human-oriented production system for meaningful working, the authors propose the human-integrated assist system for creative, meaningful work leading to improved productivity. It supports autonomous development of *kaizen* as the core of this system for the global production strategy. In the wake of the recent rapid expansion of globalization, short-term training of production operators is an especially critical issue, particularly for ensuring productivity at the start up of local production. To deal with this issue, it is urgent to apply this system to analyze the factors that contribute to the variations in the skill acquisition level of local operators. This is done with a view to establishing a training method that can support them to stably perform work despite the differences in their ability. In definite terms, a brand-new tool, the *visual manual,* is characterized by (1) convenience, (2) accumulation of know-how, and (3) utilization of CAD and CAE data for further development of advanced skills for intelligence operators. Given these circumstances, the authors have created a new intelligent IT system, which incorporates a training curriculum adjusted to the skill acquisition level of each operator, thereby bringing the training program to a higher level. During the course of implementation, the authors also adopted an aptitude test for assessing the aptitude and inaptitude of operators. This was designed for the establishment of an efficient training system. Its effectiveness has been tested at the Toyota Motor Corporation, a leading automotive manufacturer, as a system that brings about autonomous, voluntary skill improvement in intelligence operators.

BACKGROUND: THE NECESSITY OF DEVELOPING INTELLIGENCE OPERATORS FOR A HIGHLY RELIABLE PRODUCTION SYSTEM AND ACCELERATED TRAINING OF PRODUCTION OPERATORS

At present, the Japanese manufacturing industry is rapidly deploying global customer-oriented production throughout the world. This rapid spreading of production sites abroad, however, has brought about many new problems for Japanese production, which has developed a reputation in the past for assuring high quality. As seen in the case of automobiles, the "highly reliable production system" with target productivity equal to that in Japan is spreading worldwide, but the actual productivity (availability) is still often lower (Gabor, 1990).

The major cause of this situation, it has been revealed, is the dependence of the conventional production system on operators' *kaizen* awareness or individual capabilities. This has limited its applicability to overseas operators familiar with different systems and having different cultural backgrounds. In Japan, for example, the reliability of a production line is gradually improved through repeated *kaizen* actions after a new start-up, resulting in possibilities for high product quality assurance.

To solve such problems, early fostering of intelligence operators is the key to successfully achieving global production with high quality assurance. In

order to attain high quality assurance worldwide, it is necessary to ensure all intelligence operators acquire a consistent level of manufacturing skill. In other words, correct *kaizen* and maintenance of the production equipment through fostering of intelligence operators is indispensable to worldwide application of the "highly reliable production system."

Furthermore for the improvement of production quality, "accelerated skill training," among other things, will have greater importance, and be a key to successful production activities.

In connection with the recent increase of domestic and overseas production, a large number of new recruits and limited-term workers are being employed. Generally, these employees learn from their seniors by watching their work on an on-the-job training (OJT) or off-the-job training (OFF-JT) basis. Some acquire required skills quickly (within a week) and start to work at the production line immediately, whereas others cannot reach a required skill level even after three weeks, or perform unstable operation in building the product, resulting in being removed from the line until they reach the required skill level while working as supporting operators.

Such a situation where quality build-up, which plays a central role in quality, cost, and delivery (QCD) activities, cannot be sufficiently achieved has been observed from time to time. In order to realize the production strategy of "uniform quality worldwide and simultaneous start-up," it is urgent to carry out short-term training for production operators so as to level out the variations in their skill acquisition.

STRATEGIC IMPLEMENTATION OF *ADVANCED TPS*, FOR INTELLIGENCE OPERATORS

While manufacturing in workshops is being transformed thanks to digital engineering, the engineering capability in manufacturing workshops often drops, thereby weakening scientific production control for quality incorporation in processes (Amasaka, 2002, 2003, 2004). It is an urgent task to further advance TPS (Toyota production system) strategically for higher-cycled next-generation production business processes, apart from the conventional experience in success from the viewpoint of global production. The authors, therefore, considered the necessity of including and organically integrating the four elements (Amasaka, 2005): production based on information (information technology), production based on management (process management), production based on technology (production technology), and production based on partnership (human management) with strategic application of conventional TPS in view of global production, and clarified *Advanced TPS* for the global production strategy (Amasaka, 2005).

With respect to the above requirements (Amasaka, 2005), the mission of *Advanced TPS* in global deployment is to realize customer satisfaction (CS), employee satisfaction (ES), and social satisfaction (SS) through production that achieves high quality assurance (Amasaka, 2006). In implementing *Advanced TPS* for uniform quality worldwide and production at optimal locations (concurrent production), renewal of production management systems appropriate for digitized production and creating attractive workshop environments tailored to increasing the number of older and female workers are fundamental requirements.

It, in more definite terms, (a) requires strengthening the process capability maintenance and improvement by establishing an intelligent quality control system, (b) requires the establishment of highly reliable production system that achieves high quality assurance, (c) involves reformation of the work environment for enhancement of intelligent productivity, and (d) requires developing intelligent operators (skill level improvement) and establishing an intelligent production operating system. These factors combined will realize higher-cycled next-generation business processes for early implementation of uniform quality worldwide and production at optimum locations.

PROPOSAL OF "*HIAS*" SYSTEM, DEVELOPING INTELLIGENCE OPERATORS FOR PRODUCTION USING *ADVANCED TPS*

Recently, to realize the higher productivity from production operators required for global production, the authors have paid attention to the need for a "new human-oriented production system" (Iiyoshi & Hannafin, 2002). This provides for creative, meaningful working (Aspy, Wai & Dean, 2000; Aspy & Wai, 2001; Sakai & Amasaka, 2005, 2006a), based on a production phi-