# NATIONAL MANUFACTURING INITIATIVES

*New Economy needs Reshaping Engineer's Skills Profile*

Xavier Fouger

***The recent years have seen many governments realizing that sustained employment or economic development require industry at large to embrace new principles:***

***- User-centric value chains with reduced intermediate structures thanks to connectivity (Internet of Things – "IoT", Social Networks...), with increased distribution of the power to determine what is consumed and with the involvement of consumers, as crowds and as individuals, in the ideation, design and manufacturing of goods and services.***

***- Responsive, agile, distributed ("smart") production structures that are more automated and more digitized to enable global optimization of value creation, personalization, geographical distribution and consumer's reach.***

***National initiatives have mushroomed in support of the transitions of socio-technical practices, business models and economical and regulatory structures. One could name "Industrie 4.0" in Germany, "Manufacturing 2025" in China, "Manufacturing Renaissance" in the USA, "Make in India" or "Industry of the Future" in France.***

***The new economy resulting from those initiatives will be designed and operated by engineers. Many of them are yet to graduate and the challenge on engineering educators is considerable.***

Personalized production techniques, distributed engineering and manufacturing, smart production facilities, globally dispersed stakeholders are some characteristics of the new industry that determine new competences in engineers. They are all enabled by the existence and use of a digital environment that provides a high fidelity digital representation of objects and their production system. Permanently connected to their physical avatars, those representations anticipate and drive the behavior of "things" but also continually digest information provided by actual devices to represent their real status in operation. These environments create the "virtual twin" of the simplest gadgets to the most complex industrial structures. Because it is digital and reproduces reality as closely as possible, the virtual twin provides an affordable and realistic context for educators seeking to make practices of the new economy an integral part of their students' learning experience.

## 1. The virtual twin: realistic beyond virtual labs.

Virtual laboratory equipment is traditionally understood in two distinct manners. They can provide an electronic idealization of the behavior of the physical device or they enable remote operation of such device. In a recent exercise called the “Pune Experiment”, Dassault Systemes validated the educational value of combining both approaches. An Arduino controlled desktop robot in Paris was controlled by its virtual twin in Pune (India). Feedback was provided to the digital avatar over the internet and to the learner in India by a webcam displaying how the robot executed the instructions simulated virtually. Simulation in India was combining multiple aspects of the robot (kinematics, dynamics, electromechanical) into an integrated multi-physics simulation coupled with the actual parameters describing the physical device in France. In such configuration, learners can program their devices in a manner that reflects the limits of digital idealization. Assessing the existence and magnitude of discrepancies between idealized digital models and the reality is an essential engineering skill in general; experiencing such correlation, with the device and its virtual twin being distant, provides understanding of essential phenomena at work in an IoT context. The exercise, relying upon Dassault Systemes’ latest technology –the 3DEXPERIENCE Platform- takes full benefit of a cloud-based architecture providing further opportunities to learn the role of virtualized platforms to operate networks of smart machines.

## 2. The virtual twin: social beyond students’ exchanges.

Before being a “twin”, the digital avatar is a “parent”, the single source of truth of everything foreseeable about a product or a system, before its physical existence. The practice of defining and validating any device before making it is the essence of engineering. It combines in a shared computer representation all aspects of the form, the fit and the function of an object. The multi-disciplinary exercise of combining many categories of knowledge to create it is an essential skill which currently drives profound changes in educational methodologies. The ease of sharing data across distance had already enabled technical collaboration. With the advent of cloud computing and social networks, software now also supports collective innovation in its social dimension. In a recurring annual activity led by Université de Lorraine (France), the Digital Farm Project (DFP), is an international, collaborative, multidisciplinary and digital capstone project. Gathering 16 universities in 7 countries in Latin America, Europe, Africa and Asia, this educational experience is a model for project-based learning. Students in their respective universities form a globally and culturally dispersed team and discover through practice, the attitudes and aptitudes required to engineer a farming practice supported by smart equipment to enable precision agriculture. The resulting robots are actually built by mechanical and mechatronics engineering students. Field testing is performed by agricultural engineering students who also participate in the engineering.

An essential learning outcome from this use of the virtual twin is that it provides an ideal context to actually exercise the very practice of cross language, cross culture innovation as required from engineers who will experience the social paradigm underlying the new economy.

## 3. More change ahead

Beyond the examples above, many other new practices will gain momentum as a consequence of national manufacturing initiatives. The practices of additive manufacturing, crowd based innovation, big-data dashboarding, digital factory, disruptive IoT-enabled business models, etc… will have large impacts on engineering skills, Dassault Systemes works with industry to define them and with academia to bring them into the curriculum.

A complete documentation about both above examples can be found at: http://academy.3ds.com/lab/

3DS ACADEMY

DASSAULT SYSTEMES

ACADEMY.3DS.COM