44: Industry in the Future: UTC an academic partner for enterprise

The ongoing digital transformation of industry is a major societal challenge. For UTC, accompanying a growing number of companies during the changes, the phenomenon represents an increasingly strategic field for studies. This Dossier zooms in on the university’s main activities and on the specific nature of its approach to the industries of the future.

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Summary

Machining the right part perfectly, first time round

Optimization of the digital chain to industrialize a machined part, to better capitalize on the data, on the professional expert knowledge, thereby gaining in efficiency. This is the challenge assigned to research work carried out by UTC-Roberval Lab in the framework of two successive multi-partner projects supported financially by an interministerial incentive fund (FUI): Angel and Lucid.

If each link in the industrialization chain of a part to be machined uses specific software packages and therefore integrate data from different sources, there are standard data exchange formats. The CAD file is used by a CAM software that enables operators to model the trajectories of cutting tools in the 3D representation of the part. Likewise, the CAM file is exported via another standard in a post-processor which serves to generate an ISO code that can be executed by the numerically controlled machine tool.

Notwithstanding, the chain remains complex and, above other considerations, it should be noted that digital continuity is **uni**directional – running from CAD phase to implementation at the machine-tool. If, during a production phase, certain machining parameters must be adjusted directed at the machine-tool, this information is not automatically sent back to the CAM programmers: the professional experts who, on the basis of CAD, draw up the machining strategy for a given part (choice of tools, definition of trajectories …) and the machine-tool programme *per se*. Knowledge acquire after manufacturing is thus not necessarily capitalized on to be used again for later projects and make it possible to machining the right part perfectly, first time round.

Bidirectional continuity

Issues like these were addressed in a first FUI project (completed in 2014) called: Angel* (in French for 'An interoperable, agile, digital cognition workshop'). In order to 'fluidify' the digital chain, UTC-Roberval Lab worked on consolidating a new data exchange standard, STEP-NC (see below), so as to attain its industrial transposition./ The advantage here is that this standard is used at each interface of the chain and even does away with one step, viz., the need for a post-processor unit. It will be possible, in the future, for the machine-tool to read and implement directly the AM file. Moreover, STEP-NC allows you to have a return of information to the CAM level from the programme as executed by the machine tool. In this way, a **bi**directional continuity has been achieved.

*STEP-NC compliant Numerical Control

Aids to decision

What is the next step? It will consist of supporting the specifications of machining parameters drafting machining programmes, *viz.,* to come up with a system capable of analysing a given CAD model's geometry and by examining comparable parts already machined by an industrialist to automatically propose the best-fit machining strategies to make new parts. This is the objective assigned to a new FUI programme launched in

October 2016, called LUCID (in French for “machining laboratory using smart characterization of data”).**

“In order to develop this aid to decision-support tool, we must rebuild then capitalize various strategies implemented for the different parts to be machined”, explains Alexandre Durupt. *“This constitutes one of the difficulties of the project, inasmuch as it presupposes that we analyse highly heterogeneous sources of engineering data (machine-tool execution ISO coded data, the CAM and CAD files …) to identify patterns that will form the kernel of a machine strategy”.* The exercise is all the more complex that there may exist differing ways to produce a same shape through a machining process.

*: Angel combined inputs from UTC, ENS Paris Saclay, Safran, Airbus, UF1, Spring Technologies, CADLM, Datakit.

** : Lucid combined inputs from UTC, ENS Paris Saclay, ESILV, Safran, UF1, Ventana Taverny and Spring Technologies.

Digital continuity through time

Philippe Audinet, Head of Development & Support for the CAM branch of Safran Aircraft Engines and a partner to the Angel and Lucid projects, addressed some questions for *Interactions*.

As you see it, what is the main benefit in using Angel?

We use it to consolidate the STEP-NC* standard. This is all the more crucial for sectors like aeronautics that our products have an operational life expectancy of thirty, forty, even fifty years. To frame this differently, this is a far longer time than that expected of any computer device used to industrialize the process, or of the machine-tools, but even of the normal career span for the CAM programmers. It also requires that we build and use data models that are stable in time, in essence, ‘standardized’. By applying a single standard throughout the production chain, the connections between the various links becomes last longer

*STEP-NC compliant Numerical Control

What challenges does Lucid introduce for Safran Aircraft Engines?

When you industrialize processes needed to make aircraft engine parts, the human added-value factor is paramount. Programmers have to integrate huge numbers of parameters to make sure the parts are machined properly and guarantee the transition from the digital model to the real, physical part. This transition, in fact, is a sensitive issue inasmuch as we work with some complex materials, such as titanium, that prove difficult to machine. Our engineers are constantly faced with problems that relate to vibration, to temperatures, to tool-bending, to parts … Consequently, there are always small discrepancies between theory and what a machine-tool really does, and several return trips are needed between CAM and manufacturing before we can obtain the part as we wanted it. Hence the interest we place in exploiting the capital background, the history of our machining programmes to better guide the programmers. That too is a form of digital continuity in ICTs and in time. Moreover, by capitalizing on our rich background, we can also assist the young programmers to progress in their special skills.

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