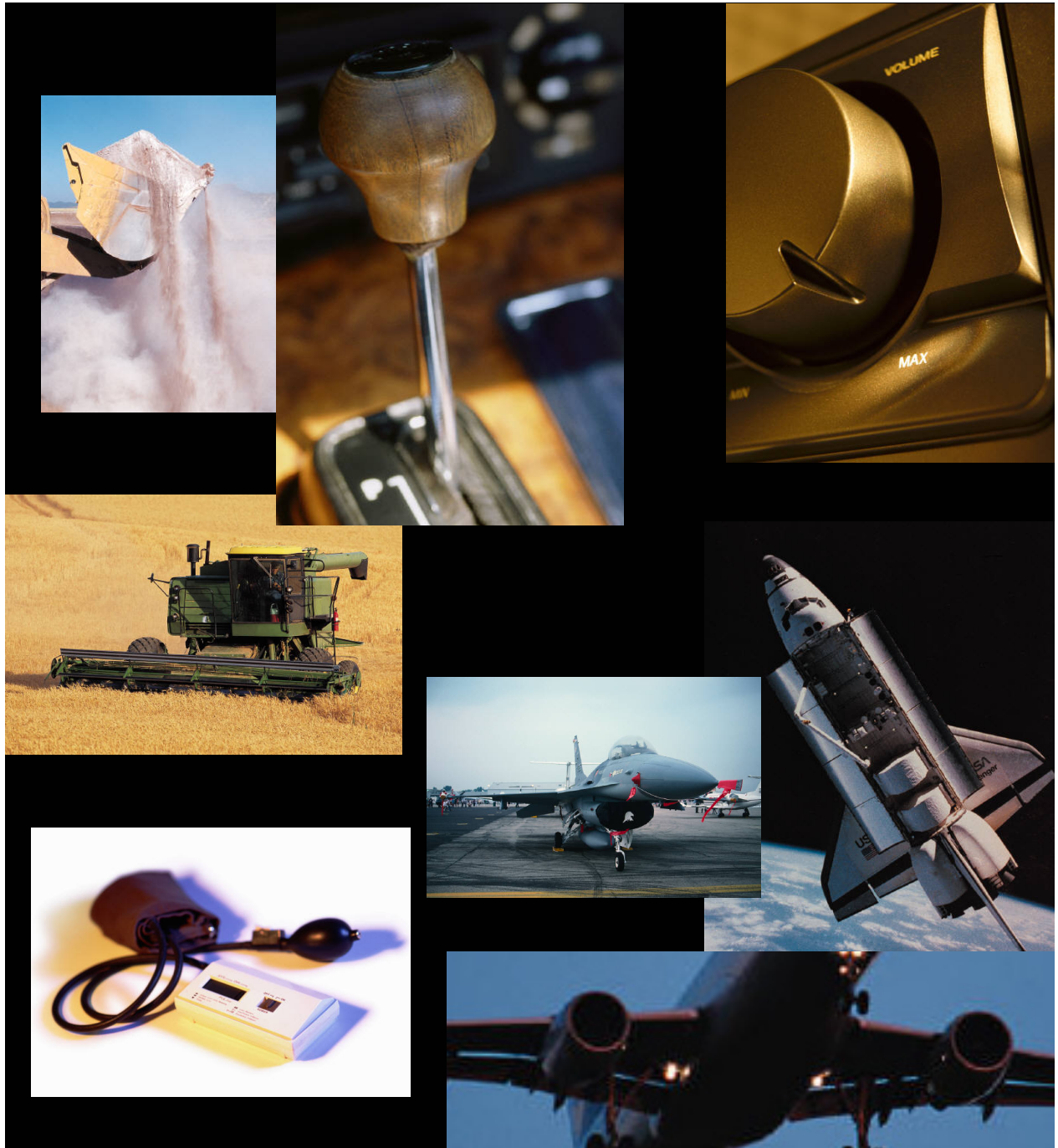


Simulation Data Management: Rationalizing the Decision



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June 20, 2006

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Background & Methodology

This report documents Spar Point's research into best practices across a range of discrete manufacturing industries for implementing digital simulation and analysis and maximizing its business impact.

Industries studied included aerospace and defense, aircraft engines, automotive powertrain, consumer electronics, medical devices and off-highway equipment.

Primary research consisted of in-depth interviews with some two dozen program managers, discipline leads, analysts, engineers and others employed by manufacturing enterprises in North America, Europe and Asia. All interviews were conducted by Spar Point senior analysts in person or by telephone.

Interviewees reported using many different CAE software products from a variety of vendors including but not limited to ABAQUS, AMESim, ANSYS, CFD++, CFX, COSMOSWorks, Elfini, EXCITE, Femap, FEMLAB (now COMSOL Multiphysics), Flowmaster, Fluent, Hypermesh, I-DEAS CAE, LS-DYNA, MATLAB, Moldflow, MSC.Adams, MSC.Nastran, MSC.Patran, NPSS, NX Nastran, Simulink, STAR-CD, Valvedyn, Vectis and WAVE.

Companies studied were generally selected on the basis of their recognition and standing in their respective industries. Interviewees were selected based on their positions in their respective companies and their knowledge of how digital simulation and analysis is being used in their organizations to improve product development, with particular attention to initiatives aimed at increasing the efficiency, effectiveness and impact of CAE usage.

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June 20, 2006

By Bruce Jenkins, Senior Analyst

This report is based on Spar Point's research in digital simulation and analysis best practices at aerospace/defense, aircraft engine, automotive powertrain, consumer electronics, medical device and off-highway equipment manufacturers. You'll learn what these industries see as

Importance: HIGH MEDIUM LOW	Medical Devices	Consumer Electronics	Auto Powertrain	Off-Highway	Aero/Defense	Aircraft Engines
Support for analyst/engineer needs for right data fast						
Corporate knowledge capture, retention						
Global CAE data sharing, reuse						
Managing intra-CAE data flows						
Managing CAE/CAD data flows						
Managing CAE/test data correlation						
Support for systems-level/whole-product simulation						
Managing DFSS, MDO, robust design results						
Collaborating with partners, subcontractors, suppliers						
Protecting IP in CAE outsourcing						
Managing ITAR requirements						
Building, managing materials data libraries						
Managing manufacturing data needed for simulation						

CAE Data Management Business Drivers

key business drivers for implementing simulation data management, then get a consensus view of best practices to:

- Determine the project scope
- Rationalize the make/buy decision
- Qualify and select solution providers
- Manage simulation data and processes
- Manage people factors

Manufacturers in a wide range of industries are working to make their use of digital simulation and analysis more efficient, effective and productive. For some – notably automotive and off-highway – the challenges center on making CAE usage more pervasive throughout product

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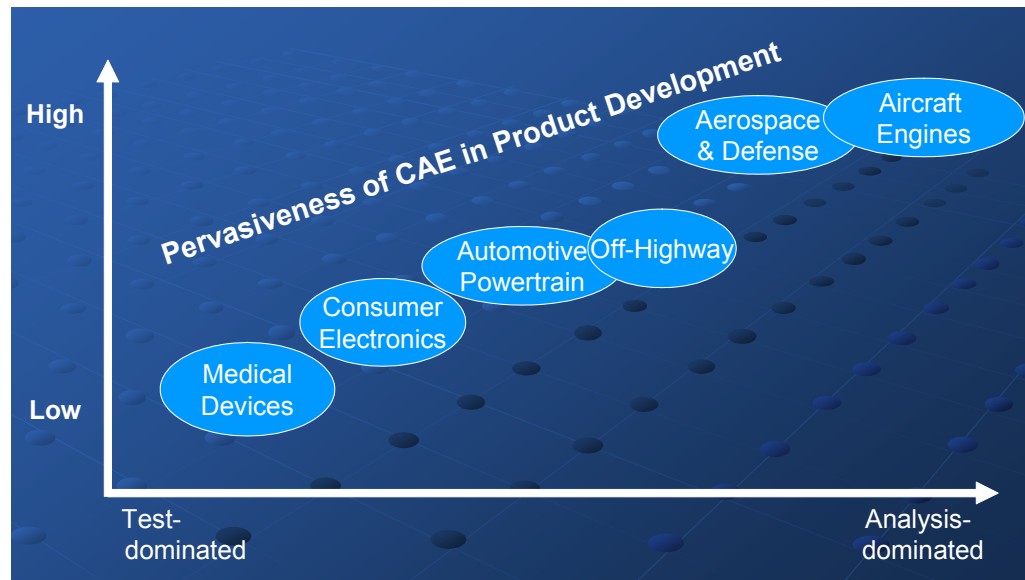
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development, and advancing its use upstream to have greater impact on product development. For others such as aerospace/defense contractors and aircraft engine manufacturers, where CAE tools are used early and pervasively, the challenges include better integrating tools and automating work processes.

But maximizing the technology's business impact, we found, is more subtle than simply buying today's best point functionality and handing it off to the analyst or discipline lead. Instead, contemporary best practices focus on making more efficient use of existing resources – software tools, engineering staff hours, corporate knowledge. At some two dozen



CAE Pervasiveness in Industries Studied

manufacturing enterprises we studied around the world, no interviewee named software budgets as a primary constraint on product development's ability to contribute to corporate business objectives – all identified time, human-resource constraints and legacy work processes as limiting factors.

At these companies we interviewed program managers, engineering executives, discipline leads and others to discover how CAE usage is evolving to target the business challenges they face. In every instance we found that better management of simulation data and processes is a key objective – many explicitly named the lack of “PDM for CAE” as their biggest constraint on getting more value from the technology.

In tackling this problem, our judgment is that best prospects for success lie in partnering with solution providers that have longtime domain expertise both in digital simulation and analysis, and in data and process management, the latter preferably both at the enterprise level and in serving workgroups and individual users.

From our research, we distilled five best practices for successfully moving to implement simulation data management:



DETERMINE THE PROJECT SCOPE

A first step for companies moving to implement simulation data management is to develop an understanding of what they really seek to achieve, the likeliest path to success, and potential roadblocks:

- What broad corporate requirements should such a solution fulfill? What will be its real value, and (not always the same question) on what basis will it be judged?
- What existing conditions – installed solutions, CAD and CAE data archives, institutional usage preferences and support competencies – should be considered?
- What will be the cultural impact? How can these issues be planned for?
- How to select a solution that satisfies both corporate/methods/IT policy makers and engineers seeking pragmatic user-level answers? That is, a solution that balances short-term payback with long-term potential?
- How to forecast the likely costs of integration, support and other elements of total cost of ownership (TCO)?

RATIONALIZE THE MAKE/BUY DECISION

Rationalizing the make/buy decision is about managing the tradeoffs between commercial off-the-shelf (COTS) software and internally developed tools. Some we interviewed, in consumer electronics for example, reported projects to develop in-house CAE data management capability based on storing data in HTML format, to facilitate ad hoc searches of past results. But most – automotive, aerospace/defense, off-highway – are managing large-scale products with long development schedules and extended (sometimes multi-decade) service lifetimes. These companies described simulation data management requirements that are on the same scale as (or greater than) the design data management needs served by current enterprise PDM offerings.

Given the scale of the undertaking required, even the most ambitious of these did not see internal development as feasible or a worthwhile use of resources. The most promising route, most all believe, is for a commercial data management provider to build on its foundation technology to deliver simulation-specific capabilities within an enterprise data management framework. Indeed, some were ready to commit resources to partner with a commercial provider for such an undertaking.

QUALIFY AND SELECT SOLUTION PROVIDERS

In evaluating simulation data management providers, potential choices range from specialist developers to major data management solution vendors. Best prospects for success, we believe, lie with providers that have longtime domain expertise both in digital simulation and analysis, and in data and process management, the latter preferably both at the enterprise level and in serving workgroups and individual users.

While analysts and engineers generally call the shots in simulation/analysis tool purchases, data management decisions tend to be made by corporate committees with significant IT involvement. Somewhat unlike point-tool purchases, which can often be justified solely on the basis of technological fitness for purpose, decisions about data management environments

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need to be grounded in both technical and business criteria: how well can a provider help tie together disparate tools (its own, those from third parties, and customers' in-house codes) without undue costs, streamline work processes, secure and shepherd corporate knowledge assets, and provide change-management expertise and support?

Technical evaluation criteria

Best practice is to seek providers whose solutions are:

- Proven to work
- Recognized as having significant market presence/market share
- Built on infrastructure technologies that:
 - Are familiar to the customer's internal support organization and, if possible, already installed and supported
 - Have long-term support costs that are well understood by the customer's organization
 - Allow simulation data management to be implemented as an extension of existing installed capability rather than a new, additional infrastructure
- Currently managing volumes of structured product data that simulation participants will be able to leverage
- Offer extensive capabilities that complement simulation data management such as visualization, project management, requirements definition, systems engineering and the like
- Equipped with tools, methods and/or standards that enable ready integration of customers' internally developed codes and commercial third-party codes, cost-effectively

Business evaluation criteria

- Demonstrated long-term commitment to, and expertise in, simulation and analysis
- Attractiveness and compatibility as long-term partner
- Consistent history of timely product delivery
- Track record of openness, neutrality
- Culture of close consultation with significant numbers of customers to architect and implement new initiatives
- Commitment to providing help with process change

MANAGE SIMULATION DATA AND PROCESSES

As detailed above, interviewees identified insufficient focus on knowledge capture, data sharing and reuse as major constraints on the value available from simulation and analysis. Data needed by collateral and downstream project functions is too often unavailable, outdated, or captive to error-prone manual methods of dissemination and re-entry. Also needed are ways to capture and share best-practice work processes beyond the project where they originated.

Individual analysts and engineers reported pragmatic needs for solutions that let them work faster and with higher confidence. Here, key needs include:

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- Ability to have confidence that analysis was based on current, correct CAD configuration
- Ability to easily retrieve data from one CAE discipline for use as input to another discipline
- Ability to easily retrieve past analysis models, processes and results for re-execution or updating months or years later

Beyond this, as manufacturers reported their requirements to us, most would find simulation data and process management of greatest value when embedded in the context of the following functions:

- Configuration management, product structure management
 - For coordinating CAD geometry and CAE models and processes. This is needed for two kinds of new-product development work processes:
 - CAD-led
 - FEM-led
 - For coordinating simulation models and results with corresponding matrices of product variants, such as in automotive and commercial vehicle development
- Change management, workflow management – for ensuring that:
 - Geometry changes trigger timely re-analysis
 - Analysis results are fed back to product development, and acted on
- Requirements management – to help ensure that:
 - System-level performance targets adhere to program requirements
 - Adherence is maintained as system-level targets are “cascaded” down to component-level performance targets
- Project/program management – for managing:
 - Controlled data sharing as determined by partner trust levels
 - ITAR compliance
 - Schedule adherence
- Document management – to associate simulation data with, or incorporate it into, documents such as those mandated by regulatory agencies
- Management reporting

MANAGE PEOPLE FACTORS

One challenge in optimizing use of simulation and analysis has to do with organizational, cultural and people issues. As described above, an enterprise-level simulation data management solution will by definition involve at least two different constituencies: (1) program/project managers, and the best-practice methods experts and IT infrastructure professionals working to advance program objectives and corporate success, and (2) the individual analysts, engineers and discipline leads whose participation in the environment is essential, and whose individual productivity will be boosted by a successful implementation and buy-in.

Thus, we found that best practices for managing people factors focus on two areas:

- Create incentives for discipline leads, analysts and engineers to take ownership
- Build on existing enterprise infrastructure success to reinforce management support

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Create incentives for discipline leads, analysts and engineers to take ownership

Our research indicates that introducing simulation data management will involve gaining cooperation and buy-in from user-level cultures that, in a fair number of cases we studied, have been accustomed to a degree of independence within the overall program and organization. Thus, a key success factor is to identify a solution that satisfies management and enterprise-level needs and, at the same time, takes account of the needs and preferences of individual participants – analysts and engineers, as well as others who need to reference simulation-derived data but are not specialists in using analysis or post-processing tools.

Primary constraints on broader use of simulation and analysis in most industries we studied were staffing and schedule. To become more productive, individual analysts as well as the discipline leads managing them expressed a desire to eliminate a number of time-wasters: searches for needed data, slow and error-prone data reformatting and re-entry, even the need to re-execute analyses that had already been run, because lack of contextual information (who originally ran the analysis, under what assumptions, etc.) caused existing results to be judged untrustworthy. In the same vein, many expressed receptivity to tools that would let repetitive task-execution activities be encapsulated and automated. Solutions that visibly and readily enable those ends are likely to find good acceptance from users.

Build on existing enterprise infrastructure success to reinforce management support

At the management level – program/project managers, best-practice methods experts and the infrastructure professionals working with them on implementation and enablement – simulation data management appears likeliest to find acceptance if delivered as an extension of existing installed infrastructure technology with a proven track record.

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Best Practices for Implementing Digital Simulation and Analysis in...

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- ***Aircraft Engines***
- ***Automotive Powertrain***
- ***Consumer Electronics***
- ***Medical Devices***
- ***Off-Highway***

Simulation Data Management: Rationalizing the Decision

Seven reports that reveal how savvy program managers at the world's leading manufacturers are implementing digital simulation and analysis to create business value.

Digital simulation and analysis is key to making better products more quickly at lower cost. But maximizing the technology's business impact requires far more than just buying the right point functionality and handing it off to the analysis department. Spar Point interviewed program managers and discipline leads at top-ranked manufacturers around the world to find out how they do it – what best practices have they developed to use simulation and analysis to break through the critical business constraints their companies face today?

Each of these concise, industry-focused reports details five best-practice lessons from savvy program managers. Use this exclusive intelligence to benchmark your company against industry best practices – learn where you excel, where to improve and how. And discover key learnings in other industries that you can apply to your own efforts.

For complete product information and details on price and ordering, contact Tom Greaves, Spar Point Research, at email tom.greaves@sparllc.com or phone 978.774.1102.