I. Introduction

This paper will present the main topics of our team. The IVGI Team (French acronym for Virtual Engineering for Industrial Engineering) defines methods for the integration of several models in the system-design process. The focus is on the integration of cost factors and human factors based on a FBS-PPR model designed to capture enterprise knowledge. For these fields, cost, human and knowledge, innovative modelers are studied and in the meantime a strategy to settle a common transposable integration base is prospected.

II. Knowledge and modeling

M.LABROUSSE’s thesis validate concepts in order to model the objects of the enterprise [1]. His model mixes two approaches : Function / Behavior / Structure and Product / Process / Resources. He initially focused on the industrial design phase modeling. But such a process is connected with all the services of the enterprise. Then, it has been naturally extended to all the activities of an enterprise (cf. Fig.1). This becomes a tool for knowledge capitalization and sharing.

S.AMAR.KHODJA will continue this approach and validate the proposed concepts. Her subject deals with the expert knowledge capture in the aeronautic industry, focusing on the industrialization phase of complex parts to enrich CAD systems. This project (USIQUICK) is an innovative project including industrial and academic partners. It aims at integrate knowledge needed for process planning in a CAD application. The first drawback encountered in the project was the difficulty to find a common discussion basis for the three kinds of partners. The aircraft-industry partner was speaking on basis of its production experience, the CAD provider was reasoning on implementation issues and laboratories were suggesting new concepts to the two others. Thus an integration of these three models was necessary [2].
A first answer came from thoughts about ontology. The main concepts of the three levels of the project have been identified and unified in an UML class diagram (but it was not sufficient to share information and to process it in order to structure the project). A second step consisted to extract the UML diagram in XMi format (XML for UML) before using an XSL style sheet to process and display it to all the partners that possess Internet Explorer or equivalent software.

Today this application, that allows dynamic updates, ensures the coherence of the concepts and models used by thirty people included in the project. Even if it is still at a mock-up stage, it shows the potential of a methodology using technologies like XML at the service of UML and/or ontology for integrating different models in enterprises.

But if this solution opens a prospective way to document management, no clear definition of what a document is can allow us to design a most effective knowledge management method. Y.KERARON works on the document in the industrial environment, linked with the product life cycle [3].

In the framework of his research work several aspects are investigated: first, the concept of document (properties of permanence, time independence, impact of digital technology on the document and on the indexing…), at the same time we try to define knowledge engineering as engineering of knowledge inscriptions on a support (according to the point of view of B.BACHIMONT). Then, the relation between document and process are evaluated (the document/file modeling and process modeling, the function of document and ontology as reference frameworks to enable the legibility and the intelligibility of digital contents/documents/files, as well as to make business applications interoperable,…) using the W3C recommendations (eXtensible Mark-up Language (XML), Resource Description Framework (RDF) and Ontology Web Language (OWL)); document editing software and ontology editing and operating software which support these recommendations for industrial implementations).

![Fig.1: FBS-PPR (Function Behaviour Structure – Product Process Resources) model](image-url)
III. Cost integration

The cost integration during the early design step of a system is the second main topic we develop in the IVGI team. The costs controls in the early phases of the product life cycle became a major issue in the competitiveness of the companies, and the design activities play a strategic role. Consequently, the costs management, from the early design to the end delivery, become as important as the other technical requests. The analytic or analogical cost-accounting methods no longer give efficient results. This lead to new approaches integrating the complete cost and spread accounting methods based on the enterprise activities (ABC for instance). Cost inductors can be directly linked with enterprise models. It might be possible to manage the cost impact of evolutions (structural, process …) on the real costs of product or services. We implemented such a costing management in a French sand casting foundry [5]. During this PhD thesis we validated the concepts but also the methodology required for a complete numerical management (multi level management).

We continue these aspects with the cost-entity concepts (specific cost features for CAD definition). M. MAUCHAND started a PhD for the integration of these concepts in the microelectronics domain, with a software-developer industrial partner working on costing and pricing.

IV. Human integration in IPAO

An other level of models integration and models (and software) interoperability is the human integration in IPAO. The aim is to improve accident prevention on work
facilities (equipment). Virtual Reality offers new solutions to simulate and understand the human / system / environment interactions. Many searches for accident prevention have been already done, but they little take into account the operator who moves and works in those environments. The human operator has to be modeled in its shape, its posture, its mobility, its dynamic interaction, and so on. Hence the challenge is to simulate (model) in real time an avatar of the human operator. In this topic we are working in two complementary directions:

   a/ The Interactive, realistic and physical simulation of the human upper limb (Using Virtual Reality for accident prevention and job safety training):
   M.POULIQUEN do this thesis in collaboration with our team, the French Atomic Centre Study CEA and the National Institute on Security Research INRS.

   b/ The human models integration:
   M.SHAHROKHI works on the human aspects in the industrial design context. The integration of human factors through all the design process phases requires the effective use of the appropriate human models. In this way we studied the human models which are used in different scientific and artistic domains. Our special object is to achieve an effective approach to develop human models applied in future industrial design applications.

V. Conclusion

Our team focus on modeling in order to support knowledge integration and sharing. We also try to extract a generically approach using the definition of ontology and the definition of meta models using UML in order to be the most efficient. We also focusing on the integration on a platform of the specific knowledge in tools, on the monitoring of the value and the impact of knowledge and to optimize the use of enterprise core competencies.

VI. References