

Tech-Clarity

**Tech-Clarity Insight:
Design Review Buyer's Guide**

***Selecting the Right
Visualization and
Collaboration Solution***



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Executive Overview

The Design Review Buyer’s Guide is a reference tool to help manufacturers select the right software to support design review and validation. The guide is composed of four sections covering software functionality, service requirements, vendor attributes, and special company considerations (Figure 1). Each section includes a checklist of key requirements that should be analyzed when selecting visualization and collaboration software to enable and improve design review.

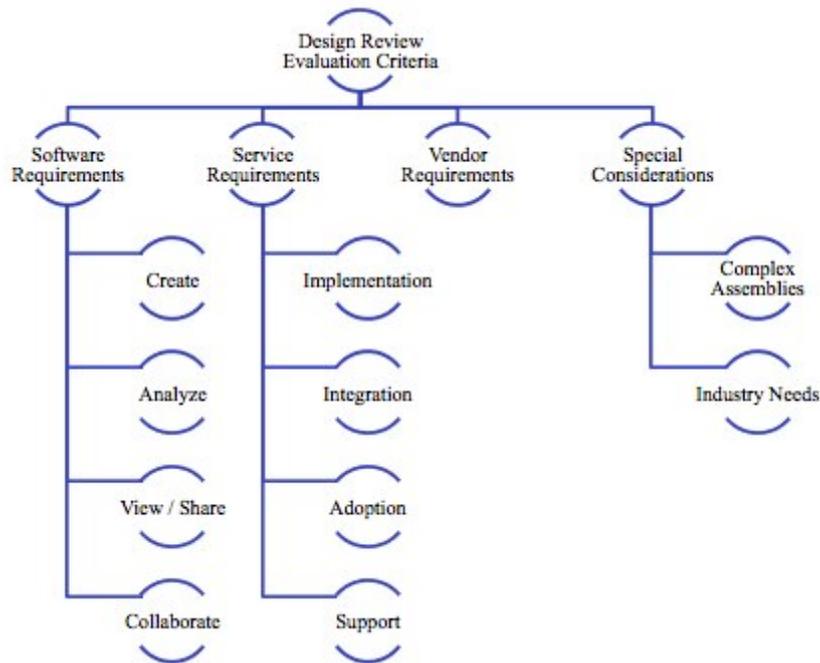


Figure 1: Design Review Evaluation Framework

Design review is a proven, low-risk process that helps manufacturers enhance quality, reduce time to market, improve productivity, and bring more innovative products to market.

Design review is a proven, low-risk process that helps manufacturers enhance quality, reduce time to market, improve productivity, and bring more innovative products to market. It supports a product development process that solicits input and feedback from a variety of people with varied expertise and points of view. This collaborative approach allows manufacturers to tap into their distributed product expertise and get products right the first time.

Achieving these desirable benefits requires more than sharing CAD files or implementing visualization tools. The guide identifies key business capabilities that must be adopted and the software needed to support them. It goes beyond software functionality to address the broader needs of the business, offering buying criteria that cover product, infrastructure, implementation, service, and business requirements. The guide also touches on special considerations for those with highly complex products and a few special considerations to consider by industry.

The Design Review Business Case

Before discussing how to select a solution let's discuss the value of improving design review performance. This section offers a short overview of the business value available from effective design review processes and enabling technology. Design review initiatives are attractive because they offer low hanging fruit compared to some initiatives. Improving design review does not require extensive process change, data conversion, or other implementation work to get started and brings a quick return on investment (ROI).

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One of the most obvious benefits of effective design review performance is improving engineering productivity. Engineers spend a significant amount of time conducting or participating in design reviews. While reviews provide clear value, the considerable time and effort spent manually preparing mockups and review data is non-value-added. Effective design review processes and infrastructure offer significant engineering productivity improvement.

Design review helps us make our machines better, easier, and cheaper because we make the right decisions in the early stages when we can changes things.
Michael Römer, Mechanical Engineer, KHS

Beyond efficiency, there are broader benefits to Engineering and Manufacturing available from getting product designs and engineering changes right the first time. Optimizing designs early in the development cycle prevents costly and time-consuming rework, and in turn improves time-to-market, productivity, quality, and more. *"It's important to have Production in design reviews and get their input from the beginning,"* explains Michael Römer, a mechanical engineer for international packaging and filling machine supplier KHS. *"Design review helps us make our machines better, easier, and cheaper because we make the right decisions in the early stages when we can changes things. In the later stages they can't help you."*

There are also benefits outside of Engineering and Manufacturing. Timely input from downstream departments and suppliers reduces errors that are difficult, costly, time-consuming, and/or impossible to change later in the product lifecycle as windows of opportunity for change close (Figure 2). “*We have learned a lot of lessons,*” offers Ralf Kiedrowski, the Leader of the CAD Department for SMS Siemag, an international supplier of metallurgical plant and rolling mill technology. “*We try to find errors very early, otherwise it costs us a lot of money.*” Broad input and validation ensures that designs are optimized for performance, but also for manufacturing, product compliance, and non-technical aspects like supply risk. The value of design review infrastructure can be extended further as the solution is deployed further into the enterprise and into the supply chain to incorporate remote sites, design partners, and suppliers.

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Ralf Kiedrowski, Leader of CAD Department, SMS Siemag

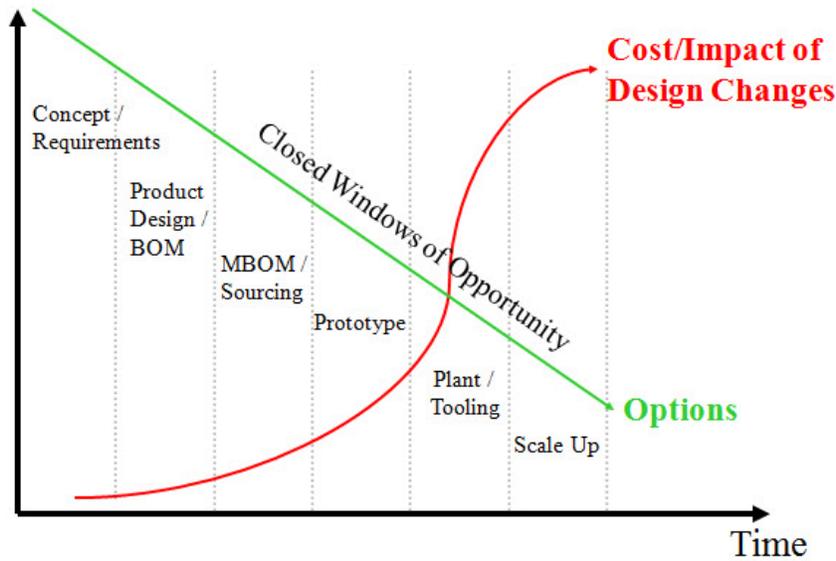
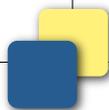


Figure 2: Closed Windows of Opportunity for Change

Finally, improving design collaboration and validation can also contribute to innovation and top-line performance by getting products designed right for the market. While it’s important to get additional input to ensure products meet technical requirements, it’s also valuable to help drive innovation. Modern design review tools and techniques offer a highly visual way to allow customers to experience products in a digital environment



before investing in materials, tooling, or marketing – saving time and money but more importantly driving higher market share and top-line revenue.

Analyze Design Review Solution Capabilities

To achieve these benefits, Tech-Clarity finds that companies must gain competence in four primary design review capabilities (Figure 3):

- Create
- Analyze
- View / Share
- Collaborate

These capabilities are explained in the following subsections along with checklists of high-priority software features required to support them. This guide does not provide a comprehensive list of requirements, but instead highlights key features that can help differentiate solutions and identify the one that is right for your business.

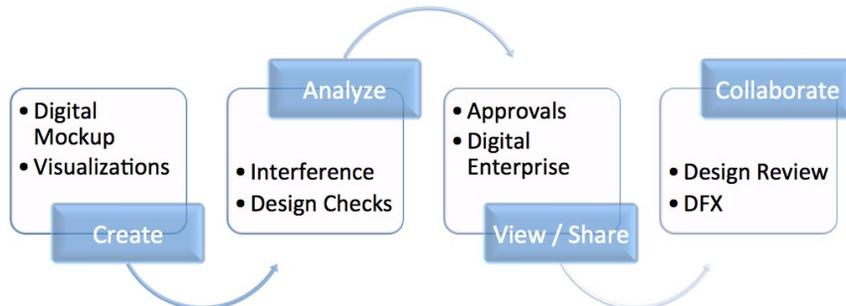
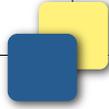


Figure 3: Design Review Capabilities Framework

Create

The “Create” sub-process combines designs into a digital mockup (DMU) that fully represents the product. This provides a holistic view of parts and assemblies in the context of the product as designers contribute their work. *“We bring the model together in DMU at a very early stage and have monthly DMU meetings on our power wall,”* says SMS Siemag’s Kiedrowski. This allows engineers to see how their designs impact others and the product as a whole, avoiding the time and expense of costly physical prototyping. The digital mockup can also include the surrounding equipment and environment to show the product in the context of an installation. As Michael Römer of KHS shares, *“We view the whole plant layout, not just single machines, by incorporating plant models or laser scanning.”*



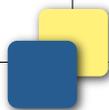
It's important to include designs from suppliers, design partners, customers, point clouds, and other sources regardless of the authoring system. This process can be challenging, and should not require licenses or expertise in the underlying CAD tools or the need to prepare or heal imported data as would be required if using CAD for the DMU. *“The system needs to manage, convert, and combine models from different CAD systems,”* says Ralf Kiedrowski of SMS Siemag. *“We also bring in geometry or models for supplier parts like gears in STEP or subfiles.”* This is a critical capability and one that requires scrutiny in the selection process. It's also important to consider that many users require drawings and that 2D is alive and well in manufacturing, so creating, watermarking, comparing, and visualizing should include 2D as well as 3D.

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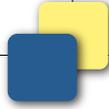
Ralf Kiedrowski, Leader of CAD Department, SMS Siemag

Speed is also critical to success, Mr. Kiedrowski adds. *“We can export and view in 5 minutes, that's important. It's a big deal.”* Timely creation of the DMU is critical to finding errors early. Design review systems should automatically create the DMU as designs are checked in. Automation reduces the high effort of manually creating digital prototypes. The visuals created from this process can also serve as a foundation for higher-level capabilities like animation, assembly/disassembly instructions, or advanced rendering to use for high-impact marketing.

Requirement	Considerations
Supports multiple CAD tools and formats	The solution should support all tools and formats used in your extended enterprise and bring them together into a single review session.
Automates design review lightweight inputs	Automation ensures up-to-date data and reduces manual preparation cost.
Supports mechanical and electronic CAD	Many products include both mechanical and electronic design data, it's important that design review tools allow seamless interaction with both.
Supports industry standards	Often, data needs to be exchanged in prescribed formats. These formats can include STEP, IGES, or JT. The solution should provide the ability to both import and export these formats.
Protects Intellectual Property	When sharing data beyond the firewall, it's important to have control of what IP can be removed to help prevent reverse engineering. This can include removing accurate geometric



	descriptions and metadata or reducing the fidelity of the visual representation.
Supports electronic PCBs and schematics	The solution should offer visualization of both electronic data formats and provide methods to compare design iterations to help understand changes.
Supports 2D drawings	2D engineering drawings remain a key component of the design review process. The solution should support a number of different drawing formats and enable them to be marked up, printed (with watermarks), and compared between iterations.
Supports non-CAD documents	The development process creates numerous artifacts of a non-geometric nature, including specifications, requirements, etc. The solution should provide the ability to display and mark-up documents to provide a holistic review environment.
Enables accurate measurement	During a design review or other validation task, users need to take measurements on the 3D model or 2D drawing. The solution should provide accurate and flexible measurement tools.
Provides watermarking	Watermarking helps prevent uncontrolled screenshots and prints. Moreover, company policy often enforces specific information to be embedded into the printed artifact. The solution should support watermarking of all product content, ideally supporting the use of current data from a PLM environment.
Includes CAD and PLM metadata	Metadata provides key non-geometrical information such as change dates, version numbers, materials, etc. The solution should provide methods to display metadata and use metadata in searches.
Incorporates GD&T	Allows the inclusion of manufacturing information in the model to support paperless, model-based enterprises through support for dimensioning and tolerancing, for example supporting the ASME Y14.5 standard.
Offers multiple output formats	The solution should be able to export design data in a number of formats for data exchange or



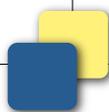
	archiving purposes. Additionally, the solution should provide seamless printing of multiple documents and data formats.
Provides Multi-lingual support	The solution should be able to create output in the languages and locales of your extended enterprise to ensure global information sharing.
Supports large assemblies	Many companies using traditional methods are unable to review their entire assemblies and are therefore unable to see their product in its entirety. The solution should support large model scalability and performance.

Analyze

The “Analyze” sub-process is comprised of manual and automated design validation. Advanced systems allow designers to digitally scrutinize designs to find interference problems, missing data, or other errors that could lead to downstream issues. Systems should support both manual and automated processes. *“We have automated model checking to make sure parameters are complete, and conduct manual collision and movement checks,”* says Michael Römer of KHS. Interference problems can be a big problem if not identified early. *“If you don’t find clashes and correct mistakes it can be a disaster at the plant,”* cautions Ralf Kiedrowski of SMS Siemag. *“For one project we had about 250 problems because we didn’t have time to model the piping in 3D. We brought it back, remodeled it, and reduced the errors to only 2 minor issues.”*

Advanced systems allow designers to digitally scrutinize designs to find interference problems, missing data, or other errors that could lead to downstream issues.

Automated approaches reduce the manual effort required to find common problems, eliminating non-value-added work and freeing up engineers to focus on design. Automation also provides better results than manual processes by taking advantage of consistent, repeatable checks against digital models. But human intervention is important, so visualization is also critical. *“We have both automated and manual checks,”* explains Ralf Kiedrowski of SMS Siemag. *“Our engineers are responsible for finding clashes and detecting errors in their designs. In the final step, we create the full plant and use automatic clash detection to check clashes between interfaces.”* Automation can also alert the appropriate people to ensure that errors do not fall between the cracks.



Requirement	Considerations
Identifies design errors	The solution should be able to identify interferences and clearance violations. This is particularly important when the design activity is distributed between multiple teams, sites, and vendors.
Visually identifies exceptions	The solution should enable rapid visual inspection of designs, including the viewing of section cuts to review internal detail.
Validates design standards	Effective checking and feedback on design standards prevents reworks and streamlines communications between different stakeholders in the product lifecycle.
Automated interference checking	Should be support interference checking as the design evolves with additional support to validate various product configurations.
Provides automatic triggers during product development	Often, specific activities must take place during various gates within the product design cycle. The system should support workflows triggered by specific events.
Routes issues to appropriate people	Streamlines assignment of resolution tasks to the right person ensures overall effectiveness.

View / Share

Beyond the design team are a host of others that need product data to do their jobs. Some of these are reviewers and approvers or other collaborators that play a direct role in validating designs. Others are downstream departments that rely on product information. A common rule of thumb is that for every engineer there are ten more people that need design information to make decisions and do their jobs. It's important to keep in mind that these users are not likely to have CAD licenses, expertise, or training. *"We use visualization in Production and Assembly in some locations,"* says Michael Römer of KHS. *"In the shop we can open the machine in 3D to measure, look up part numbers, or add comments."*

We use visualization in Production and Assembly in some locations.

Michael Römer, Mechanical Engineer, KHS



Providing information to downstream departments helps them make better decisions. It also saves engineers' time from interruptions because people can access the information they need on their own. For example, Legal can retrieve a picture for a patent or someone in Logistics could calculate a weight for shipping. Sharing designs with Sales and Marketing offers advantages because they can entice customers with highly realistic, compelling, 3D product representations. *“Our viewables are stored in our PLM system so we can use them for quick viewing,”* explains Ralf Kiedrowski of SMS Siemag. *“If we want to visit a customer we can share it on a laptop. We can also embed 3D in a PowerPoint and we can rotate, section, and measure it. It looks very nice.”*

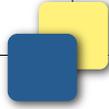
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Not everyone that needs product data is a part of the company. It's extremely important to be able to share designs with everyone in the right level of fidelity. For example, design review solutions should be able to optionally strip away precise geometry and/or features to share externally. *“We don't send models out of the company to protect IP,”* offers SMS Siemag's Ralf Kiedrowski. *“We export different levels of information. We share less with the shop floor and even less to send to the customer so we don't lose our know-how.”*

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Requirement	Considerations
Offers standard viewing capabilities	In order to ensure successful adoption across all roles, the tool must provide intuitive methods of interacting with digital product data. Inspection and navigation of 3D models should be smooth and easy to understand.
Allows viewing mechanical and electronic data concurrently	Users must be able to navigate between MCAD and ECAD data.
Does not need underlying authoring tool	No need for expensive CAD licenses, expertise, or training for users who do not create 3D models.
Allows version compare	Should support drawings and models.
Runs on lightweight hardware	The tool must enable effective usage across standard computing hardware.
Runs in a browser	The solution should support the browsers used in your business and supply chain.



Provides ability to share in office productivity tools	Often, presentations are provided using tools such as Microsoft PowerPoint. A particularly effective method is to present the digital product data “live” within the presentation document.
Offers ability to share via web	The solution should understand web protocols and work seamlessly in today’s internet-rich environment.
Provides ability to share via mobile	Users are now becoming to expect to be able to access engineering data in the ubiquitous landscape of handheld and portable devices. The tool must provide intuitive navigation using touch-interface metaphors.

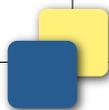
Collaborate

Developing a successful product requires input, expertise, and feedback from multiple people and domains. These people must become active participants and not just bystanders. “*When colleagues from Steelmaking and Piping are ready for construction, we merge their assemblies and have a meeting on the power wall so they can clean up mistakes and solve problems,*” says SMS Siemag’s Kiedrowski. This enables a “design for,” or DFX, approach that allows downstream parties to find and address issues early. Collaborators should be able to mark up models and drawings directly to provide feedback to engineers on issues. This feedback should become part of the product record to support future learning, audit, and offer contextual information as the product is revised or reused.

If a designer changes something and tries to promote it, a viewable is created automatically and sent to a checker, who then pushes a button to promote it or writes comments and sends it back.

Michael Römer, Mechanical Engineer, KHS

Advanced solutions provide automated workflows that ensure the right people get involved. For example, Michael Römer of KHS describes that, “*We have a ‘four eye’ principal to promote or change things. If a designer changes something and tries to promote it, a viewable is created automatically and sent to a checker, who then pushes a button to promote it or writes comments and sends it back.*” Adding simple rules to ensure designs are reviewed by the right individuals prevents errors.



Requirement	Considerations
Supports markup	Markup capabilities should support all commonly used digital product formats in the enterprise and supply chain.
Captures granular feedback	The solution must provide the ability to comment on many aspects of the model, from large-scale form and fit issues to details on model feature tolerances.
Provides workflows	The system should support review notifications and workflows.
Stores feedback	Feedback from design reviews should become a part of the product record.
Offers selective access control	Allows creation of a simple, granular security model to provide the right individuals access to the right information.

Assess Service Requirements

Ensuring design review software has the right capabilities to create, share, analyze, and collaborate does not ensure design review improvement. The software must be successfully implemented and adopted in order to make a positive impact. Fortunately, design review software implementations tend to be less risky and lower effort initiatives than many PDM- or PLM-related projects. Manufacturers should not accept multi-year implementations and should look for rapid return on investment.

It's simply not realistic to expect executives, suppliers, and others to download complex plugins or take on any significant learning curve.

One of the primary demands for design review solutions stems from the fact that they serve a broad number and range of users, many who will use the solution only rarely. This sets a high bar for ease of use and adoption by untrained and non-technical users, who will likely undergo no training and have no formal CAD or design expertise. The solution will also need to have either a very simple, rapid installation (or no install) for basic functionality. It's simply not realistic to expect executives, suppliers, and others to download complex plugins or take on any significant learning curve. Even for advanced users, the software should support enterprise software delivery methods to simplify and standardize the implementation.

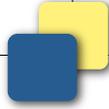
The software should provide rapid updates to support new CAD and EDA software releases.

Another critical set of requirements comes from the need to integrate with other solutions. The software should provide rapid updates to support new CAD and EDA software releases. Maintaining support for the most current releases is critical. In addition, the software should integrate with enterprise systems such as PLM. *“One of the most important things is the database,”* according to Ralf Kiedrowski of SMS Siemag. *“With PLM everything is stored in one system and all things are presented and located in one place. It’s very important for the business.”* Another important consideration is ERP integration. *“Before we had to manually write the BOM into the ERP system and some faults could happen,”* recalls KHS’ Michael Römer. *“Now the materials, BOM, and documents are all created and you see what you will get. It helps with spend and quality.”*

Requirement	Considerations
Provides integration toolkit	The investment in review and validation tools often requires data access or integration with other business tools. A toolkit is important to enable the interoperability between the review and validation environment and other systems.
Easy to use for untrained users	The solutions should support casual, non-technical users.
Makes self-service support available	Offers easy access to support for casual users.
Does not require CAD	Users should not be required to have CAD licenses or expertise.
Provides global support	Users need to be able to collaborate between many participants in different geographies, time zones, etc.
Supports multiple languages	The system should support the common languages in your extended enterprise.

Consider Vendor Requirements

The vendor you work with can have a large impact on the value you receive from design review solutions. As with most solutions, a stable, financially secure supplier that has experience working with other companies in your industry reduces risk. As always, it’s a good idea to ask for references to understand the experiences of companies like yours who have implemented the capabilities you are looking for. It’s also important to



recognize that vendors with solutions suites offering broader capabilities may add more value, such as use downstream tools for animations or technical documentation.

It's important that the vendor is willing to work across multiple CAD platforms.

There are some requirements that are specific to visualization and collaboration software. For example, it's important that the vendor is willing to work across multiple CAD platforms. In addition, vendors should have a proven track record of adopting open standards so viewables can live beyond the life of the tool.

The vendor should also invest in their products, for example rapidly adopting new technology innovations such as multi-core computing, multi-threading, and 64-bit processors. They should also address key trends such as supporting mobile computing. Ralf Kiedrowski of SMS Siemag stresses the importance of staying current. *“Our design review solution is also available on a tablet. Having quick access to current data on a mobile device is the future.”*

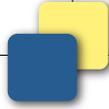
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Finally there are commercial issues that the vendor should support. For example, casual users should not be required to pay license fees. In addition, there should be no CAD license required to support the basics of design review.

Requirement	Considerations
Has financial stability	
Offers regional support	
Invests in products	
Has broader solutions available	
Willing to partner with other vendors	

Special Considerations

There may also be some unique considerations for your business or your industry. For example life sciences companies may require electronic signatures to support 21 CFR Part 11. Defense contractors will need to support ITAR regulations. Others may have specific customer or regulatory mandates to support “digital enterprise” requirements such as PMI. Most companies, particularly high-tech companies, will need to support the interplay of mechanics and electronics for mechatronic products.



Industries with very large assemblies must ensure they adopt a scalable solution ... that supports millions of parts and thousands of assemblies.

Other business or product characteristics could also play a role. One that can have a large impact on selecting the right solution is product size and complexity. Companies with very large assemblies must ensure they adopt a scalable solution, for example those in the automotive, aerospace, shipbuilding, or industrial equipment industries may need a solution that supports millions of parts and thousands of assemblies.

Conclusion

Improving design review process helps manufacturers get products right the first time, resulting in improved productivity, product quality, and innovation. Design review processes, and the visualization and collaboration software that support them, are relatively easy to implement. There are big differences in the solutions that support design review, however, and getting the right one in place is crucial to achieve benefits.

Using a high-level list of requirements such as the ones in this guide can help narrow down potential solutions by providing a quick “litmus test” to determine if a solution and partner are a good fit before conducting detailed functional or technical reviews. In the end, it’s important to ensure that functionality, service, vendor, and special requirements are all considered when selecting a solution.

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Recommendations

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations:

- Identify and weigh requirements based on company needs, product complexity, company size, industry, and any unique company needs
- Use high level requirements such as the ones in this guide to evaluate solutions based on business fit before engaging in detailed evaluations
- Look for easy to use, easy to deploy solutions that don’t require a multi-year implementation
- Consider long-term business and process growth needs and the potential to expand to a more scalable solution

About the Author

Jim Brown is the President of Tech-Clarity, an independent research and consulting firm that specializes in analyzing the business value of software technology and services. Jim has over 20 years of experience in software for the manufacturing industries. He has a broad background including roles in industry, management consulting, the software industry, and research. His experience spans enterprise applications including PLM, ERP, quality management, service lifecycle management, manufacturing, supply chain management, and more. Jim is passionate about improving product innovation, product development, and engineering performance through the use of software technology.

Jim is an experienced researcher, author, and public speaker and enjoys the opportunity to speak at conferences or anywhere he can engage with people with a passion to improve business performance through software technology.

Jim can be reached at jim.brown@tech-clarity.com. You can read additional research, watch Tech-Clarity TV, or join the Clarity on PLM blog at www.tech-clarity.com. You can also follow Jim on Twitter at [@jim_techclarity](https://twitter.com/@jim_techclarity), watch him as a “dueling analyst” in the [Tech4PD web show](#), or find Tech-Clarity on Facebook as TechClarity.inc.