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Engineering Knowledge Management

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INTRODUCTION

The business forces driving the need for a managed simulation environment have been with us for years and have been the impetus for the widely recognized corporate initiatives such as Total Quality Management (TQM) and Six Sigma. Engineering mantras such as "reduce cycle time" and "improve quality" translate into business objectives such as "reduce costs" and "improve the bottom line". These needs have given rise to the concept of "Virtual Prototyping" or "Simulation Driven Product Development".

For many, Product Lifecycle Management (PLM) has come to embody the software enabled solution used to address this grand challenge. Defined broadly, PLM is an information-driven approach to managing all aspects of a product's life. A product's "lifecycle" includes its design, manufacture, deployment, maintenance, and eventual removal from service and disposal. PLM seeks to streamline these steps by coordinating and integrating all the various process-es, methods, tools and data used during a product's lifetime. The approach has gained a wide audience; however, there are still many shortcomings, especially when applied to computer-aided engineering (CAE).

PLM systems are an outgrowth of the document management or Product Data Management (PDM) systems devel-oped initially to manage computer-aided design (CAD) data. As a result PLM systems still tend to be very document-centric and are not well-suited for managing the processes and data associated with CAE simulation. In fact, CAE usage is most commonly restricted to a small but extremely important segment of a product's lifecycle, specifically, within product engineering. Since managing simulation processes and data is in reality a specialized subset of the larger PLM vision, it is often overlooked or poorly addressed by the PLM solutions being offered today.

The purpose of this paper is to describe the means of achieving a "Managed Simulation Environment" or "Simulation Driven Product Development", by addressing critical product engineering issues related to the integration and pro-ductive use of CAE.

BUSINESS DRIVERS IN THE PRODUCT ENGINEERING ENVIRONMENT

The diversity of data and the rising process complexity of using CAE tools to simulate today's products has passed a threshold. Traditional organizational approaches and tools no longer support the fidelity and response time need-ed to drive down product development times. For most companies, the value they add to their products is tied up in their knowledge of the process used to perform design and the historical design data to which they have access. Effective management of both the process and data made possible through CAE is paramount to driving down prod-uct development times. This means using the right tools, the right methods and the right data.

The potential benefits of more effective CAE process and data management are substantial and include:

- Access to and reuse of historical design information & expertise to aid in the progress of new designs
- System modeling & simulation testing that improve overall performance
- Capture & leverage of existing engineering knowledge
- Addressing loss of engineering expertise while protecting intellectual property
- Reduction of future development costs & risk by simulating a wider range of operating conditions
- Lowering training costs as a result of better modeling tools
- Better use of engineering resources

PROCESS MANAGEMENT

Process management in the context of product engineering essentially means optimizing the design workflow through the more effective use of CAE simulation tools. This can result in a wide range of improvements including:

- Enterprise standards for work procedures
  - Codified process knowledge
  - Consistent processes across an enterprise
- Consolidation & automation of best practices
- Increased quality & reduction in errors
- Broadening the use of CAE tools beyond expert users
  - Bridge the gap between design and analysis
- Improved productivity and efficiency

DATA OR KNOWLEDGE MANAGEMENT

With the explosion of data from CAE modelling tools the old methods of storing designs in a filing cabinet (whether physical or electronic) for later access does not allow for the full exploitation of the valuable information available in this data.

Most designs do not start with a clean sheet of paper. Usually, a new design is a derivative work, with changes made to make it more suitable for a new application. In these cases, the engineer's first steps typically involve resurrecting models from an earlier design to use as a baseline. Assuming a similar study can be found, the models are then either modified for re-use- or scrapped entirely in favor of rebuilding, a decision largely dependant on the usefulness of the archived files. If there is any uncertainty about the pedigree of the files, it is often easier and less risky for an engineer to recreate a simulation than to try to glean new information from the previous result. Engineers would prefer to start an analysis from the comfort of a well documented baseline; however, it is often difficult to find an appropriate study, even if one exists in the design archives. Once found, it is often more work to decipher what was done than to recreate and re-benchmark the models. Effectively storing and reusing CAE simulation data is more than an exercise in file capturing management. In order to store the data in a way that makes sense to an unfamiliar future user, an archiving system needs to allow for searches based on relevant and descriptive tags that help identify files and their contents. These tags, also called metadata, should be automatically extracted whenever possible to reduce the drudgery and increase the consistency during the archiving process. Thus, what is involved here is knowledge management – capturing both data content and context – rather than just file or data management. This information can later be mined for insight into the how and why of a design or simulation.

The archiving standards for CAE data vary widely not only from company to company, but from engineer to engineer within a company. Most companies where CAE simulation is widely used have an archival and retrieval system for storing files that were part of a design study. Engineers are required to adhere to certain archiving standards; however, entering data into these systems is often laborious and requires the engineer to manually enter descriptions of the files for the benefit of future users. A managed simulation environment can address this issue by automating much of the uploading and data entry steps.

THE ANSYS ENGINEERING KNOWLEDGE MANAGER (EKM)

The ANSYS Engineering Knowledge Manager (EKM) is aimed at meeting the challenges presented by simulation process and data management. It is a design and simulation framework, which builds on the ANSYS Workbench infrastructure and is aimed at hosting all simulation data, processes and tools (whether in-house or commercial) while maintaining a tight connection between them. It provides three tightly coupled services: Access Management, Process Management, and Knowledge Management, which together allow for the creation of enterprise solutions.

The *Access Management* services represent the front end and provide the following environment and infrastructure services for the system:
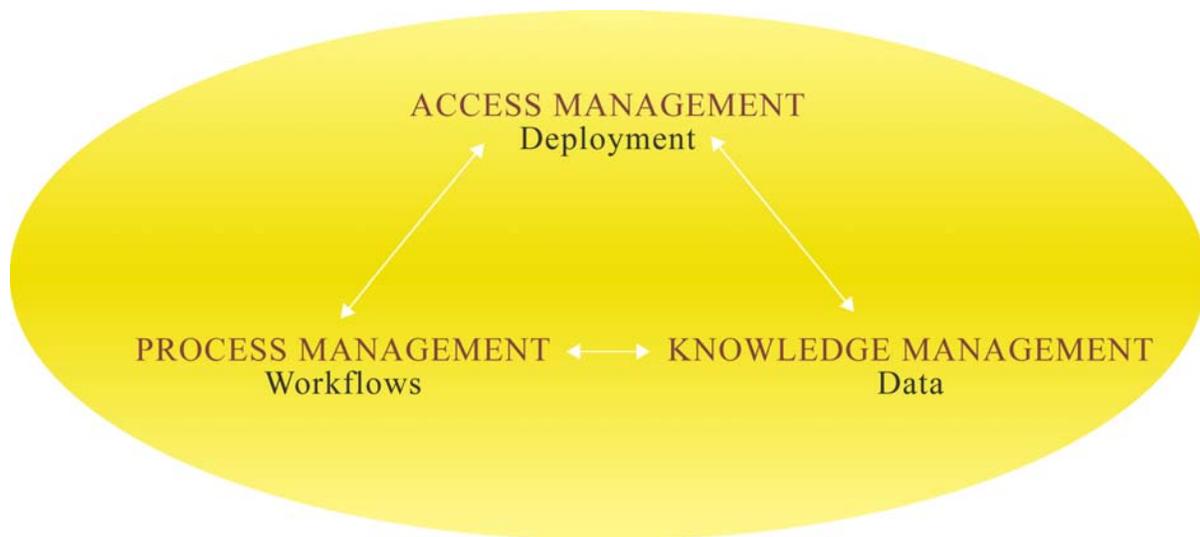
ANSYS EKM

- Enterprise access and deployment
  - Support for both local and hosted (RSF) deployment
- Web enabled
  - Customizable and localizable web interface
  - Internationalization support

- Portal interface
  - Single view of & access to capabilities
  - Wizard and expert modes
- Job submission system integration
  - User & data access control
    - Authentication by LDAP server, Windows domain, …
  - Integration with corporate wide systems
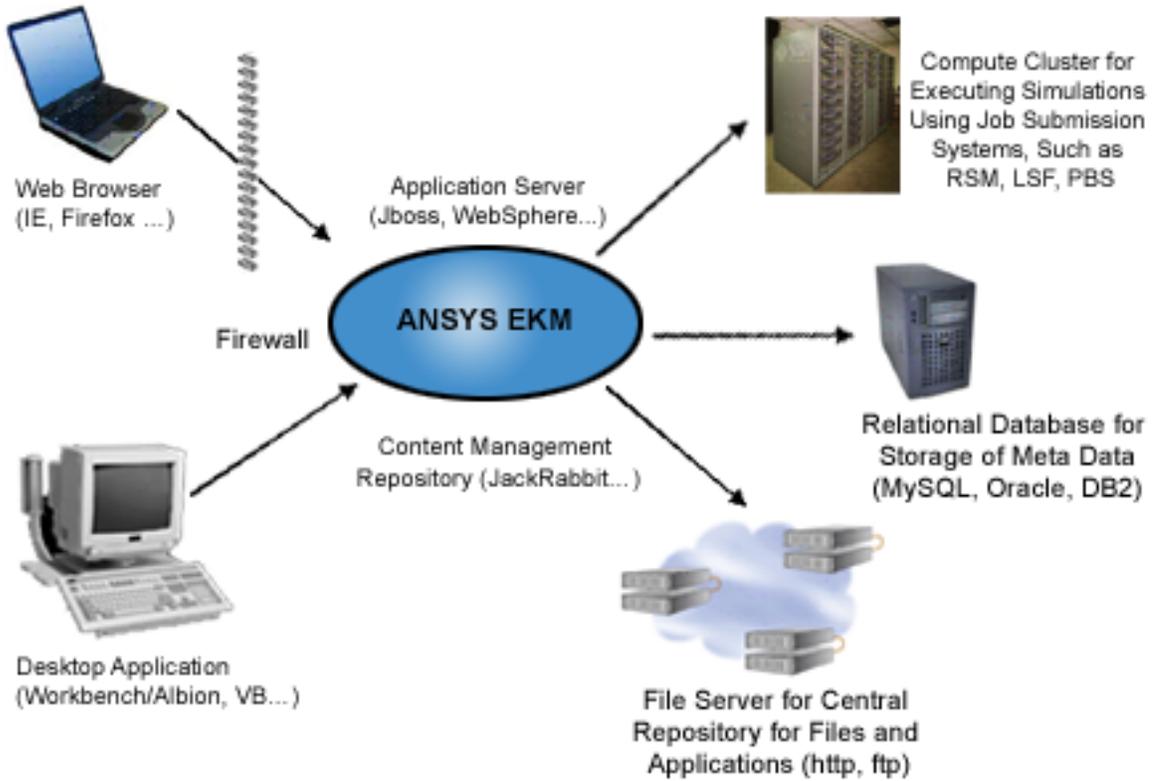   - Databases, archival systems, …

The *Process Management* services enable the creation and hosting of customized applications and workflows, ranging from a simple vertical application to a full design workflow, which are then accessible via the Access Management services:

- Host ANSYS Workbench workflows and applications
- Host customized applications
- Create customized customer web applications
- Enable complete design process solutions
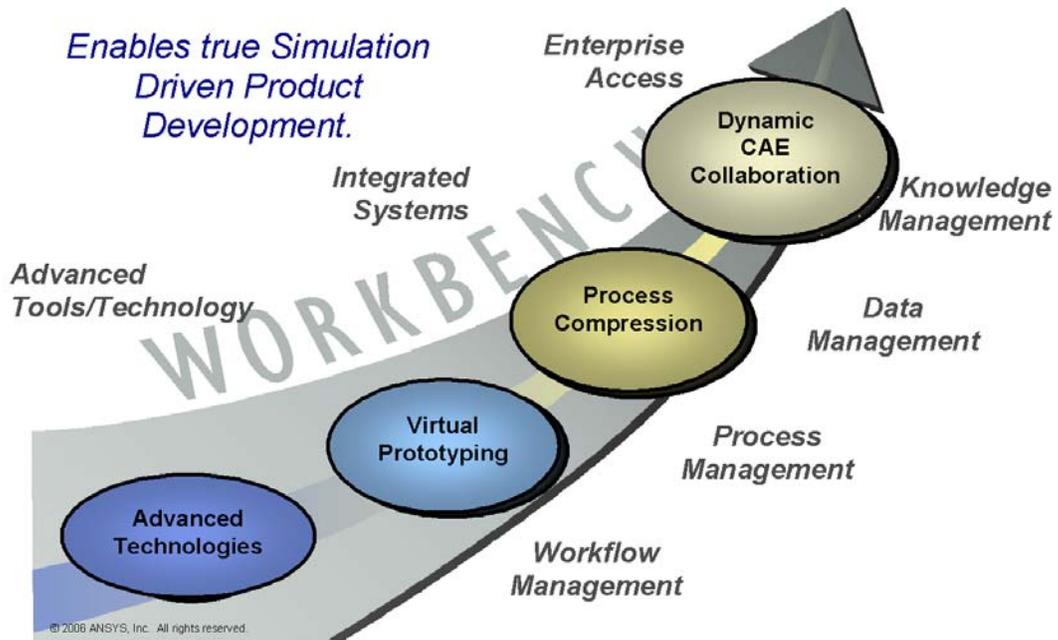- Interface with high-end data management services provided by Knowledge Manager

The *Knowledge Management* services manage all the data associated with a project including simulation input and data files, documents, reports, post-processing results, etc., as well as providing other tools such as data mining and report generation:

- Hierarchical management of simulation data
  - Navigation tree-based hierarchy of folders, sub-folders, class of data, …
  - Organization structure that is project-based, simulation-based, user-defined …
  - Data file management – input files, documents, reports …
  - Version and access control, audit trail
- Automated meta-data extraction or manual tagging
  - Metadata extracted on upload by file type, e.g., Fluent, ANSYS
  - Dynamic metadata definition by user
- Meta-data based queries & keyword searches
  - Ability to create complex search criteria
- Higher level data management for workflow management tasks
- Correlation with experimental results
- Data mining, extraction and reduction
  - User-defined plug-ins for data extraction
- Report Generation Facility
  - Report wizard and templates
  - Comparison reports

ANSYS EKM is based on modern open standards which can accommodate a wide range of enterprise environments:

Plug-and-Play Environment

ANSYS®

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About ANSYS, Inc. Solutions

ANSYS designs, develops, markets and globally supports engineering simulation solutions that are used to evaluate and support the product development process. Its integrated, open portfolio of tools is flexible enough to fit into any customer's product development process yet powerful enough to drive it. The ANSYS Simulation Driven Product Development vision is to enable customers to optimize designs throughout the product development process, especially in the early stages when changes can be efficiently and cost-effectively implemented. The process can help a business reduce development time, prototype testing and time-to-market — and ultimately help win the race in product innovation. The solutions ANSYS provides in the areas of structural, fluids, chemical, electromagnetic and coupled simulation are adaptable to customer-specific needs.

ANSYS tools provide customers strategic advantages by:
- Offering time- and cost-saving alternatives to expensive prototype development and experimental efforts
- Providing the opportunity to examine and optimize more design alternatives in the product definition and design stages of development
- Reducing product development time
- Enabling the customer to use simulation in order to optimize and support a product through its entire lifecycle

As one of the fastest-growing simulation companies worldwide, ANSYS remains dedicated to offering best-in-class simulation solutions that repeatedly demonstrate success.

About ANSYS, Inc.

ANSYS, Inc., founded in 1970, develops and globally markets engineering simulation software and technologies widely used by engineers and designers across a broad spectrum of industries. The Company focuses on the development of open and flexible solutions that enable users to analyze designs directly on the desktop, providing a common platform for fast, efficient and cost-conscious product development, from design concept to final-stage testing, validation and production. The Company and its global network of channel partners provide sales, support and training for customers. Headquartered in Canonsburg, Pennsylvania, U.S.A., with more than 40 strategic sales locations throughout the world, ANSYS, Inc. and its subsidiaries employ approximately 1,400 people and distribute ANSYS products through a network of channel partners in over 40 countries.

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