AP209 Edition 2 Overview

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AP209 Edition 1 Background and Overview

The Design/Analysis integration problem is typified by the requirement to share geometric shape and analysis information in an iterative environment. The integration is made more difficult when composite structures become a part of the problem. Figure 1 illustrates the interconnectivity that this overview addresses. Most production systems currently employ specific point-to-point translators to enable this process, and very few analysis systems are able to seamlessly return geometric shape information to the design shape modeler. With composite structures there are the additional problems of calculating true fiber directions and ply flat patterns that are shared with the manufacturing process. All of this information needs to be shared with commercial or in-house detailed analysis codes such as those for fastened joints and panel buckling.

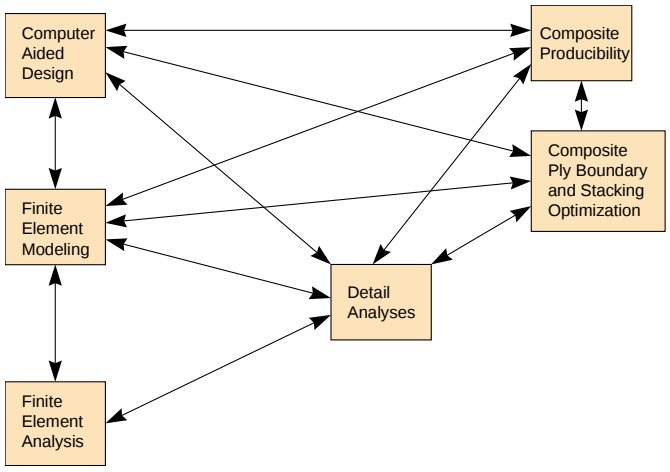

Figure 1. Engineering design, analysis, and manufacturing information interconnectivity.

Given this problem AP 209 Edition 1 was created to enable:

Collaborative analysis and design: Companies using different CAD and FEA systems will be able to exchange engineering design and analysis data using standard file formats. The same data schema used to share information via standard file formats is also usable to dynamically share information tool to tool. Configuration management data within the standard can ensure that design and analysis activities carried out by the different teams relate to the correct product versions.

It is possible to provide separate, but associated, versioning for the product, the analysis idealisation of the product, and for the finite element model.

archiving of analysis and design data: A company will be able to archive associated, configuration managed CAD and FEA data in standard format, confident that that data can be reused in the future, whatever system changes have occurred. This is of special importance where FEA has been used for product certification, because additional analyses may be required to investigate in-service problems.

Development of integrated systems: A company will be able to develop an integrated system combining design and analysis based upon standard interfaces. Such an integrated system may address different analysis disciplines such as structural, thermal and fluids, and may be used for design optimisation. The use of standard interfaces will ensure that the system is not locked-in to a particular system supplier.

AP 209 Edition 1 covers:

Finite element data: This includes models, analysis definitions and load cases, and results. A model can be specified in as much detail as required - if necessary down to the level of element shape functions, discretisation points and integration rules. Static and natural frequency analyses are within the initial scope.

Configuration management data: A version of the finite element model is linked to a version of the product. This ensures that the correct finite element data may be associated with the correct version of a product within a PDM (Product Data Management) system.

Product geometry: Both the design geometry and the idealised geometry created for analysis can be recorded. Nodes, finite elements, their edges, faces and volumes can be explicitly associated with aspects of the product geometry.
It is possible to specify element properties, loadings or boundary conditions on a curve, edge, surface, or volume of the geometric model.

Composite lay-up: The lay-up of a composite part can be specified in detail. Shape, stacking sequence, and property information can be supplied about individual plies and their fibre orientations.

<u>AP209 Edition 2</u>

The second Edition of ISO 10303-209 (AP209) has integrated a generic Engineering Analysis capability complimented by specific CFD and generalized mesh based numerical analysis capabilities to the AP209 Edition 1 classical Finite Element Analysis capabilities. The CFD capability is based upon the NASA/AIAA CGNS standard and the Volvo Aero EAR-model work. The generalized structured and unstructured analysis and mesh capabilities are based upon work done in the Generic Engineering Analysis Model (GEM) project from the European Union. In addition there is a complete discrete/continuous mathematical field representation capability that has been added based upon the Daved Talyor Labs/Boeing DT-NURBS package. All of these added capabilities have been integrated into the STEP common resources Parts 50, 51, 52, 53, 107, and 110 as a basis for use in Application Protocols. The intent is that AP209E2 will now address a much wider set of multi-disciplinary analysis and optimization problems

A high-level planning diagram that provides an overview of the contents of AP209E2 is shown in Figure 2. The SC4 community has gone to a modular approach to developing Application Protocols (APs) to promote integration and ease of re-use. Due the modularization of existing AP209 capabilities it is now possible to take advantage of this new SC4 Modular Architecture by embedding the second edition of AP203 and get all the new shape, presentation, and GD&T capabilities.

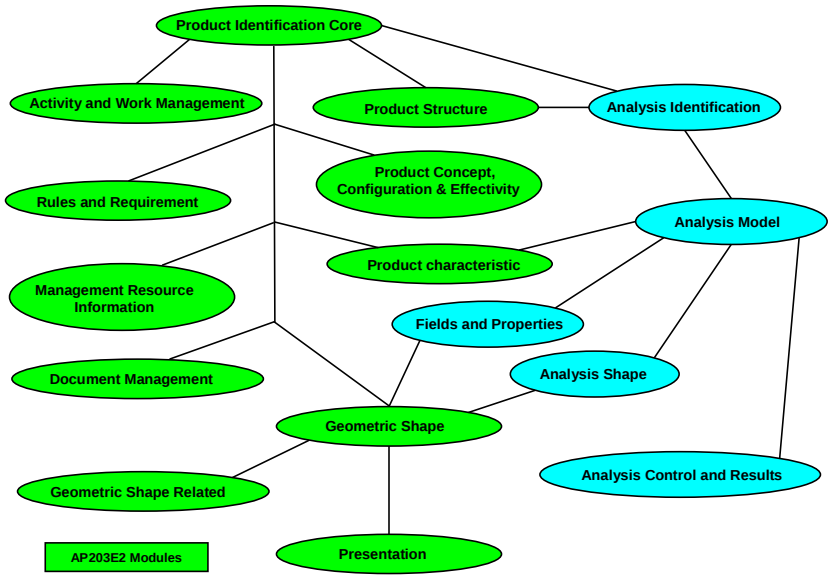

Figure 2. ISO 10303-209E2 High Level Overview

Figures 3 and 4 provide a more detailed overview of the capabilities of AP209E2. Figure 3 illustrates the AP203E2 capabilities portion of AP209E2. Here there is more detail on the new Presentation, shape, and product characteristic capabilities. Note that the composite structure shape, structure, and material properties capabilities from the first edition of AP209 have now been incorporated into AP203E2. Figure 4 shows more detail of the modular components of the classical Finite Element capability, and the added capabilities for generic structured and unstructured mesh based numerical analysis, CFD, and field based property definition.

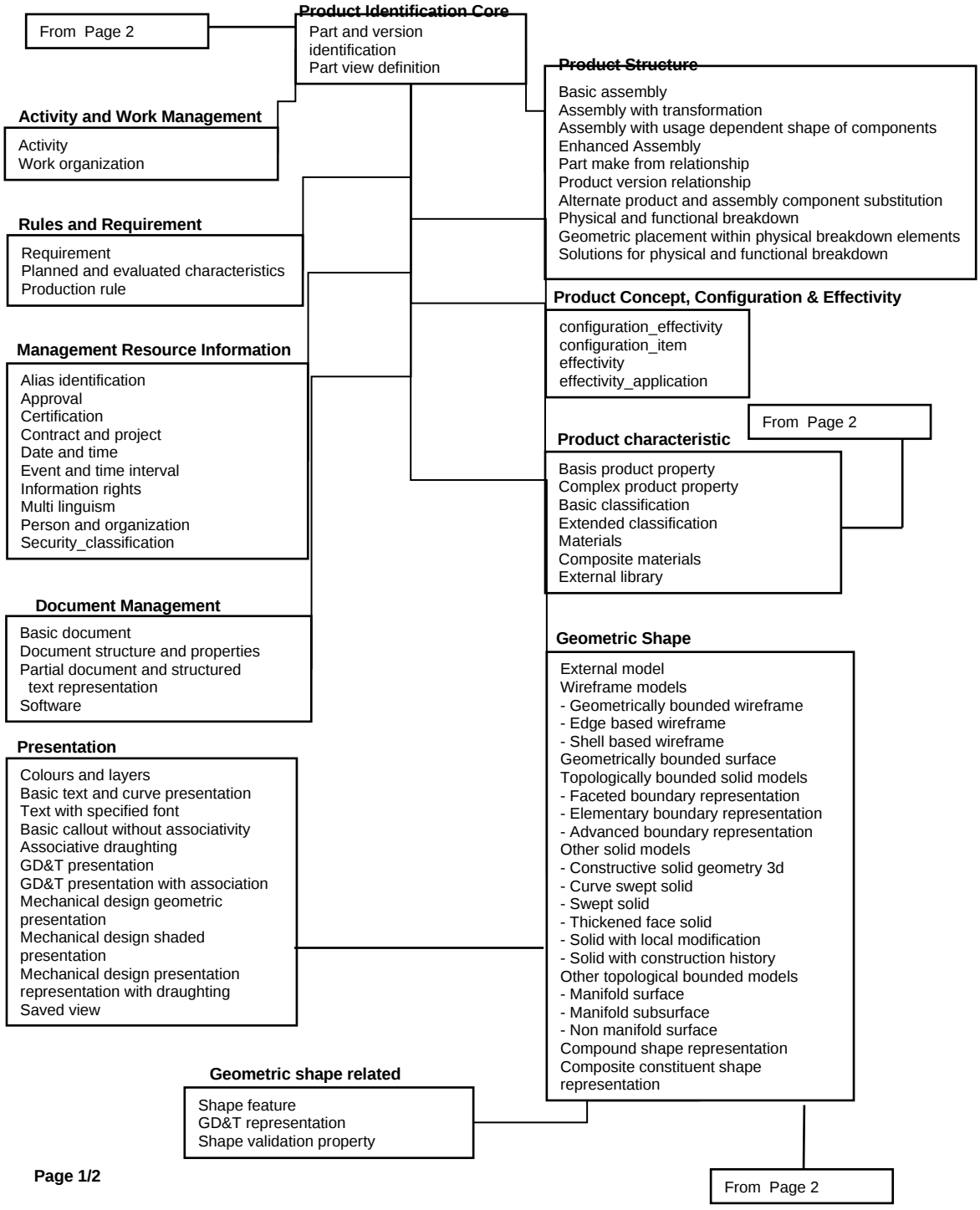

Figure 3. AP209E2 Planning Model, Page 1 of 2

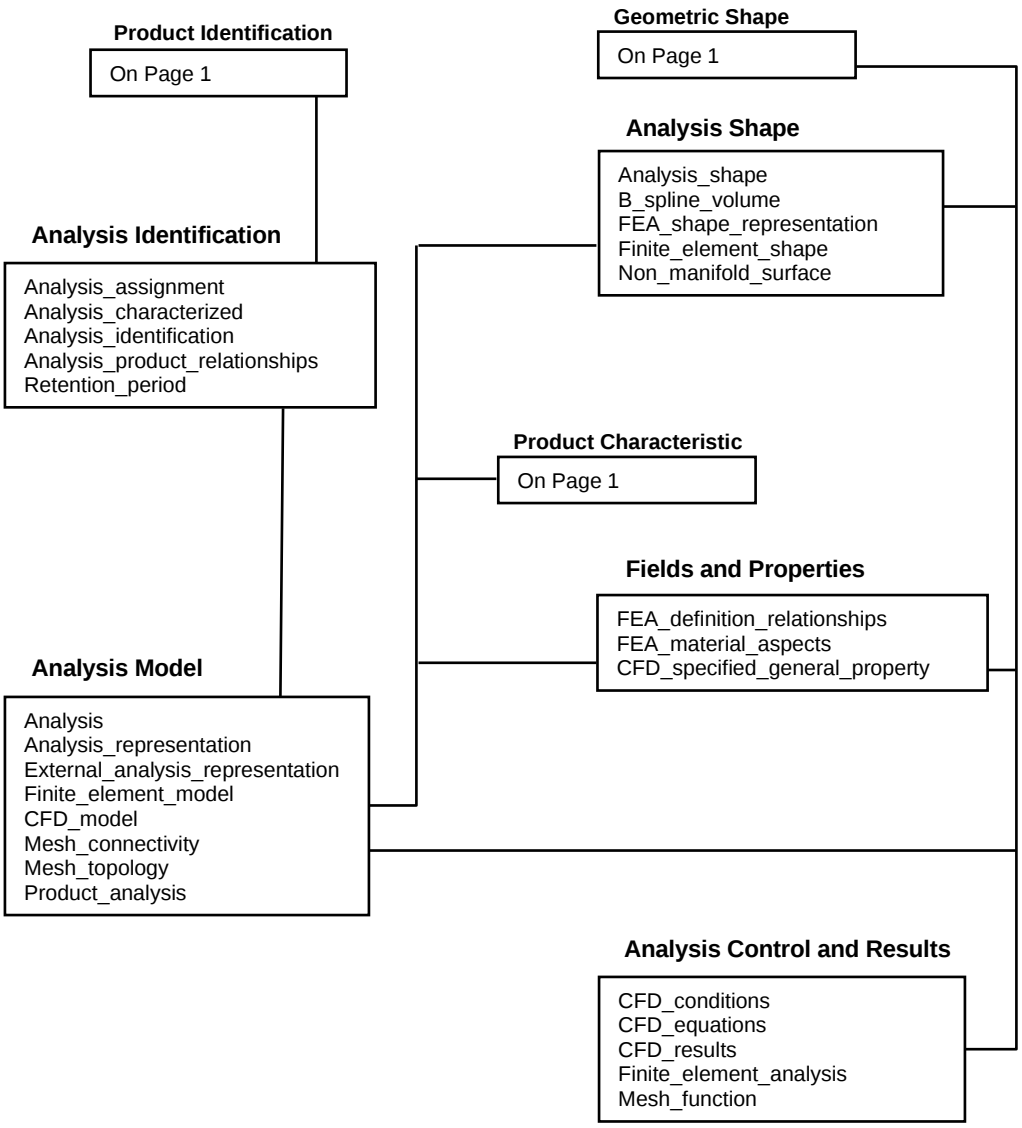

Figure 4. AP209E2 Planning Model, Page 2 of 2