Qualifying People for Embedded Software Development and Data Science: An Experience on University-Industry Cooperation

Marcelo J. R. Lemes[1], Adriano Sarmento[2]

[1]Embraer
São José dos Campos, SP, Brazil

[2]Centro de Informática – Universidade Federal de Pernambuco
Recife, PE, Brazil.

mjrlemes@embraer.com.br, aams@cin.ufpe.br

Abstract. *Trained people is a key aspect in the success of a company. There are several ways to train people but the partnership between companies and academia is have been shown good results. This paper presents the collaboration experience between Embraer and Universidade Federal de Pernambuco in the creation of the Software Specialization Program (PES)[1], a postgraduate program for training people in embedded software development and data science.*

1. Introduction

The success of a company is strongly related to the knowledge and ability of its professionals to perform their tasks. This implies, among other aspects, in having personnel properly trained in the subjects related to the company's business. This is not a simple task, as it requires planning and continuous effort within a corporate strategy.

According Cloutier et alli (2015) training is not only a way for capacitation but also a motivational tool for employee retention by raising the commitment of employees toward the company objective. Several techniques are frequently used for training people. As examples of such techniques, we can mention on-the-job-training [Sekerin et alli 2018], gamification of training [Larson 2020], mentoring and coaching [Al Hilali et alli 2020] among others. It is common for companies to develop their internal training projects or outsource them for specialized companies. However, one formula that has shown good results is when company and university come together in collaboration [Fisher et alli 2019][Gazzetta, Kato-Cruz and Endo 2020].

In this sense, the objective of this article is to present an experience of partnership between Embraer and Universidade Federal de Pernambuco (UFPE) in the creation of a *lato sensu* postgraduate program for training people in embedded software development and data science.

[1] In Portuguese: Programa de Especialização em Software (PES)

2. The Embraer Demand

Ten years ago, Embraer took the decision to verticalize the software development of the most critical system of its aircraft regarding the safety, in this case, the Fly-By-Wire system. The initiative presented very good results which led the company to verticalize other software developments embedded in its products. Therefore, the demand for professionals increased, imposing a great effort of hiring every year.

It is not an easy task to find in the market professionals with knowledge in embedded software development. The analysis of resumes and interviews took hundreds of hours of human resources personnel and technical leaders. Not rarely, the hiring process finished without the positions filled.

In parallel, some areas of the company experienced similar difficulties to that lived by the embedded software teams, however referring to another subject: data science. In recent years data science has gained importance in various activities of the company, becoming a strategic discipline for the business. As an example, predictive analysis processes of equipment failures are one of the subjects that could be developed based on the application of data science techniques.

In the face of this scenario, Embraer decided to create a program to train the professionals needed to develop embedded software and to work with data science in partnership with a reference university in the respective areas. In this way, the Software Specialization Program was created.

3. The Software Specialization Program

The Software Specialization Program (PES) was conceived as a *lato sensu* graduate program to train professionals in the areas of embedded software and data science in two distinct courses. The program lasts 9 months and was organized into 3 modules. In the first and second modules the students have classes and in the third module they develop a project in a subject proposed by Embraer. PES students attend the program as scholarship holders and are hired at their end, according to their grades and needs of the company.

To carry out the program it was necessary to find an educational institution that was a reference in computer science. Embraer has opened negotiations with three universities that have evaluation 7 from CAPES for their graduate programs in computer science. At the end of the process, Universidade Federal de Pernambuco was selected.

The preparations for the program, from its conception until the inaugural class, took almost 2 years. It is possible to divide that time into 5 stages. The first refers to the definition of the disciplines as well as their initial syllabus. The second stage involved the process of internal approvals. In the third stage there was conversations with universities and the presentation of the respective academic and commercial proposals. Also at this stage, it was created a committee composed of people from technical and commercial areas to evaluate the proposals, selecting UFPE as a partner for conducting the PES. The fourth stage was dedicated to the administrative adjustments and review of the syllabus with the teachers of each discipline. The fifth stage was the selection process.

4. Universidade Federal de Pernambuco

UFPE has a large experience in conducting cooperation programs with industries. In particular, regarding Embraer, this cooperation is not new, dating back to 2006 a first initiative, when a project on formal methods for qualitative and quantitative analysis of models for aeronautical applications was conducted. The current project, in this case the PES, has an educational character involving the creation of a new graduate program at Centro de Informatica -UFPE (CIn). This kind of project is also not new for CIn, as in the last 20 years, CIn has successfully created other *lato sensu* programs with several industry partners, using different formats and methodologies.

This program has 15 professors who teach 17 disciplines of the Courses of Data Science and Embedded Software for the Aeronautical Industry. Disciplines are taught remotely, one at a time in periods of two weeks each. This imposes a high level of engagement on students who have full time dedication to the program. This approach has proven to be quite productive since students keep the focus on a single subject during the period of the discipline.

An important aspect for the success of the program is the way in which the interaction between UFPE and Embraer occurs. A program of the size of PES requires continuous coordination between the parties so that ordinary issues can be quickly discussed and addressed. The lack of active coordination may compromise the results desired for the program.

5. Selection Process

In just over 15 days, when the online registration for PES was open, 2,300 people signed up for the selection process, which was conducted in 3 stages. The first stage was performed as part of the candidate's registration. To finalize his registration the candidate had to take an English and a Logic test. Of the total number of registrations, approximately 1000 candidates were selected and called for the technical test that addressed questions of Data Structures and Algorithms, Software Engineering, Statistics and Mathematics for Computer Science. The elaboration of the questions, application of the test that occurred remotely and the correction was carried out by UFPE. In the technical test, 140 candidates were selected who went through a process of group dynamics and interviews.

This last stage although quite demanding was fundamental to know better the candidates. The candidates were organized into groups of 8 people and were accompanied by two engineers and a representative of Embraer's Human Resources area. At the end of the group dynamics and interviews, for the 2022 PES, 35 students were selected.

6. Mentoring

A concern of PES coordination, beyond giving a solid conceptual background to students, is bringing them, as much as possible, to the company reality. To this end, as a complement to the classes taught by UFPE, lectures by Embraer experts on courses related subjects were planned. In these lectures students can learn about the daily challenges, processes and methodologies of the company. In addition, each group of 2 or 3 students has a mentor who acts more directly with students understanding their expectations and providing career advice.

7. Conclusion

Embraer has been establishing partnerships with several Brazilian universities and abroad. In the same way that UFPE conducts projects with industries from different sectors. These partnerships have brought excellent results to those involved. The industry gains from the knowledge available by universities and the universities by knowing and understanding practical problems that the industry presents.

However, it is important to highlight the aspect of planning and monitoring of this type of initiative. A project like PES was thought of for almost a year within Embraer and discussed during another year with UFPE. In terms of follow-up, periodic coordination meetings and contact among mentors and students are fundamental to the good outcome of the project.

The class of 2022 is in progress, but the results have been very good, and the planning of the class 2023 has already begun. Adjustments of the syllabus of some disciplines, addition of new disciplines are some of the topics that are under discussion to be implemented in the next class. The renewal of the partnership is also being negotiated, but this time for the next 5 years. Embraer and UFPE are looking for a long-term partnership.

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