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DISTRIBUTED WORKFLOWS FOR MULTIPHYSICS APPLICATIONS

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ABSTRACT

Demanding applications in the industry require innovative technologies to support the numeric design of products in order to reduce time-to-market delays and improve the performance of the products as well as the efficiency of the industriy in the globalized competitive market. Innovation also requires advanced tools to support the collaborative design of new products. For example, teams are working on the preliminary design of future aircraft that will be "safer, quieter, cleaner", and environmentally friendly by 2020. Other industries are also faced to such challenges. The automotive industry has similar concerns, the telecom industries also (mobile phones design is an example) and nuclear powerplant design all face large-scale multiphysics simulation and optimization challenges. They all have considerable human and societal impact.

In order to achieve this goal, the aircraft manufacturers aim at virtual flight tests for new commercial aircraft within 10 years and at their virtual certification in the future. This means that reduced prototype testing will occur, if at all. This means also that exhaustive design, simulation and optimization will be required, including optimization of the aircraft flight dynamics and engine efficiency.

In order to support such projects, various disciplines must interact in the aircraft design and simulation, including structural, aerodynamdics, acoustics, electromagnetics, etc. Such expertise is usually available in various teams distributed among the various partners of the projects. It is therefore important that the project management includes global protocols for the team interactions. It entails that various experts using different specialized tools interact in a common collaborative environment. To support these collaborative environments effectively, we advocate the use of Virtual Collaborative Platforms [1].

Workflow techniques have long been used in the industry and service sectors. However, the control techniques used are usually dedicated to documents processing and project management in the business sector, involving a control flow approach. In contrast, the e-science sector has extensively used a dataflow approach for the processing of large numeric data sets.

In order to support efficiently the industrial projects to come, the necessary workflow techniques must include: distributed support to collaborative teams, deployment, management and monitoring of distributed workflows, seamless hierarchical composition of distributed workflows, distributed execution of workflows on wide area grid computing facilitéis, immersive visualization techniques, fast transfers of petabytes volumes of data, secure and reliable access and execution of large applications that invoke remote software and data [2].

Advanced technology based on distributed workflow techniques can support large distributed multidiscipline projects. They can be deployed on wide area (grid-based and broadband) networks involving remote expert teams working seamlessly in collaborative environments. High-performance computing facilitéis can be hooked k.o. these collaborative environments based on standard interface with middleware.
A number of points must be addressed, including workflow interoperability, knowledge sharing and ontology development and management, workflow specification languages and workflow modeling techniques. Also, are to be considered distributed computing issues such as dynamic resource discovery and allocation, component relocation and dynamic reconfiguration, which are out of the scope of this paper.
It is clear that Web-based distributed workflows running on distributed computing facilities that include large PC-clusters and supercomputers are an industrial reality. Large aircraft manufacturers have already tested and are currently planning the development of such environments for their new aircraft design.
Augmented with workflow composition techniques, fast data transfers for petabytes files and immersive visualization environments, multidiscipline Virtual Collaborative Environments are an attainable goal using current information technology.

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