FACING WORLD ENGINEERING GRAND CHALLENGES

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MANADGING A LARGE INTERNATIONAL PROGRAMME ?

- How to address large complex questions, without setting up complicated organizations ?
- How to address jointly a major world scale project, while most of the resources are national, and locally scarce ?
- How to address a central problem needing a strong focus, while providing for flexibility and reactivity to new ideas and opportunities, and leaving room to individual research ?

THREE PERSONAL EXPERIENCES FROM GLOBAL RESEARCH PROJECTS

EXAMPLE : THE WORLD OCEAN CIRCULATION EXPERIMENT

10 years – 40+ countries

- Question-driven : Needs elaboration of the question into a scientific and technologic program, by a program Committee.

- Needs a large set of partners, acting mostly at their national level : Implies an organization to mobilize and set the pace (a small office), and commitments from national research systems.

- Needs sharing of tools and data to get more science done: Needs standardization, data centers, access…

- A large variety of studies could be derived from the program on the long term (decades): Needs to stay open to propositions, multiple seminars and conferences…

- Demonstrate the validity of the effort to all stakeholders: Effort to synthetize and communicate.

- Prepare the next step ? : very difficult…

APPLICABILITY TO SOME OF THE ENGINEERING GRAND CHALLENGES ?

- The economic dimensions and proximity to the market lead to specificities

  eg : "Making solar energy economical" is not only a set of engineering issues (yield issues; process issues; system aspects) but largely an industrial issue (cost and scale of production, integration along the value chain...), with political aspects

  - Þ Needs industrial R&D in both open innovation and restricted modes
  - Þ Needs to act at the industrial ecosystem level to address the system aspects
  - Þ Needs understanding of policies and social dimensions

ISSUES FOR AN OPEN INNOVATION INTERNATIONAL R&D SYSTEM :

THE PV CASE IN TOTAL

- Create an R&D system adaptable to the fast evolution of the technology and of the industry, in a short timescale, in support of our assets.

- Develop efficient relationships with advanced laboratories worldwide on the different subsets of knowledge, necessary for the various components of PV systems and their production.

- Facilitate R&D relationships within the PV industrial ecosystem (material, processes, equipments…), in order to accelerate developments.

- Implement an advanced R&D capacity for issues transverse to the various technologies such as characterization, analytics or modelization.

- Develop the capacity to provide high level expertise, manage the R&D system, integrate the results leading to development, manage the two-way relationships between the R&D organization assets and the technical laboratories.

GLOBAL CONCEPT (1)

1. An R&D management team combining high level expertise and R&D management experiences
   - R&D strategy, technology Intelligence, scouting, project portfolio,…
   - Process management, IP…
2. A large Institute (200 person) inside a first class University Campus
   - with a strong system approach
   - in partnership with industrial and academic labs
   - linked with R&D networks and graduate school
   - sharing tools
   - with both open and closed activities
   - managed by company representatives
3. A limited network of lab partners
   - on key technology bricks
   - selected based on competence, complementarity and demonstrated partnership practices in adjacent sectors
   - teams of Total engineers inside these labs

GLOBAL CONCEPT (2)

4. A broader of “small” projects portfolio, mostly on exploratory research, and tools for a dynamical R&D system (grants, PhD program, chairs…)

5. Development teams within each asset, with pilots similar to industrial tools

6. Management processes for :

- linking R&D strategy and BU strategy
- governance of the partnerships (including R&D and institutional relationships)
- building project port-folio from lab ideas, opportunities and asset needs
- HR management in the long term