Questions asked of potential collaborators:

• Why does your university want to join the CDIO Initiative?

All around Europe the Bologna process has provided a strong momentum for curricula change. In Spain, this process has been delayed by different governments and we are now designing and starting to implement new degrees. Other Schools and Universities in our close and medium-range environment address a change, by adding soft skills to the curricula. In our case we consider the situation an opportunity to modernize the curriculum focus and methodology and go one step beyond. In an internal survey conducted by the school, we have analyzed not only reference documents given by the Spanish government, we have also examined the approaches that are used in several universities in Europe and the United States, as well as several lists of competences developed by different organizations (ABET, Tuning, ...). We concluded that our direction was well aligned with the CDIO initiative, which we consider the most comprehensive and integral approach.

• To which of your programs do you plan to initially apply CDIO? How do you expect CDIO to impact these programs? What goals do you hope to achieve?

CDIO has already being considered in the definition of the five new BS degrees to be offered by our School, two of them starting September 2009, the rest in September 2010. These five degrees will substitute the current 5-year-long Telecommunication Engineering degree (in Spain this discipline is equivalent to Electrical Engineering degrees), namely:

- 4-year long Bachelor of Science and Technology in Telecommunications, covering the breadth and width of the discipline. This degree will be integrated in a 5,5-year long BS+MS structure
- 4-year long Bachelor Degree in Telecommunication Systems Engineering
- 4-year long Bachelor Degree in Electronic Systems Engineering
- 4-year long Bachelor Degree in Networks Engineering
- 4-year long Bachelor Degree in Audiovisual Systems Engineering

We plan CDIO to impact notably since this perspective has been used pervasively in the definition of the 5 new programs.

1 The last four degrees are also designed to observe the laws concerning regulation of liberal professions that in Spain are tight to higher education degrees.
The overall goals are to 1) Change the traditional focus, 2) Improve the student learning orientation and 3) Improve the student skills.

Additionally, in front of our traditional rigid structure degree, we strongly think that CDIO-related methodologies are unique to cope with diversity at two planes: a) The diversity of student capability, previous knowledge and attitude/interest, and b) the diversity of engineering profiles as learning outcome of our degrees.

- **As a CDIO Regional Collaborator, what would be your plan for participating in, and contributing to, the International CDIO Initiative?**

  Indeed we plan to actively participate in regional meetings and activities as well as to share our CDIO perspective with other CDIO partners. We also plan to give visibility to the CDIO initiative University-wide, a process which has already been initiated.

- **Do you envision helping to involving other universities and locally developing the Initiative do you envision? If so, how might you do this?**

  We plan to be an active CDIO partner expanding the CDIO influence on a University and region basis. Additionally, ours is a reference School for Schools of EE and Telecom Engineering in South America. Apart from strong partnership with several Schools there, the School at PUCP, Lima, Peru and the UCAB, Caracas, Venezuela designed their curricula taking ours as a model, and hence there is an on-going strong interlocution for new curricula development.

  We have a strong network of international partners with more than 150 Universities (dealing with exchange programs, double degree agreements, research projects) with whom we could share our CDIO experience.

  On the other hand, the local government (Catalonia, roughly 7 million inhabitants), is interested in organizing an international conference about methodologies for Universities, and we have been approached to help with the organization\(^2\). This conference could give local exposure of the CDIO initiative, in case CDIO members consider this to be appropriate and interesting.

- **What experience do you have in engineering educational reform at your university which might contribute to the effort and form a foundation for the work as a collaborator?**

\(^2\) In case a CDIO meeting is held in Barcelona, we could try to juxtapose in time both events and, invite some CDIO members to participate
Project-based learning and design-oriented experiences have naturally arose in our School in the past years, scattered throughout the curriculum by different faculty members.

As regards tools, the school has a strong tradition of Distance and blended learning experiences. These experiences have been recently upgraded to encompass experimental labs to be remotely accessible though a specific “Remote Labs” project.

It is our intention to institutionalize these approaches and integrate them in the CDIO philosophy (see last section of this report).

• **What level of commitment and support do you have from your university's Dean and Central Leadership?** *(Attach supporting letters, if applicable.)*

The Dean of our School is directly involved and is leading the strategy to incorporate the CDIO approach, which is transversal to all of the areas in the School and hence directly affects all Associate Deans areas.

There has been a committee in charge of defining a strategic planning to precede the committee in charge of changing the curricula. Both of them are composed of around 30 Faculty, including administrative staff and student representatives. Both committees have been introduced to CDIO, have carried out the CDIO Survey and have approved its application.

Recently, our new curricula, which incorporate the CDIO approach, have been approved by all Faculty members.

• **Who will be the key two to five participants in your effort?** *(Attach short CVs as appropriate.)*

The people involved initially are:

- Prof. Elisa Sayrol, Dean of the School
- Prof. Ramon Bragos, Associate Dean for educational labs and strategic planning
- Prof. Eduard Alarcon, Associate Dean for International Affairs
- A new Associate Dean for Quality Assessment (faculty member to be determined yet)

We are setting up a CDIO committee involving 5 Faculty members to lead the process, by Conceiving ways of integrating the CDIO approach in our curricula, Designing such integration both at curricula structure level and at course level, practically Implement the integration in tight cooperation with all Faculty members involved, and Operate the change, by monitoring and assessing the outcomes at different levels and modifying the curricula accordingly when appropriate, closing a loop around CDIO.

• **Differential aspects of our School as regards the CDIO consortium:**
We consider our participation to have three-fold singularities to contribute differentially to the CDIO initiative, namely:

- **Regional representatives.** We would like to be the first institution in Spain following the CDIO initiative, willing to take leadership in the initiative in Southern Europe, hence helping to involve close institutions.

- **Discipline specificity.** Our School offers degrees in the Electrical and Telecom Engineering fields, and in that sense it will complement other disciplines more abundant in the consortium, such as aerospace and industrial engineering.

- **Low-level CDIO practices.** We support applying a Conceive, Design, Implement and Operate approaches at a system-level, hence oriented to products. The fact that our discipline is younger compared to other such as Aerospace or industrial engineering, allows to explore learning experiences to foster the acquisition of the Conceive, Design, Implement and Operate skills at a lower level, say at device, circuit, signal processing or protocol level. In that context the design skills play a pivotal role. Note that eventually students should master high-level and low-level co-design in a broad sense, by building bridges and interrelationship among the four competences at both levels. The EE discipline combines both solid and thorough fundamental aspects together with their use in diverse and specialized applications. We think that, eventually, the ultimate task of an EE engineer is to design, in a broad CDIO sense. We plan to migrate from an “analysis” approach, to a “design-oriented” approach, the concept of design tightly matched and surrounded by conceive, implement and operate skills. Proper design is a two-fold process, namely: 1) First to appropriately model the interdependencies among a set of performance indexes and the variables that form the multidimensional input design space. 2) Afterwards, appropriate application of optimization tools which lead to a final optimum design. The second part of the design process can be thus carried out automatically, so that the optimum design process relies on the modeling process. This modeling process can be carried out in two ways: A) By hand calculation, in which the human designer should derive an intuitive low-order model. To avoid that algebra and analysis clutters the derivations it is proposed to use low-entropy design-oriented analysis, to improve the model intelligibility, following the methodology proposed by Caltech professor David R. Middlebrook. B) By computer-based simulations, which come into play when more sophisticated dependencies and not only intuitive trends are required. In any case, though this approach yields an optimal design, either the system architecture or the circuit topology is given a priori. Exploring the design space thoroughly can be a way to understand how to circumvent a given system fundamental limitation, thereby paving the way to conceive and innovative a solution the can outperform the precedent system, either through simple design-oriented analysis or through thorough but more aseptic and unintelligible design-space explorations. The bottom-line of this approach is hence not only to teach/learn the “knowhow”, but to add also the “know why”,

which naturally leads to the question “why don’t …?” of “what if?”, the answer of which potentially leads to new designs.

Details of our curricula design and how CDIO is incorporated might be provided to the CDIO organization if requested (partly written in Spanish, could be translated).