

Centro Ricerche Fiat, Italy, 11/02/2013: A New Manufacturing Information Framework

In the FoFdation project an automotive test case has been developed with the objectives of optimizing the manufacturing planning process and the energy consumption of the machines tool. Regarding the production planning process optimization, the manufacturing information framework that has been developed should manage different manufacturing steps such as production scheduling, production sequencing and production execution.

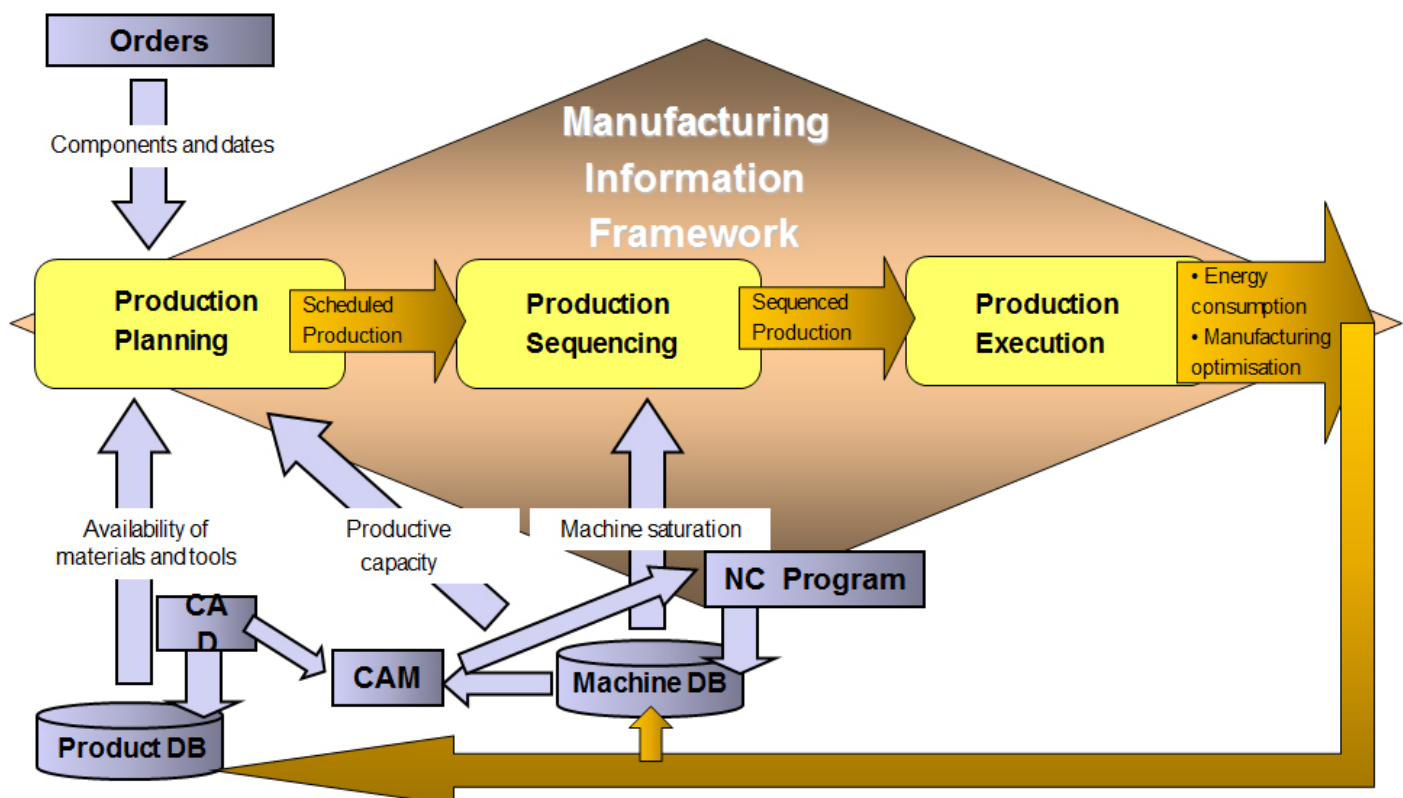


Figure 1: Scheme of Manufacturing Information Framework

The production scheduling phase starts from customer requests (orders) which are translated in a scheduled and sequenced production plan, considering specific plant constraints. Finally, in the production execution phase, the sequenced production plan defined is assigned to the selected machines.

Generally the traditional approaches for production plan definition allow for generation of a scheduled plan in advance on the basis of the production capacity of each resource. In the FoFdation project the intention is to modify in real time some parameters in order to optimise the workload of the machines and their energy consumption, with the help of project partner ARTIS.

The added value of this developed tool is to realise a unique system for the whole process management (production sequencing, production scheduling and production execution) and not to have independent modules. Moreover the developed system must be sufficiently flexible in order to manage the production of different variants of the same product and in order to be applied in several plants with different configurations in terms of the level of automation, number of models and number of components.

The second aim of the automotive test case is represented by the evaluation of environmental impact at

machine level in terms of energy efficiency, which is fast becoming an important competitive factor, because it allows organisations to meet the environmental objectives imposed by legislation and it permits the reduction in the plant operating costs. The manufacturing system can be studied at different levels of analysis, ranging from the entire enterprise to the single machine tool. In particular, the objective of the automotive test case is the analysis of the energy consumption related to work centres and the evaluation of the energy consumed by machines during different operating phases (i.e. working idle and set up phase).

Automotive Use Case: application to engine cylinder head production line

The automotive test case is focused on the definition of production scheduling and sequencing plan in a plant for the production of an engine cylinder head (see Figure 2). The cylinder head is one of the main components of an engine, which is in fact constituted by three major components: cylinder head, engine block and crankshaft.

For the processing of each macro component of an engine we have different groups of machine tools: for instance working centers for the cylinder head and engine block, or lathe for the crankshaft (see Figure 3). The work centers are self-contained units of the manufacturing process in which some manufacturing activities are performed.

The schematic production process of a cylinder head is shown below in Figure 4. The cylinder head is transferred to a first work centre (C1) where a roughing out operation is carried out. A second work centre (C2) performs a semi-finishing activity. After that a finishing operation is carried out in a third work centre (C3). In C1 milling and drilling operations are carried out, in C2 and C3 milling, drilling and tapping activities are performed. When this operation is completed the cylinder head enters a washing machine and then it is sent to the assembling line.

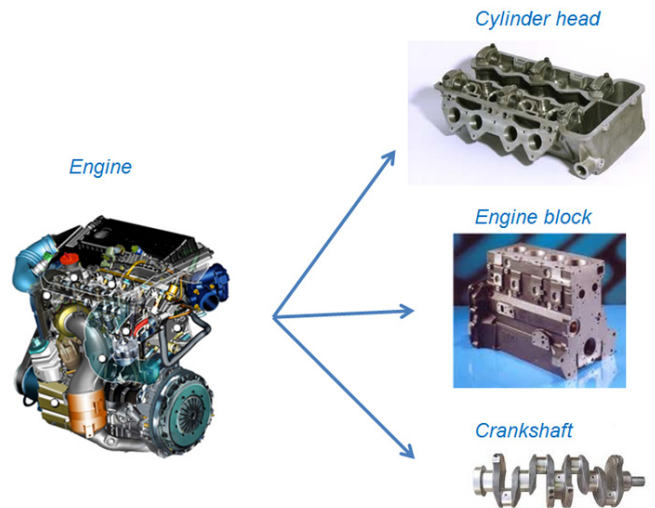


Figure 2: Engine macro components



Figure 3: Example of work center - Comau Urane 20 in the Centre Ricerche Fiat laboratory

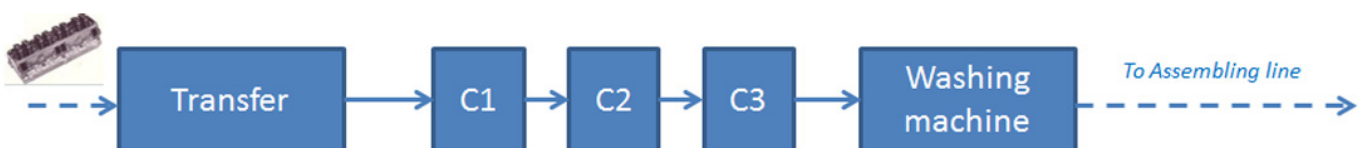


Figure 4: Cylinder head working process

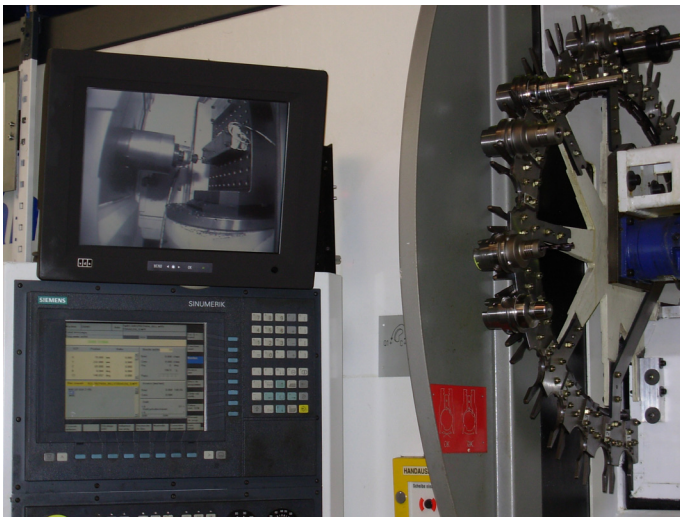


Figure 5: Tool magazine, video camera and numerical control of Urane 20 machine

The work centre used in FoFdation for the cylinder head processing is a URANE machine that is designed for high speed machining of lightweight alloys, such as aluminium. The centre has 3 axes driven by linear motors (X, Y, Z), a rotating table, and a tool magazine. The linear motors allow fast acceleration on the axes of up to 1.5g. The machine tool's closed working chamber is equipped with a video camera, connected to an external display in order to better see the machining process inside.

The manufacturing information framework will provide a new production plan optimized in terms of machine work load and energy consumption for each work centre. The collected data is aggregated in a dashboard that shows relevant KPIs with their targets and actual value.

For more information about the FoFdation project visit <http://www.fofdation-project.eu> and the project's social media pages, including Facebook ([#fofdationproject](#)) and Twitter ([@FoFdation](#)).

Acknowledgements:

This project is co-funded by the European Commission as part of the European Economic Recovery Plan (EERP) adopted in 2008. The EERP proposes the launch of Public-Private Partnerships (PPP) in three sectors, one of them being Factories of the Future (FoF). Factories of the Future is a EUR 1.2 billion program in which the European Commission and industry are collaborating in research to support the development and innovation of new enabling technologies for the EU manufacturing sector.

For further information please visit:

http://ec.europa.eu/research/industrial_technologies/factories-of-the-future_en.html