

Repeatable Digital Validation

SIEMENS

White Paper

Teamcenter's integrated solution for digital product validation

Teamcenter® Repeatable Digital Validation (RDV) provides an integrated solution that enables your enterprise to rapidly validate product configurations as they continuously change across your product lifecycle.

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Executive summary

Today's mainstream product development processes are inherently inefficient when it comes to handling product change. Design teams, suppliers and manufacturing stakeholders often encounter inaccuracies as they exchange and share change-related data. Errors are introduced as data is modified or when data is re-entered but not validated across multiple disciplines and systems. Additionally, quality decision-making is hampered by the failure to integrate data and core business rules between multiple systems. Significant reduction in new product introduction time and total cost – and increased product quality – is possible with a new paradigm for engineering review and validation.

Product development requires that support systems focus on the entire range of products and processes of the enterprise. As the complexity of the products and processes grow, the product development community needs tools that are integrated into efficient, process-oriented applications. Critical product decisions require the continuous availability of the latest digital product and process information. Finally, the tremendous amount of data contributing to the definition of a product and its manufacturing processes must be navigated efficiently and reduced to the minimum set of data that will accurately represent the full decision context.

A solution that enables a continuous and accurate decision context based on the latest product and process information must be able to:

- Integrate information from a variety of tools, including multiple CAD authoring tools, validation and analysis tools and business systems
- Configure and apply business rules to product and process configurations for rapid "what-if" analysis and knowledge re-use
- Quickly navigate large amounts of product and process information and work with only relevant data while retaining the context of the total product

- Interrogate and validate the configurations for form, fit and function, and comply with requirements such as cost, weight and investment
- Integrate into your product development process with minimal training and support while sustaining your organization's ability to develop innovative new products

Today, there are software tools available that attempt to solve each problem separately. For example, digital mockup (DMU) software addresses digital prototyping but is time consuming, static and invariably prone to errors. Similarly, PDM solutions address problems related to configuration and business rules but lack tight integration with CAD tools or DMU solutions.

Teamcenter's Repeatable Digital Validation (RDV) solution facilitates a true paradigm shift for companies that perform complex product development and want to integrate a suite of core systems, such as design tools, visualization, product configuration and change management into a single integrated web environment. Never before has such a ground breaking technology been able to dramatically reduce time-to-market in product development while delivering decision making knowledge directly to stakeholders responsible for getting the right product to the right market.

RDV dramatically reduces product development latency by providing an "always on" digital mockup of the complete product and all of its variations. RDV enables companies to make optimal product decisions quicker resulting in faster and better products to market. Product changes and alternative ideas can be done "real time" in a controlled process while assessing the impact of change across the finished product and the impact on its performance characteristics. No other product development suite in the market can support this level of integration. In addition, RDV reduces a company's ownership costs by supporting multiple product development processes on a single integrated solution.

Business challenges

The discrete manufacturing industry is rapidly shifting from mass production to mass customization – which demands that companies build a larger number of products according to geographic and cultural style preferences – and bring them to market on average 5 to 10 percent faster every year. Product innovation and time compression are primary drivers across marketplaces. The sooner a product can be brought to a customer, the greater its lifecycle profitability potential. This is complicated by the need to increasingly deliver variations of each product according to submarkets and respond to ever-changing customer hot buttons.

Globalization has helped manufacturers find suppliers in far away places at very competitive prices, but has added complexity to the product development process. For example, the new “global reach” concept requires communications and collaboration across a distributed supply chain in order to avoid long delays and costly errors as information propagates across all tiers of suppliers.

Since approximately 70 percent of a product’s costs are committed during the product development phase, the biggest cost savings opportunity is during the upfront product design phase. These large savings opportunities are not going to come from ERP, SCM and CRM.

Business challenge complications The biggest challenges to increasing productivity and eliminating errors and cost overruns are:

- Efficiency of the change process as demonstrated by a company’s ability to immediately evaluate and analyze changes in the context of other changes and their impact on the complete product.
- Ability to configure and visualize each part in all its usages in all products to fully understand change impact.
- Ability to provide the right individuals the right data, rapidly and easily, and in the right context at the right time. To meet this challenge and facilitate a totally effective product decision, companies need to deliver tightly focused product information to their designers. In essence, all of the participants in your value chain need to access

virtual product content on a consistent and repeatable basis. To illustrate the value of delivering the most relevant information to your product team, your value chain needs to be able to answer the following kinds of questions: “find all parts within 5 mm of the engine so I can do packaging study,” or “get me the solid models for all parts released this week so I can assess the impact on product weight”.

- Ability to design and validate products with complex variability. This functionality allows companies to correct errors in early design phases rather than during the manufacturing phase. For example, designers may need to be able to ask their digital solution to “evaluate behind dashboard clearance for wire harness with both left and right side drive, with and without air conditioning, with and without a GPS system. I need to know that I can assemble the product for all variants, not just the one in the current configuration”.
- Reducing risk by institutionalizing the re-use of existing designs, which already embed corporate best practices and lessons learned from previous products.
- Ability to configure and visualize a part in all its current usages in all products to determine if it can be re-used in a new product.

Take the example of a new car design. A typical car has over 10,000 parts. On average, 2500 parts change during any given week. Trying to pull all these changes can take 2-3 weeks. Once a change is initiated, it must be validated and its impact on overall weight, cost and supplier schedule must be analyzed. This is a time consuming, resource intensive task. While knowledge workers are pulling the changes together, more design changes will invariably need to be initiated. This cycle is repeated every 2-3 weeks during the product development process, which lasts 12 to 18 months. The second problem faced by the design team is that even when it brings up the whole product containing 10,000 parts, it can take hours to zero-in on the part and surrounding area that needs to be analyzed. Because of this complexity, many engineers try to only work with a

few parts at a time. This creates a risk of not envisioning the change in the context of the entire product, or the entire surrounding environment impacted by the change.

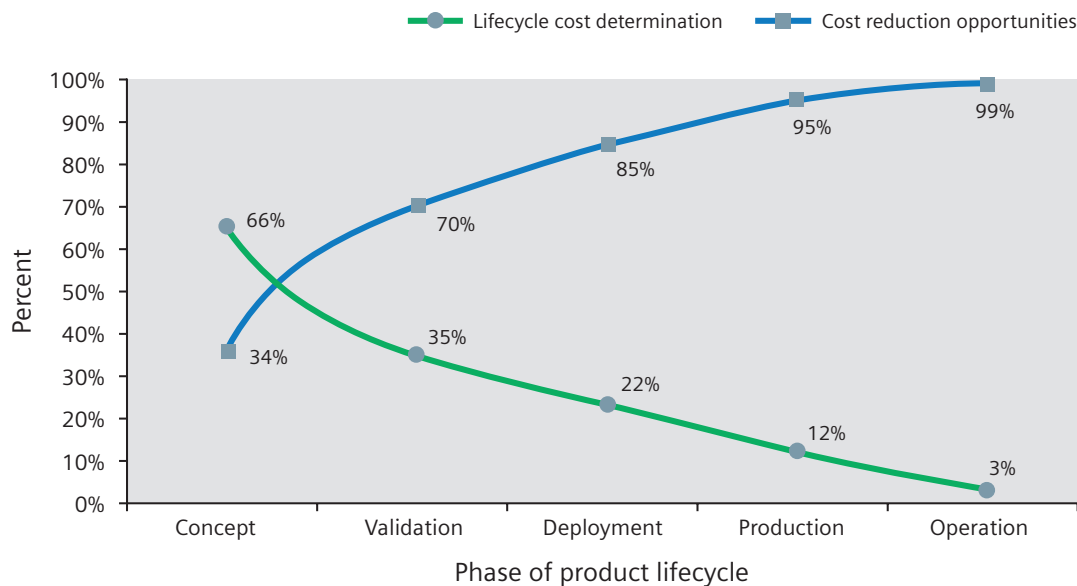
Technology’s promised added value versus the reality of adding more complexity Today’s software tools attempt to solve each of the previously enumerated problems. For example, digital mockup software addresses one set of problems while PDM solutions address another set. However, productivity gain will only be significant when a solution is able to address all of these problems simultaneously.

Consider the following excerpt on configured digital mockup from the recent paper titled “Fundamentals of Shared Product Structure” by Wayne Collier, DH Brown.

“A design component may represent, for example, right and left tires as two instances of the same CAD model. But digital mockups create a visualization of a total product in three dimensions and require separate entities to visualize the right and left sides. Similarly, representations based on part records may use a single part number for an entire end-item

assembly actually consisting of dozen parts, while digital mockups require unique identification of each entity included in a configuration to resolve interference, packaging and other design integration issues. Digital mockups come into use during design reviews at early phases of product development, before part records have been released, as conceptual designers explore alternatives across multiple configurations. All of these characteristics of digital mockup make it difficult and time consuming to generate them automatically for multiple configurations if those configurations are based on traditional, parts-based bills of materials or traditional CAD assembly model.

In response to these limitations most companies today resort to brute force – manual reconciliation to assemble as-ordered product configurations generated by order configuration representations from families of design components managed in CAD data managers. This reconciliation is tedious and error prone...Traditional approaches and automated versions of them simply do not serve the need to rapidly validate designs across hundreds of product configurations generated on the fly.”



Source: US Defense Advanced Research Project Agency

Figure 1: Embedded costs per phase of product lifecycle.

Teamcenter’s RDV solution

Teamcenter Repeatabe Digital Validation (RDV) combines industry leading CAD integration, product modeling technology, high performance visualization, spatial search engine technology and a design in context application that provides a powerful, innovative and integrated digital product validation solution.

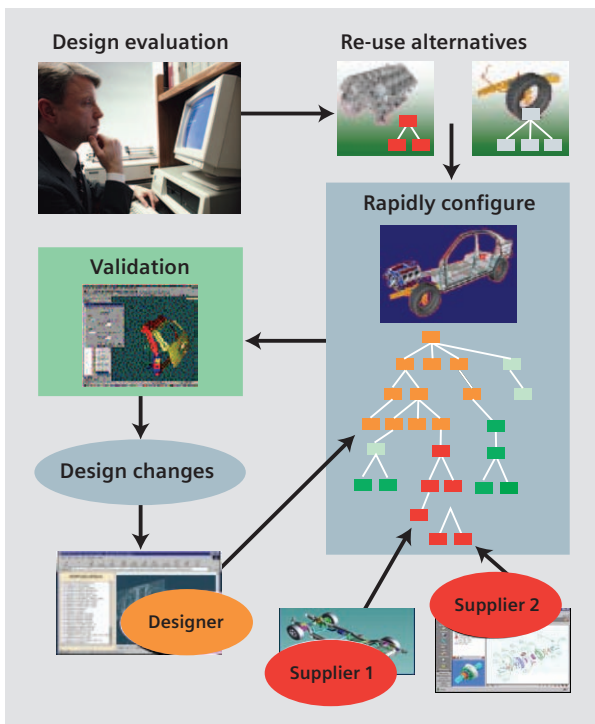


Figure 2: Typical RDV process flow.

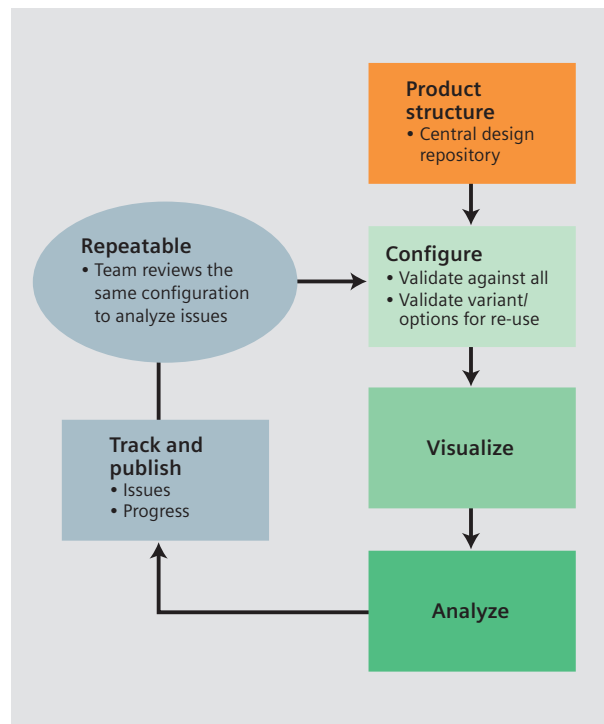


Figure 3: Key RDV capabilities.

RDV reflects a wide variety of robust capabilities:

- RDV is continuously repeatable with a new configuration or with an alternative design configuration. It allows the same validation process to be repeated at different sites or by different individuals including suppliers. This ensures consistency of result and eliminates human errors during configuration.
 - RDV provides a powerful tool for abstraction and relevance in an extremely complex product development process so that the entire value chain can use a consistent way of accessing virtual product content.
 - RDV enables engineers to design and validate products with complex variability. Change is validated against one product, as well as against all possible variations.
 - RDV always keeps product configurations up to date with the latest changes.
 - RDV allows a user to visualize the whole product as well the specific area of interest. The search engine database is specifically optimized for quick search.
- RDV synchronizes CAD, visual and product structure data based on business rules and best practice processes captured in a company-specific workflow.
 - RDV provides a powerful classification application enabling both product and process re-use, while reducing risk and direct material costs.

Collision detection and interference analysis is the first of many potential product validation applications based on the RDV platform. These common digital validation applications require easy and efficient access to all CAD files of a specific product variation or product family. The CAD data is converted to the standards-based JT™ format, an optimal and accurate CAD geometry format for visualization and collision detection. For collision detection and spatial searches, Siemens PLM Software's harvester approach replaces time-consuming queries on the entire database with an efficient filter that carefully selects only the parts that are changed, and for the selected or appropriate configurations.

Benefits

1. Substantial enterprise productivity gains are realized by enabling continuous product validation Digital validation in the traditional form (DMU) is unable to address all the challenges and offers disappointing payback. This is due to the lack of a repeatable and continuous process available to every stakeholder in your organization. With traditional DMU, you get some exciting discrete events but you cannot count on them reflecting the latest product intent. Benefits accelerate and allow you to achieve your vision only when the process becomes repeatable and continuous.

2. RDV enables designers and suppliers to spend more time on innovation and creativity RDV removes nonvalue-added tasks from your product development process, such as searching for components and creating the right context or environment for validation. RDV also eliminates human error and ensures the right version and right configurations are always selected. RDV presents only the relevant information for decision-making and validation, instead of requiring users to navigate through plethora of data to find what they need to complete their job.

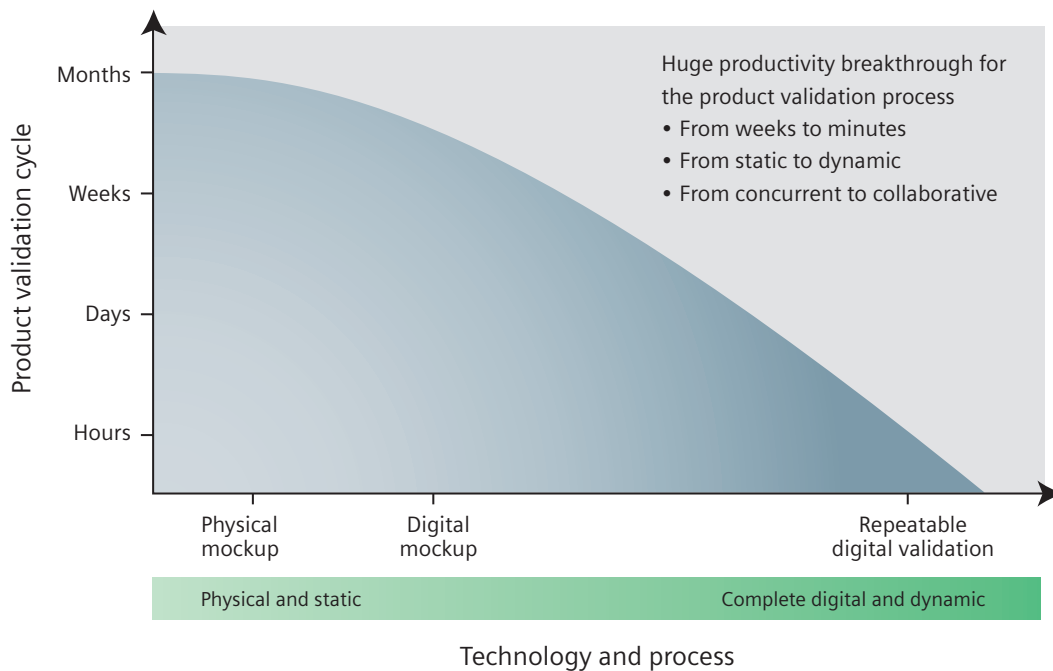


Figure 4: RDV productivity improvement.

Examples of potential time savings

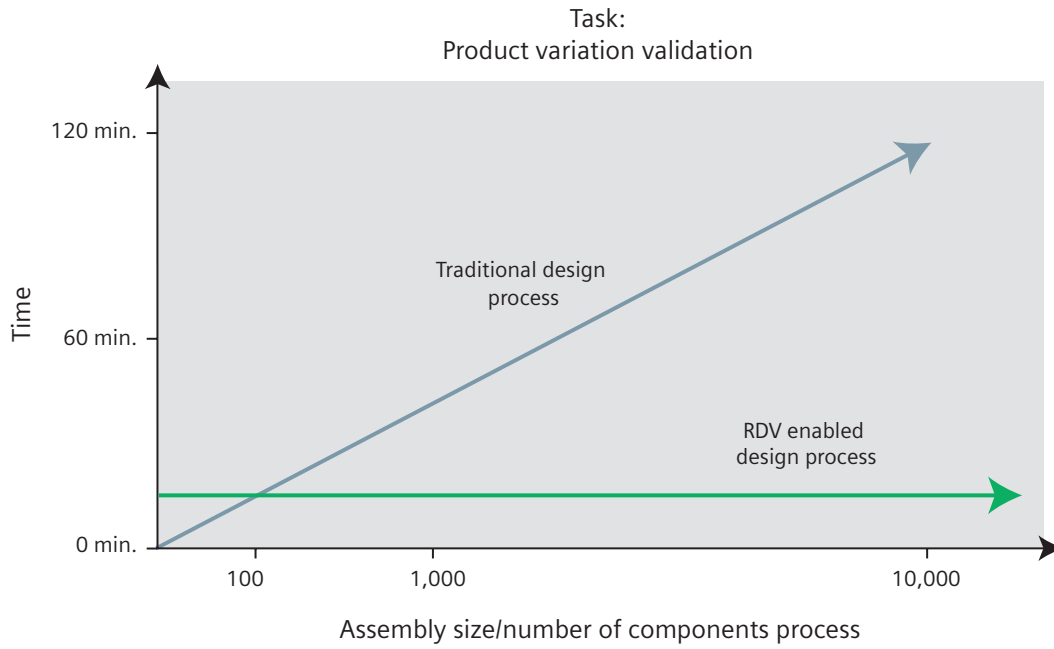


Figure 5: First example of potential time savings.

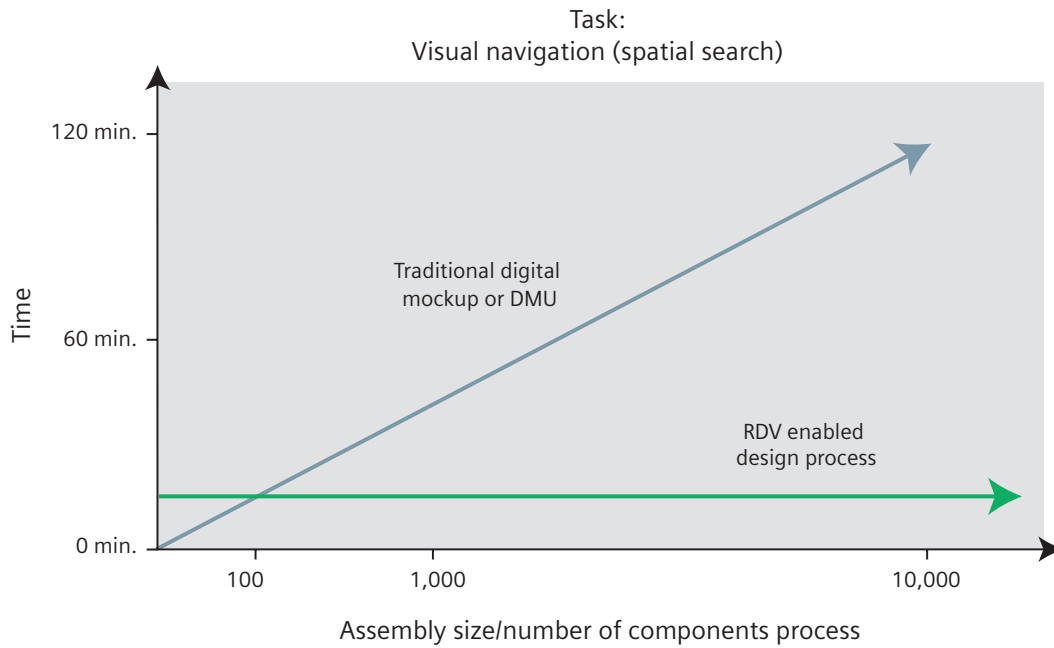


Figure 6: Second example of potential time savings.

- If designers spent 75 minutes a day searching and navigating to find the right components and its context for validating their design then:

Time savings per day = 75 minutes

Time saving per year = $200 * 75 = 15000$ minutes = 31 days

- RDV's ability to present only relevant data also benefits your infrastructure. If you have 200 users searching a 5000-part assembly once per day, your network will be burdened with

$200 * 5000 * 1 \text{ MB/part} = 1$ terabyte/day just for visualization

Using more intelligent searches, you could decrease your amount of actual loaded relevant data by ~80 percent or more depending on your users' working habits.

$200 \text{ users} * 100 \text{ parts} * 1 \text{ MB/part} = 20$ gigabytes/day.

This saves you money on network hardware and enables you to maintain good performance and happy productive users on your existing infrastructure.

3. RDV reduces errors during your production and/or assembly phases by enabling early problem detection RDV allows designers, suppliers and manufacturing planners to evaluate product changes continuously against specifications and business constraints, enabling them to reduce errors and make optimal total product decisions.

4. RDV accelerates your time-to-market cycle Companies are able to quickly evaluate more alternatives early in the design phase, allowing them to deliver right product faster to market.

5. RDV enables design re-use RDV enables designers to easily and quickly evaluate many alternatives early in the design phases.

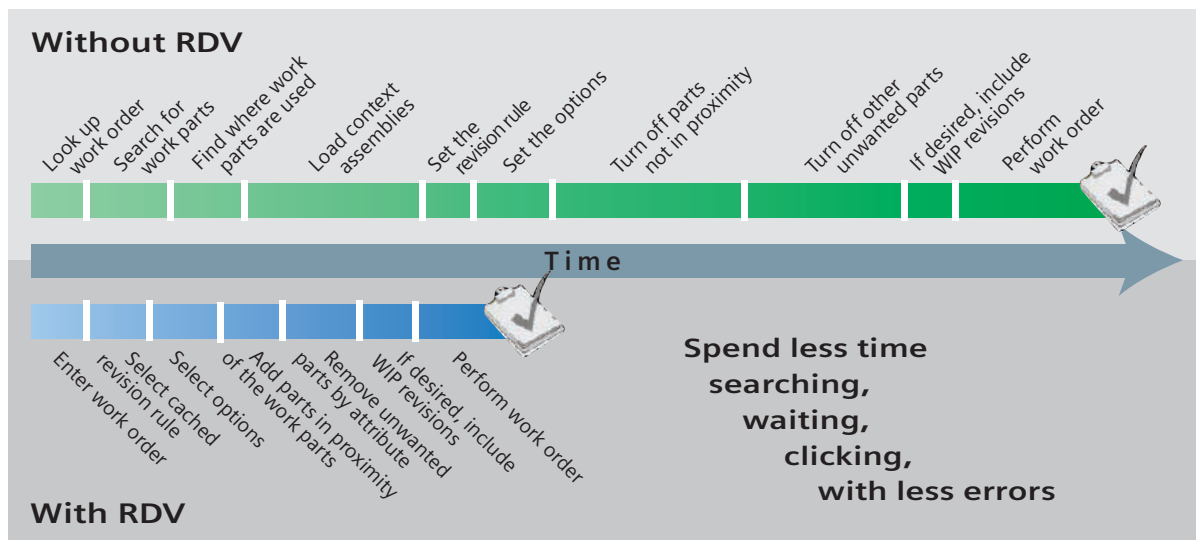


Figure 7: Comparing RDV and non-RDV digital validation solutions.

Why RDV excels

A variety of factors cause conventional digital validation products to fail. The following comparison explains why Teamcenter's RDV solution succeeds while other approaches falter.

Problem: Single product focus. Typically, conventional solutions revolve around a single CAD visualization or PDM product. This cannot work. CAD and visualization products do not provide change controls, configuration management or advanced searching techniques. CAD and PDM do not have sufficiently rich and fast visualization capabilities. PDM and visualization do not have sufficient validation capabilities that complete solid models and high-end CAD and CAE applications provide.

RDV solution: RDV contains tightly integrated CAD visualization and PDM modules. RDV combines PDM's control and searching capabilities with high-speed lightweight visualization and high-end CAD validation/ modeling. These integrated capabilities work in concert to enable you to achieve multiple validation goals in a single solution.

Problem: Too many tools, not enough application. Perhaps through super human effort or a talented project champion, you can get enough custom programming and procedures together to get through a conventional validation pilot. However, many solutions are too shaky and dependent on key individuals to keep running them on a long-term basis. Frequently, companies discover that nobody can remember the "right buttons to push" to maintain and use their pilot system – or they learn that their customized code no longer complies with new product versions. In addition, companies often find it difficult to justify the budgeting requests needed to sustain a customized solution (e.g., when management no longer sees a financial payback).

RDV solution: Siemens PLM Software delivers a complete RDV solution. It is integrated and tested for exactly your purpose before shipping. Out-of-the-box processes and documentation are provided for exactly your purposes, instead of a collection of independent, unrelated tools that you use to build your own solution.

Problem: Unavailable digital environment when you need it. Many design engineers face pressing deadlines on a regular basis – deadlines that result in the following mindset. My deadline is today. I need to give a go/no-go answer on an engineering change today. I cannot wait a week for other people to assemble a digital mockup for me. I cannot trust such a decision to digital data that is 2 weeks old. I need all of the latest data now.

RDV solution: RDV is a process not an event. All necessary indexing and caching is built continuously as data is released so that you can perform searches whenever you want. Visualization and CAD can be launched directly with the search results; there is no need to export data into special environments or perform special translations. You get what you need when you need it.

Problem: Too much data and manual filtering. Additional approaches based on visualization packages require the user to load huge products then filter down to what he or she really needs. This is often preceded by a lengthy export and translation activity. The amount of data can be so large that performance is unacceptable. Typically, the graphics scene is too big and cluttered to be of immediate use until after considerable manual filtering is complete.

RDV solution: With RDV, the filter is specified upfront, indicating: what project, what configuration and what spatial area you need. Then, the system finds and loads only the data you require. Subsequent searches quickly expand your data set if you need more. Good performance is maintained on this smaller set and you always have a manageable graphics environment.

RDV is a powerful platform for the digital product validation process, providing a foundation for an all-encompassing "rapid decision system." This "rapid decision system" for product development aggregates results from multiple validation processes and presents them to decision makers in an easy-to-understand web-based portal. RDV enables optimal product and process decisions and allows more time for creativity and innovation by eliminating mundane nonvalue-added tasks.

Collision detection and interference checking (initial applications released with the RDV platform) instantly obsolete traditional digital mockup while eliminating many of the issues and drawbacks associated with this current best practice technology. Although DMU applications visually represent the product concept and facilitate complete product validation, they encounter many problems when implemented on highly engineered products. Examples of such issues are validating multiple configurations, keeping configurations up to date with changes and allowing anyone in the organization access to the latest information.

RDV provides immediate value by solving the issues associated with these traditional techniques, while providing a solid foundation for the addition of many future digital product validation applications that will support a “rapid decision system”. Siemens PLM Software envisions a suite of digital product validation applications, including:

- Simulation analysis
- CAE validation
- Manufacturing validation
- Cost validation
- Function specification validation
- Test analysis

RDV allows designers to make design changes, validate the complete product for packaging, CAE, process simulation, manufacturability, test, serviceability, cost and function, and compare the validation result to other alternative designs. It enables designers to rapidly configure, visualize, analyze and compare the new part design in all its usages in all products to fully understand change impact. Design engineers can configure and visualize a part in all its current usages in all products to determine if it can be re-used in a new product.

RDV enables designers to make optimal product decisions taking into account all variability and constraints.

By delivering ROI long expected from digital product definition, Teamcenter’s RDV solution provides the foundation for facilitating the digital transformation of today’s product-driven companies.

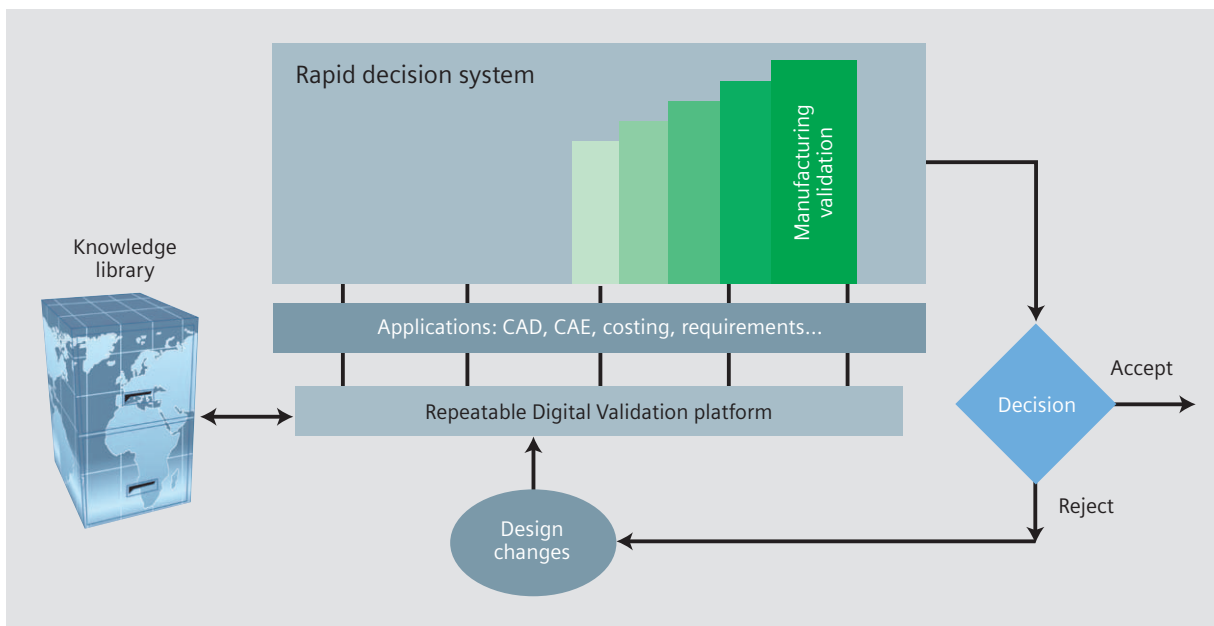


Figure 8: RDV-enabled rapid decision system.

About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division, is a leading global provider of product lifecycle management (PLM) software and services with 6.7 million licensed seats and more than 69,500 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with companies to deliver open solutions that help them turn more ideas into successful products. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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