**Sustainable Performance and skills in Chemical Engineering 4.0**

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When we enter in a process engineering classroom, what do we see? Is it in 2019 as in 2000 or 1960, close to the introduction of chemical engineering courses in France? The teacher stands at the front of the room, copying part of his/her notes, less and less often on the board, and more and more often using Power Point presentations, more or less personal, repeating aloud what he/she writes or presents on a screen.... Students sit, often passively, play with their mobile phones, a little less during the supervised exercises, which are essentially deductive, read more rarely, work on the homework of another class, or dream...

Understanding the learning environment invites us to consider the activity of today's learner in its intentional, instrumental and social components. This activity, in a formal or non-formal context, involves questioning the engineering of training systems, how to formalize processes, learning products and their evaluation. It is a complex set of approaches, not only because of the diversity of teaching methods on the one hand, but also because of the theoretical and epistemological frameworks used to describe and understand learning on the other. In Process Engineering, “teacher-researchers” are confronted with the lack of a framework for building their methods, both in terms of data production and analysis. What methods can be proposed? What criteria should be identified and defined to ensure their scientificity?

Today, the main axis of development of higher education institutions (and French Schools of Engineers) logically concerns the disciplines and contents of training. Graduates' professions are changing, sectors of activity are changing, and learners can no longer have the same skills and/or culture relative to the recent past. Among the current incremental trends, we retain the following aspects: occupation, sectors of activity, learners' cultures, the effects of spontaneous and stimulated pedagogical conservatism, etc. New knowledge is only placed on old knowledge without much change. Teaching is only partially successful: as soon as the conditions for learning are changed, common knowledge reappears. In other words, the student's mental representations are probably the main obstacle to teaching science subjects....

At the same time, our universe, which is globalized, but also weakened by different types of crises and trade wars, requires differentiated development of proactive, creative and supportive personalities: trained, through appropriate and varied accompaniments, to “juggle” variously with incessant new (artificial intelligence (AI)) or old topics, cognitive and methodological (complexity) objects, as well as material ones, without weighing down or bothering them, within a liberal and open civilization. Paradoxical tasks! Teachers and trainers can no longer be limited to mere masterful inculcations or binding and marginless imitations. They need a range of pragmatic modalities, gathered and certified cooperatively, following a progressive scientific research, in order to constitute a reasoned set of Methods and Instruments, Techniques and Values, Combinatorics and robust Modelling: that is, a varied, plural range of Engineering Sciences of training and education.

A forecasting analysis highlights various major trends (depletion of reserves, various types of pollution, clean processes, renewable energies, changes in trade, recycling, information inflation, exploration of complexity, interdisciplinary projects, etc.). However, in the field of matter and energy transformation processes, we can observe the simultaneous presence of century-old processes (Sodium carbonate production, for example) at the same as recent activities in full development (additive manufacturing, some biotechnologies, etc.). How to manage such diverse temporalities and technological issues?

On this “simple” basis, the volume of information, which engineers are collectively called upon to know, is increasing considerably, faster than the ability of current curricula to take it into account.

This observation for an engineering domain that is rather difficult to attract students (in France), but which does not currently have any difficulty in placing graduates, raises a number of questions today:

1- How can the system of evaluating engineering education and training be made to understand the radical need to change working methods?

2- How can we anticipate a future that will have to take into consideration the complexity of the socio-technical systems covered by process engineering (PE)? How then can we support emerging problem-solving skills? How will the students be able to become successful researchers in PE?

3- How to encourage risk-taking and creativity in current training courses based on traditional deductive methods? How can it be adapted to anticipate and manage change?

4- With the development of the concept of Industry 4.0 and Artificial Intelligence, is there not a need to take this important contribution to training, saving time on basic teachings?

5- How to think about the transition concerning innovation on new processes resulting from research towards training?

6- How to take into account the notion of social and environmental responsibility in training?

7- Can we take into consideration the contributions of digital technologies to participate in training on the one hand, and in industrial development on the other? How to take into account the students' appetite for these new technologies?

8- How can we obtain "sustainable" engineers who will be able to participate in technological progress in their field of competence based on the answers to these various questions?

The increase in the knowledge required in the current disciplinary educational system, limited in time to a 3+2 year schooling, is not possible. Artificial intelligence can fill certain gaps, even more and better; it can then participate in an emerging process in the training of managers and in decision support. The emergence of AI is therefore an opportunity to rethink and relocate, in time and space, the exchanges between teachers and students, especially individualized ones. It is a world under construction that is becoming closer, going beyond the current “MOOC's” (Massive Open Online Course).

To achieve this objective, facilitators will be sought to develop the company's competitive subsidiarity, taking into account its processes and constraints (safety, supply, waste management, environment, society, etc.) as well as communication methods, a good estimate of current societal and technological movements, etc. So these are open proposals for reorienting the mission of process engineers?

It seems important that a student discovers the complexity of the subject matter of a practical question when leaving the (indispensable) disciplines learned, that he or she “goes beyond” the limits of his or her basic teaching to try to see the question in a way other than through disciplinary filters. This is why it might be useful to introduce into a compartmentalized system the idea of a virtuous “circle” over various openings in order to achieve an updated performance... But in a world in profound change, are the characteristic times of the different changes compatible? To do nothing is a mistake, to do nothing is a risk taking! Then, let us follow Henri Bergson, a French philosopher who wrote: “Man is the only animal whose action is poorly assured, who hesitates and gropes, who forms projects with the hope of success and the fear of failure”. Let's dare...

The purpose of the presentation will concern, on the one hand, the factual elements present and envisaged in the future, but also proposals that could be the subject of questioning and debate with the GP audience.