Virtually Hands-On Training

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Assembly line workers of the future will be trained by a space-age system that puts them into a virtual reality simulation, including touch and feel. Thanks to AutoCRC's research team from Deakin University and CSIRO in collaboration with GM Holden, training to assemble parts can begin in a virtual world before they are made, identifying opportunities for improved manufacturing efficiency and productivity. Manufacturers are expected to include the virtual training system as an integral part of their processes.

Motor vehicle manufacturer and supplier profitability relies heavily on the efficiency of their production processes. Engineers design the parts and the processes and tools used to assemble them. In the assembly plant, all the processes are divided into tasks and assigned to "stations", where all the parts and tools are available for the job. Assembly line "operators" must perform a sequence of activities at their "station" in the line before the next operator takes over at the next station. This process ensures the parts are correctly and consistently assembled, with the performance quality we expect from modern motor vehicles. Operators are trained so they can correctly complete their activities within the time set for each workstation. The cycle time, or "takt time" as it is sometimes called, is the heartbeat of the factory, and each operator works in step with it and each other.

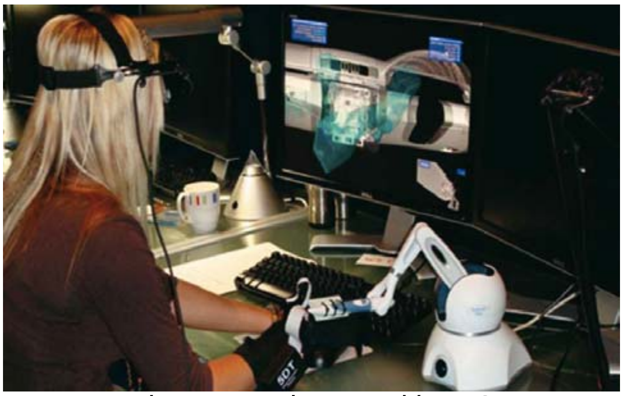
New operators are a fact of life in production lines, as are continuous improvements to the product and processes they encounter. These changes to personnel and components happen often, but do not change the cycle time, so manufacturers must manage through the potential disruptions. Change management is key to maintaining quality, and so plant engineers help operators become familiar with the new parts and assembly steps. They are trained at team meetings or in a classroom-style training and practice environment, but operators need to learn the procedures with real parts and tools in their hands. This means using the production line as a training room.

To reduce the risk to quality of the product, production cycle time after a change is increased, to allow time for operators to be trained and to identify potential issues. Any issues are hopefully minimised and affect a smaller number of products. The problems are flagged and rectified later, to ensure final product quality is maintained.

Operators complete tasks in a cycle time.

Reduction in production rate and cost of fixes to maintain product quality reduces the effectiveness of the production system and the changes. In the worst case, a problem might be undetected until many products have left the plant, leading to customer discontent and damage to company reputation.

Professor Saeid Nahavandhi, Project Leader at the Intelligent Systems Research Laboratory, Deakin University in Geelong believes virtual reality and human-machine-interface systems are the key to solving the problem. Prof Nahavandhi and his team have developed a prototype training environment of the future to demonstrate the key features of the system. The virtual training demonstrator "Hivex", is a highly portable, standalone system that demonstrates the principles of performing fine motor, and gross motor movements by operators on a production line, but in a virtual reality environment. In addition to virtual reality "haptics" or force feedback, has been incorporated to create a realistic component assembly experience.



Haptics research at Deakin's ISRL

The AutoCRC portable Virtual Training Demonstrator is for Automotive General Assembly Operators. This demonstrator offers training even before new components are produced. This productivity shortcut is the result of a partnership between Deakin University - AutoCRC - CSIRO and GM Holden. Haptic devices are used to create physical force sensations and vibrations simulating the feel of assembling physical components. This delivers a real life feel to the training task. The portable trainer's advanced Virtual Reality software with 3D displays also provides depth perception when manoeuvring three dimensional objects. The AutoCRC virtual reality trainer means automotive manufacture can now benefit from reduced training costs and production lead times

Dr Assim Bhatti supervises a trainee on Hivex.

Now in the third stage of research, the research team has grappled with many issues confronting an operator when learning in a virtual reality environment. The resulting technology they have created is a hybrid of hardware and software, giving operators a realistic experience when using "virtual tools" to assemble the "virtual parts". GM Holden will explore the benefits of virtual training, beginning with an evaluation of the system by plant engineers and operators this year. Holden's aim is to achieve "flawless" introduction of part and process change in its plants, dramatically improving quality while saving millions on reworks and rectification costs. In addition, plant engineers and designers can easily simulate and analyses the impact of changes and quickly optimise allocation of tasks to stations, and the arrangement within the stations for operator comfort and safety.

If successful, the virtual training system could be enhanced to perform in-depth studies of design for assembly, and ergonomic factors for a variety is components including electronic modules, engine components, hoses and wiring harnesses to name a few. AutoCRC believes this is a significant contribution to Australia's national research priority of transforming manufacturing industries with innovative technology.

Another exciting feature of this collaboration between research and industry is the engagement globally with the manufacturer's R&D scientist and manufacturing engineers. The team is regularly participating in reviews on a global scale, generating valuable visibility of Australian research capability.

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