# HARCO Project: Intelligence in manufacturing equipment

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For many years we have been witnessing an unstoppable process towards the incorporating of "intelligence" into manufacturing processes. In the 1950s the incorporation of Numerical Controls, and the subsequently computerised ones or CNCs at the MIT, signified a fundamental step forwards in the process to automate machine tools. 60 years later, the aim to increase the final quality of the parts manufactured and the productivity of plants goes on demanding an ongoing effort to improve manufacturing technology. Particularly critical are the effects of the vibrations produced during the machining process on the spot when the tool is in contact with the surface of the part. The precision and final quality of the surface largely depend on these vibrations.

"Hierarchical and adaptive smart components for precision production systems application" is a project within the 7th Framework Programme, recently concluded and funded by the EU, in which Tecnalia is participating alongside 9 companies, centres and universities in Italy, Germany, the United Kingdom, and Belgium; it is tackling the challenge of manufacturing from the perspective of applying totally new concepts to machine tools and to the design rules used. The aim is to develop very stiff structures, but at the same time light, with good damping during operation. New functional capabilities have been integrated into the project; they include active vibration control, an adaptronic interface connecting the head with the ram, adaptive fixturing and thermal stability control, all integrated into a machine that is competitive and economically viable.

The adaptronic interface and the adaptive fixturing are fitted with sensors and smart actuators that allow the vibration level to be measured and action to be taken to increase damping and thus reduce the vibrations. The choice of sensors and actuators and their integration together with the control algorithm are the critical points in the overall system.

The smart actuators and the sensors incorporated are fitted to modular devices that can be easily connected; they are known as Adaptive Smart Components, ASCs. These systems support the new processing logic and can modify the behaviour of the machine according to the changes in the operating environment. Energy efficiency also increases in parallel with the productivity of the plant and the final quality of the part. The sensors pick up the vibrations that can affect the final quality of the part. The intelligent platform fixes an active control strategy that eliminates the harmful effects, and a built-in adaptronic model assesses the actions carried out, and from that moment onwards, it is capable of predicting the damping needs of the process. The whole active system is consistent with the design of the machine and with the dynamic analyses carried out in a preliminary simulation.

The final result is a process without vibrations in a machine that is better designed for its function. The useful life of the tools is also greater, which improves the productivity of the plant even further. Adaptronic devices can be used in a large number of plants and machines. The technology developed will enable Tecnalia to go further into the Future Factory line by promoting intelligence and flexibility in the new production concepts.

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