Interview: Carlos VelÃ¡zquez â?? Director, CPEDaL, Puerto Rico

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The Center for Pharmaceutical Engineering and Learning (CPEDaL) was established in 2006 as a ten year training program that is currently awaiting funding for the next five years. Carlos VelÃ¡zquez, director of CPEDaL, explains how the Center introduces high school students to pharmaceutical engineering and their pioneering work in mixing and granulation for some of the largest manufacturers in the industry.

Could you describe how the program started, what you needed to do to convince people to invest in this idea and how it all took off?

CPEDaL is an initiative that emerged as part of a federally funded program and a center called C-SOPS (Center for Structure Organic Particulate Systems) supported by the Engineering Research Center Program from the National Science Foundation. The program involves the MayagÃ¼ez Campus of the University of Puerto Rico (UPRM) and three institutions from the mainland: Rutgers University, which is the leader of the center, the New Jersey Institute of Technology and Purdue University. The initial funding was only for ten years so we had to demonstrate every year that we were progressing to continue receiving those funds which are meant for research and education. As such, UPRM was required to develop a research and an education program. In addition, a key difference with other NSF programs is that the ERC program requires an industrial membership program, which provides additional funds for research and education.

The research that we conduct here at CPEDaL is focused on process control and the FDA initiative PAT (process analytical technology). In terms of education, we mainly work with K-12 students. We bring students to the lab and they work with the different operations available here such as mixing, granulation, dissolution and PAT. We also developed a summer camp which began in 2011 and the idea behind this is to bring students from different high schools around the island to the lab and provide them an insight into the pharmaceutical industry. They are here for a week and they carry out all the steps to prepare a tablet and then characterize the product. Finally, they have to do a

presentation for their parents. With these two initiatives, we are hoping to create a pool of students that are aware of pharmaceutical engineering and that want to continue in this sector and undertake advanced degrees in pharmaceutical engineering. Therefore, when they go into the industry, they will have a better understanding of the processes, phenomenon and the manufacturing so they can contribute to the company faster and can help with the transformation that is taking place in the industry. This combination of education and focus on the technology needs of the industry has been the hook to get a real support from the industry.

Puerto Rico is in a very privileged position to be able to offer these kinds of programs to students because this concentration of industrial engineering does not exist anywhere else in the US to the extent that it is engrained in the culture. Having young people involved from an early age is truly special and advantageous because few such programs exist around the world.

The industry began developing here in the 1960s, so most of the students we are receiving here have parents who have worked in the industry. They are therefore already familiar with the industry and want to learn a little more. For 2014â??s summer camp, we received 271 applications for just 24 positions. Hopefully we can increase our capacity in the future to accommodate this. When we mention all these opportunities they are very keen to take advantage of them, so as the years pass more and more students are willing to do something in pharmaceutical engineering. We are currently establishing a minor in engineering as part of the chemical engineering program and a lot of students are choosing these electives. Moreover, they want to undertake undergraduate research here at CPEDaL. We see an increase in the number of students interested in this area; this means that, we can have a greater impact on the industry through these students.

The fact that there are so many students interested in pursuing careers in the industry or related research must be a good bargaining tool when looking for new sources of funding.

Hopefully we can use this fact as leverage to gain access to more funding and more government support. The fact that the Chancellor and the Dean are both aware of what we are doing and are eager to support CPEDaL and that the industry is also behind this initiative are important points when it comes to gaining government support.

You mentioned that you have two main research focuses: PAT and process control. Could you elaborate upon what they entail?

Actually, we have expanded our research to other topics. The basic topics that we are researching at the moment are mixing, granulation, drying, PAT and process control. With mixing, for example, we developed a continuous tumble mixer which we have submitted for patent. The goal of our research in granulation is to understand the process from a phenomenon perspective and for drying we are working on batch-mode drying and continuous drying which would be critical for the transformation that the industry is seeking. In terms of PAT, our focus is on how to use technologies to measure some variables in-line so we can send those values to a control system; for example, if we are working with a granulator it is important to measure the particle size. We can use a vision system to measure the particle size in-line and send this value to a control system where we can develop a control strategy by looking at the value and comparing it to the desired particle size. Based on that comparison, the control strategy can adjust different factors in the process so that we get the desired value. There are many different control strategies for process control; the most interesting aspect in that sense is to use control strategies to optimize the operation because you can control a variable with a strategy, but that does not mean that the overall process is operating at the optimum level. As such, the value of doing work on control systems is to optimize the processes and maintain them at that optimum level.

You mentioned that at CPEDaL you work alongside pharmaceutical companies. Have there been any particular success stories or milestones from this collaboration?

One of the Centerâ??s best success stories is related to the projects we are currently carrying out with local companies to improve their operations. We have projects with Janssen, BMS, Lilly and we are now setting up a project with HP which will involve 3D printing and is related to granule material. The success stories are the interactions with these companies. Our second success story is the establishment of a continuous manufacturing room here, which can be used by those companies for experiments or projects. One of the highlights for C-SOP, the umbrella organization that helped create CPEDaL, is the success of the construction and development of this Center. CPEDaL has managed to integrate research, education and services for the industry and facilitate intercommunication and collaboration between the three. It is this intercommunication with the industry which drove us to focus on process control and this research could be a great asset not just for the pharmaceutical industry but also other industries such as petrochemicals. With the patent problem that the pharmaceutical industry is facing, manufacturing your products in the most efficient way with no energy or product waste is fundamental. Process control is integral to this procedure because by monitoring the systems you can ensure you are getting the right quantities at the right time. So the philosophy behind integrating research, education and industry has been to stimulate and facilitate collaboration between the three and, as such, work to improve process control for the benefit of the industry.

Are you receiving a lot of interest from the international industry for your work on process control?

Some pharmaceutical companies are very aware of the advantages of process control so they are already enquiring about the technologies we have here and how they can incorporate these technologies into their own processes. For a specific project with Janssen, we are helping with their mixing and granulation modelling and how these models can be used to set up a control strategy that ensures they have no failures and operate at the optimal conditions. So our work is attracting the attention of companies.

Assuming that CPEDaL is successful in renewing its funding, what would you like to have achieved in another decadeâ??s time?

I have two main goals, the first of which is to contribute to the transformation of the industry and continue preparing engineers and scientists who will go into the industry and be involved in this transformation. The other thing I would like us to achieve is to have local people starting their own manufacturing sites because with the experience that we have and particularly with this continuous operation mode, it will be cheaper than the classic batch operation for producing specific products. I believe the incentives are there to have our own manufacturing shops so hopefully our work here will make this a reality.

Do you see a local manufacturing industry as a viable option over the next twenty to thirty years which could realistically come to fruition?

I am not an expert in economics but I believe we have the necessary knowledge; we have people with the drive to achieve this and we have already had many local people who have started successful companies so I see no reason why we could not accomplish this in the manufacturing sector. I honestly believe that in twenty years we will have a couple of local companies producing products with continuous manufacturing methods. If we continue preparing new engineers with that kind of mind-set, for example, by modifying our curriculum so they can take courses in the Business Administration School and therefore gain a basic knowledge of entrepreneurship, I think it will be

possible to have our own manufacturing shops.

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