

Tech-Clarity

making the value of technology clear

Tech-Clarity Insight: The Business of 3D Technical Communications

***Evolving Strategies to
Document Products***



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Executive Overview

Communicating technical product information is a fundamental requirement to profitably sell and support today's products. Documentation is a basic necessity, and in today's cost-sensitive manufacturing firms it has to be efficient. But there is more at stake in improving communication processes than simply optimizing the documentation workload. Streamlining communication development can help improve time to market by taking technical documentation off of the critical path. Gordon Benson describes this from the perspective of NACCO Material Handling Group, a division of NACCO Industries that designs, engineers, and manufactures material handling equipment. *"Given the product complexity and effort required to document today's electromechanical systems, documentation cannot afford to be done sequentially or it becomes a huge encumbrance on new product introduction schedules,"* explains Mr. Gordon, a Senior Visualization Specialist.

Although few companies will turn down an opportunity to reduce cost, there is more value to be achieved than lean product documentation processes. Technical communications are evolving to convey the critical details of products to a broader array of people in a wider variety of ways. People need to know the way the product works and how it is produced, assembled, maintained, and more. Manufacturing, suppliers, partners, customers, service technicians, and a host of others rely on this information to play their role in delivering product value.

3D product communication goes beyond flat, static documents to incorporate richer, interactive, more realistic representation of products.

To meet this need, companies are changing their views on technical documentation to a more strategic approach. 3D product communication goes beyond flat, static documents to incorporate richer, interactive, more realistic representation of products. Better communications leads to enhanced productivity of engineering, manufacturing, sales, and service. It also provides the opportunity to improve product quality (both actual and perceived) through better up-front design collaboration and clearer downstream communication. *"3D product communications are very good for quality,"* says Grant Ward, Project Engineer for S&C Electric Company, a global provider of equipment and services for electric power systems. *"It helps lean manufacturing initiatives."*

The good news is that with the right 3D technology, companies can increase the efficiency of their technical documentation team, improve product documentation quality, and set the stage for even greater business benefits. Many products have followed a pattern of becoming better-faster-cheaper – offering more value for less cost. Technical documentation is now poised to follow the same path as it evolves to 3D product communications.

3D Product Communication: Operational View

The three manufacturers interviewed for this report highlight both operational and strategic benefits available from 3D product communications. Today's manufacturers are required to manage multiple types of product documentation, including user manuals, service manuals, manufacturing instructions, assembly/disassembly procedures, training, product catalogs, bids, marketing materials, and other illustrations. These documents are often produced using antiquated methods, despite the fact that they must describe highly technical details on products that are becoming increasingly complex. For example, Tech-Clarity's *The Five Dimensions of Product Complexity* report identifies the need to address five critical dimensions of product complexity to achieve maximum profitability; mechanical complexity, mechatronics, global markets, global design and manufacturing, and lifecycle profitability. To be successful, product documentation must be able to address the resulting complexity in communicating product details, including documenting different configurations. Compounding the problem, documentation is frequently authored independently by different product teams. "*No one person has all the knowledge,*" explains S&C Electric's Grant Ward, "*It's all about communication.*"

Prior to using 3D communications technology, no engineering model information was shared and people impacted didn't see it, even when it may have impacted something downstream like tooling.

Bill Abely, CAD Manager, AS&E

Operationally, people need engineering and other product-related data to do their jobs. "*Everything we do as an engineering department is being used by other people,*" explains Bill Abely, CAD Manager for AS&E, a producer of state-of-the-art x-ray detection solutions. "*Prior to using 3D communications technology, no engineering model information was shared and people impacted didn't see it, even when it may have impacted something downstream like tooling. All communication was performed via a drawing.*" Engineers need to communicate information to the rest of the business. Outside of the Engineering department, however, few people have CAD tools or know how to use them, so developing documents that they can work with is critical. "*Engineers use 3D product communications when there is a need to effectively communicate with others,*" comments NACCO's Benson. "*For example embedding 3D into a PowerPoint presentation or sending 3D documents to vendors.*"

Any delay in creating product documentation can lead to a delay in delivering a product to market.

Research studies show how critical time to market is to driving profitability. Considering that a full product offering typically includes user manuals and/or service instructions,

documentation is critical to timely product availability. This means any delay in creating product documentation can lead to a delay in delivering a product to market. NACCO's Gordon Benson explains how this is changing. *"By leveraging 3D product communications, deliverables like service documents can be moved earlier, in parallel with the product development process, removing bottlenecks,"* states Benson. In addition to adopting more efficient documentation workflows, teams employing 3D communications technology can get started sooner in the product development process to get themselves off of the critical path to product delivery (and profitability). *"We used to have to wait for pieces and parts to come in to take pictures of them for our visual process documentation,"* recalls Bill Abely of AS&E. *"Now, we can start preparing right from the get-go so we don't have the lag to get manufacturing processes ready. It has been extremely beneficial on our new product line."*

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Gordon Benson, Senior Visualization Specialist, NACCO

The most advanced 3D product communications tools can also keep your documentation up to date throughout the product lifecycle as engineering changes are introduced, improving efficiency and keeping documentation in sync with products. As the paper discusses later, this improved efficiency extends beyond the documentation team to others including the engineers themselves.

3D Product Communication: Strategic View

Improving efficiency and time to market are valuable operational benefits that companies can achieve by improving product communications, but that is only part of the story. Looking beyond this, the benefits of 3D product communications also include the opportunity to improve quality, enhance customer service, provide more compelling marketing, and enable global manufacturing. For example, visual communication with downstream departments such as Manufacturing helps remove ambiguity from drawings and prevent the need for production personnel to freelance on processes. *"We want to take instructions straight to the floor,"* says S&C Electric's Grant Ward. *"If assemblers don't get instructions it sometimes leads to quality problems. We want to short circuit those before they happen to be proactive about improving quality."*

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In much the same way, 3D product communications provide the ability to improve service, reduce cost, and improve customer experience through better installation, maintenance, and service execution. By implementing clear, concise instructions that can be followed without interpretation and confusion, people that work with products in the field can more clearly understand and follow best-practices. This is not to discount the knowledge in downstream organizations. In fact, many best practices come from the leading technicians that can then share this information with others for consistency and quality. Ultimately, this benefits customers who experience better service and a better experience with the products they purchase.

***Manufacturers can develop compelling product literature
by leveraging the designs of the products themselves.***

3D communications can also help with sales and marketing. Manufacturers can develop compelling product literature and demonstration material by leveraging the designs of the products themselves. This approach is both efficient and effective. *“Customers are being barraged with rendered content through mainstream advertising outlets such as TV and magazines,”* says NACCO’s Benson. *“They are starting to perceive such content as linked to technical competence.”* Seeing that better instructions and communication can improve product quality, it’s easy to understand that more visually appealing and effective communications can influence how customers perceive the value of products.

Another potential strategic benefit is enabling a design anywhere, build anywhere strategy. Leveraging 3D product communications, manufacturers can implement clear, consistent processes across the globe to improve quality. These processes can be tailored to a specific production facility anywhere across the globe. The benefit is that visual communications are more clearly understood because they are less reliant on written language and its interpretation. Seeing an action performed is considerably better than reading about it. *“We make a lot of products and occasionally have to move product lines between manufacturing facilities, including the ones in other countries,”* explains Grant Ward of S&C Electric, *“We need to be able to easily move things to different areas where it makes sense for the company by saying ‘Here are the assembly instructions and here is how to make it.’”*

***Improving technical documentation processes can be strategic while still
providing short-term operational value through increased productivity.***

The fact is that improving technical documentation processes can be strategic while still providing short-term operational value through increased productivity. The following sections will provide more detail on specific improvements that are possible with 3D technical communications.

Improve Technical Documentation Efficiency

It has been established that better documentation and communication have both operational and strategic value, but in lean times how can companies find the budget to invest in new technology? 3D technical communications are not only better and faster, but also cheaper. Many companies start with small projects with short-term ROI from saving time and effort in developing technical documentation. While not many people are documenting using pencil and paper, a lot of electronic illustrations are still accomplished through a manual process of digital sketching. Others are even less technologically adept, and simply take photographs of prototypes or finished parts. *“Without automation, technical publications couldn’t get done as quickly,”* comments AS&E’s Bill Abely. *“We were using FrameMaker documents and snagging PDFs and JPEGs all over.”* This is clearly an inefficient process, and recreates what has already been documented by the engineer. Instead, technical documents should be able to leverage the industrial design done by the engineer, reusing that existing asset.

Without automation, technical publications couldn’t get done as quickly.

Bill Abely, CAD Manager, AS&E

Using 3D technical communications tools adds speed as well as productivity. Technical documentation experts don’t have to recreate the wheel or wait for prototypes, so they have more time. They are also more in control of their own schedule, because they don’t have to wait for engineers to take screen shots and don’t need to wait for prototypes to take pictures. It is also much more efficient because reusing the existing CAD models is less prone to errors, so requires less rework. There are frequently direct cost savings as well because documentation experts don’t need to travel to the plants to take pictures.

Another advantage of 3D technical communications is that using the 3D model makes it much easier to incorporate engineering changes. With manual drawings or photographs, documentation must be rebuilt from scratch when designs change. This example from AS&E highlights the value of technology when designs change. *“The day before the first printing of our manuals a tech pub writer overheard a conversation about a change that he wasn’t aware of. The change affected 50 images! Including the change would normally take about ten days – instead it was ready by the next afternoon,”* recalls AS&E’s Abely.

The tool helps in our assembly areas because a picture is worth a thousand words and language issues are largely eliminated.

Grant Ward, Project Engineer, S&C Electric

As mentioned earlier, visual communications can be extremely helpful in global manufacturing environments. They also add efficiency, because images and interactive documents reduce the need to translate text to multiple languages. *“The tool helps in our assembly areas because a picture is worth a thousand words and language issues are largely eliminated,”* describes S&C Electric’s Grant Ward. *“We can reduce all that text to a couple of frames in an animation.”* Better documentation tools and approaches drive higher efficiency and better results, offering direct cost savings and getting technical documentation teams off of the critical path to launch products or changes.

Improve Engineering Efficiency

Efficiency gains from 3D technical communications extend beyond those directly responsible for technical documentation. In most companies, engineers are required to spend a significant amount of time helping to document and communicate product information instead of working on innovating product designs. While engineers will always need to communicate and transfer their knowledge downstream, not all activities still require the engineer to be directly involved. *“Designers are responsible for all assembly instructions,”* says S&C Electric’s Grant Ward. *“But our tool allows a non-engineer to work on them, freeing up the design staff to focus on developing more products in a shorter period of time.”*

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Engineers frequently complain that they are being interrupted for a screen shot or another view for documentation. 3D product communications reduces this documentation “tax” on the engineers’ time. Of course to be fair, documentation specialists don’t like having to rely on getting the engineers’ attention. They would much rather have autonomous access to the information required to get their job done. *“Our VP of Engineering wants engineers to focus on the CAD models,”* Bill Abely of AS&E says. *“With our 3D communications tool people don’t have to go to engineering to cut sections or change colors.”* Changing the color of a part or creating a different view shouldn’t require an engineer, or even someone trained on 3D CAD.

***Not only are engineering personnel unburdened,
but we can provide data that is more clear and secure.***
Gordon Benson, Senior Visualization Specialist, NACCO

Increased efficiency shouldn't come at the cost of poor documentation. "*3D product communication tools open design data up to non-CAD users,*" explains Gordon Benson of NACCO, "*So not only are engineering personnel unburdened, but we can provide data that is more clear and secure.*"

Improve Documentation and Communication

Although efficiency typically pays for the implementation of 3D technical communications tools, the strategic benefits come from their ability to deliver significantly improved understanding. Artistic renderings and photos not only take extra work, but also fail to convey certain information. This is particularly true for large or complex assemblies where a virtual tour of the product is much more valuable than the prototype or the product itself. It is hard for a camera to "see inside" of an assembly, for example to understand how wires are routed in a finished item. "*Sometimes we need to show parts of our product such as a complex cross section that would be very difficult or even impossible to do with a real product,*" comments NACCO's Gordon Benson. Let's face it; real products can be pretty hard to physically cross-section. Why should companies have to manually disassemble their products to take pictures when a system can do it virtually based on precise three dimensional knowledge of the product structure?

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3D technical communication tools can deliver better graphics, but more importantly they can offer richer and more effective communication. They offer the ability to transition from 2D drawings to 3D representations, and transform deliverables from passive documentation to dynamic, interactive communication. Imagine the benefits of moving from a picture to an interactive model that can be virtually drilled into, manipulated, rotated, exploded, or otherwise "interrogated" to see different views than were pre-conceived. "*The elegance of 3D product communications is its ability to provide useful information to a target audience,*" Mr. Benson of NACCO states. "*3D product communications bridge the gap between unstructured information and knowledge about a product, system, or process.*" 3D product communication technology not only helps make documentation more efficient, it improves the ability for users to digest complex information more effectively.

The art is moving from creating (or recreating) the image, to determining how to best convey the required information visually.

Of course, providing visibility to the engineer's design is not enough. Communication professionals have to pass on the right information. The art is moving from creating (or recreating) the image, to determining how to best convey the required information visually. *"3D product communication is a creative process. You leverage CAD geometry that is created by design community, and our tool allows us to be creative in putting together assembly instructions, etc. We put a lot of thought in how to make the content easy to access and comfortable for the users,"* describes Grant Ward of S&C Electric. *"We want to make it so useful and easy to use they are drawn to it."*

3D product communication tools offer the ability to highlight a specific part, play a sound, or indicate a potential safety issue. This helps users transition away from 2D pictures to 3D graphics in order to tell a more engaging story or describe a procedure interactively. The result is much better knowledge transfer than what is available from flat, passive 2D documents.

Improve Collaboration

3D communication tools get more people involved with product designs earlier in the product lifecycle. This allows downstream departments, such as tooling in Manufacturing, to get started on their work in parallel. *"To improve time to market, you need to get more collaborative,"* explains Bill Abely of AS&E. *"If Manufacturing or Tech Pubs have questions they need to be involved right away. Communication and collaboration are the keys."* When done successfully, time to market is not only reduced, but downstream departments also gain more time to innovate on their own processes. *"We were developing a new product series and the flexibility of 3D product communications allowed Manufacturing to explore radically different methods of assembling the product,"* recalled Gordon Benson of NACCO. *"This resulted in finding a very creative solution to assembling some notoriously difficult components before they were introduced to the assembly, greatly enhancing efficiency, cost, and quality."*

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Early visibility also allows downstream departments to provide better feedback to Engineering during product development. Timely input from others opens the opportunity to improve manufacturability and product quality by design. *"The earlier manufacturing is involved in the product development process, the opportunity to reduce cost and improve quality go up because designs are more manufacturable and less prone to error,"* says NACCO's Benson. *"Enabling organizations like Manufacturing to interact autonomously with the 3D data is a significantly step in realizing these benefits."*

Similar benefits are available by having other departments like service involved sooner. *“By ensuring designs are serviceable, customer satisfaction is improved,”* Mr. Benson added.

Improve Manufacturing

Product communications aren't limited to customer-facing documentation. Manufacturing and assembly personnel need to understand the product and the way it is put together. This is extremely important in distributed manufacturing environments to reduce variability and improve quality. Traditional manufacturing instructions include 2D drawings and large volumes of text. *“For a new product, we would document it to the hilt,”* recalls S&C Electric's Ward. *“We spent a lot of effort on detailed assembly instructions that turned out to be of limited utility. Very few people looked at them, and language was a barrier.”*

Not only does it take forever to manually create a lengthy specification, it doesn't lend itself to easy updates so they typically lag behind product changes.

Grant Ward, Project Engineer, S&C Electric

Not only are large, text-based documents difficult to read they are difficult to keep current. Outdated manufacturing instructions plague manufacturing sites. *“Not only does it take forever to manually create a lengthy specification, it doesn't lend itself to easy updates so they typically lag behind product changes,”* explains Grant Ward of S&C Electric. 3D technical communications can be linked to the originating design documents to ensure that design changes are incorporated and allow for automated documentation updates. Manufacturing instructions can be a compelling first project. *“Tech Pubs wanted to jump on the 3D technical communications bandwagon right away,”* said Bill Abely of AS&E. *“But we also saw the advantages of improving manufacturing process documents.”*

There are two aspects of manufacturing, participation in the design process and actually building product, 3D product communications is strong in both areas.

Gordon Benson, Senior Visualization Specialist, NACCO

There are additional strategic benefits of reusing 3D CAD for technical communications. One such benefit is improving manufacturing throughput. For example, the plants don't need to take equipment offline to take pictures or make videos because it is all done in a virtual environment. The resulting digital communications can also reduce training cost. Interactive simulations of manufacturing processes reduce the need for travel and on-site instruction. *“The feedback from assemblers is very positive, as we create content to*

describe everything from basic things to more complex designs,” remarks Grant Ward of S&C Electric. *“Shop floor supervisors say they can get people up to speed much faster.”* As mentioned earlier, getting manufacturing involved up front to collaborate on designs has significant benefits. *“There are two aspects of manufacturing, participation in the design process and actually building product. 3D product communications are strong in both areas,”* NACCO’s Benson comments. *“Poor 3D product communication would present itself with manufacturing or service issues, making it harder and more costly to address.”*

Improve Service

The benefits of improving manufacturing through better collaboration on designs and clearer instructions are paralleled in service departments. *“In the past 1-2 years we have significantly ramped up the use of 3D to train service personnel,”* says Gordon Benson of NACCO. 3D animations more clearly show assembly and disassembly processes including travel paths. As such, they are a more effective procedural communication tool than 2D drawings with arrows and text descriptions. *“We are mostly using 3D communication for service manuals and visual manufacturing processes, but we will be introducing the install group to the technology for their installation manuals,”* Bill Abely from AS&E says. *“There is a lot of in-house knowledge that is only in the heads of our team leaders.”*

3D animations ... are a much more effective procedural communication tool than 2D drawings with arrows and text descriptions.

Improving service operations is increasingly more important as service management becomes more strategic. As Tech-Clarity’s *The Service Lifecycle Management Approach* report indicates, *“There are hidden opportunities for greater revenue and market share available by focusing more attention on the aftermarket.”* And considering today’s shared risk and performance-based service agreements, profitability is much more dependent on successful service. Improved communication can help. *“Service departments have also voiced positive responses to new 3D product communications based documents which are more clear, particularly on highly complex tasks,”* says NACCO’s Benson. *“Clear, 3D service instructions translate into less training time, fewer errors, and more efficiency by the service organizations.”*

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Sharing best-practice service processes is becoming progressively important as service becomes more global. Companies require clearer documentation for products that may be serviced around the world. Better communication is also critical as many companies rely on 3rd party service technicians. 3D technical communications help better train and certify service technicians and enable customers or technicians identify spare parts more readily and interactively. Clear instructions help get the job done right, regardless of who is doing it and where.

Get Started

As the previous sections show, there is no lack of opportunity to improve performance and profitability with 3D technical communications. There are also other uses, including developing more intuitive, interactive training materials. The key is to find a real problem in the business and get started. *“Have a plan on how to use it,”* Grant Ward from S&C Electric rightly says, *“If you have a business need for communications in Engineering, I would consider this tool, and not just because it’s cool.”* Once a project is identified, keep things simple in the beginning. Although more advanced options exist, the ROI doesn’t require a significant amount of sophistication. The benefits of 3D technical communications are available from a relatively simple implementation, and the value continues to grow as usage matures.

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Selecting the right tool is important. The tool should have strong documentation and graphical capabilities such as auto align, advanced rendering, and “WSYWYG” editing. The software should allow non-Engineers to adopt CAD geometry and move it, locate it, add to it, and annotate it. But effective 3D product communications requires more than just a drawing features, it needs to understand the product. It should access 3D geometry from any CAD tool, but also access parameters and other information. Communicating product behavior requires an understanding of the product structure to facilitate explosions. Communication tools should be able to generate reference designators for parts, understand properties like material types, gather manufacturing information such as tolerances, and allow for measurements and cross sections. In short, technical product communications should leverage and convey true product knowledge as opposed to just geometry. As AS&E’s Bill Abely says *“The technology does a great job of seeing the custom properties information (metadata) such as part numbers and descriptions.”*

Another important consideration is to be able to incorporate information from multiple sources, including multiple CAD systems. To effectively communicate a design, you may need to add components that aren’t considered important in the engineering drawing, such as fasteners. You should also look for the ability to publish in multiple formats such

as MS Office documents, HTML, and PDF, and through multiple channels including the web, presentations, documents, and others. The key is to allow documentation specialists to spend more time on value-added communication instead of recreating the geometry from scratch; and then to convey this information in an easily consumable format.

Extend the Business Value

As mentioned earlier, manufacturers can start small and grow. Many companies start in one area of the business and then extend to additional processes over time. For example, they may focus first on efficiency in product documentation and then find other areas to apply the technology. Once in use, other opportunities become apparent. As Bill Abely of AS&E says, *“This technology takes a life of its own.”* The benefits can come very quickly, but also provide the foundation for continued extension of the value as implementations mature.

***Many companies start in one area of the business
and then extend to more processes over time.***

Another way to extend the benefits is by gradually increasing the level of automation. For example, companies can associate product documentation with underlying drawings. *“We want our instructions linked to our 3D models, so that the tool can help with updates to the assembly instructions if changes are in order,”* explains S&C Electric’s Grant Ward. *“We are laying the foundation for this type of automation where we can update the visual content automatically when a design changes, but that will take some time.”* 3D technical communication tools should provide the ability to flag items that should be updated, and update automatically through a synchronization process if desired. For example changing a material property can change the way it is displayed. *“Every change to the model could update the images automatically,”* says AS&E’s Bill Abely. *“But we want someone to review it first and accept it.”*

***We want to tie visual manufacturing more closely to PLM
to closely align it with products so when there are revisions
we can quickly update the manufacturing instructions.
Grant Ward, Project Engineer, S&C Electric***

All of the companies interviewed mentioned plans to add more value by integrating with Product Lifecycle Management (PLM) systems. As Gordon Benson explains, NACCO has already done this. *“Our system is integrated with our CAD/PLM, and our PLM system initiates data conversion into our 3D product communications tool.”* Grant Ward explains the importance of integration for manufacturing processes. *“We want to tie visual manufacturing more closely to PLM to closely align it with products so when there*

are revisions we can quickly update the manufacturing instructions.” AS&E is also targeting integration. “One of our next steps is to get more involved with PLM,” AS&E’s Abely says. “It will help with communications, so when we make changes to a model it will flag Tech Pubs, Manufacturing, and Service to take a look.”

Conclusion

Technical product communications provide both strategic and operational benefits. The first and most obvious of these is that it improves the efficiency of technical documentation, both in initial development and when designs change. It also improves efficiency of engineers because others can more readily access the engineering information they rely on to do their jobs. “We have already paid it off, the ROI was pretty quick,” says AS&E’s Bill Abely. “Mostly in Tech Pubs, mainly in efficiency.” This efficiency, coupled with the ability for downstream departments and technical publications helps improve time to market, perhaps one of the biggest product development concerns among manufacturers today. “All downstream organizations have moved their document creation efforts much earlier in the product development process,” recounts NACCO’s Gordo Benson. “Without 3D product communications enabling this, our product development schedules would not be half of those just 5-10 years ago.”

We have already paid it off, the ROI was pretty quick.

Bill Abely, CAD Manager, AS&E

Clearer communication also drives enhanced product quality through improved collaboration. As NACCO’s Gordon Benson says, “Communication is a value added activity, and in the world of product design, 3D product communications speaks our language.” Clearer communication also reduces the potential for errors. “We have so many product configurations it is often a challenge to keep them straight. A mistake on a critical assembly creates costly scrap,” explains S&C Electric’s Grant Ward. “Improving product communications reduces errors and saves money. The payoff is substantial.”

Improving product communications reduces errors and saves money.

The payoff is substantial.

Grant Ward, Project Engineer, S&C Electric

The benefits of 3D technical communications are compelling, as the companies interviewed for this paper clearly articulated. “The solution is exceptionally beneficial,” says AS&E’s Bill Abely, “I have no concrete numbers but it has really saved us a lot, especially when we are growing so fast.” The value can come quickly and then grow over time as usage matures. In the end, 3D product communications become a strategic tool with significant benefits. “I think it’s difficult for many to see the larger role this

technology plays in the product development process,” explains Gordon Benson of NACCO, *“I liken this technology to e-mail or the telephone, you don't know its value unless you take it away.”* 3D product communications have significant potential to add value to today's manufacturer with short-term payback and even greater long-term benefits.

Recommendations

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

- Expand the view of product documentation to a more strategic view of 3D product communications
- Leverage existing 3D assets (CAD models) to improve technical documentation efficiency
- Explore interactive, 3D communications to improve the effectiveness of product communication
- Leverage 3D product communications to improve product quality through better collaboration and communication
- Pick a problem area and introduce automation to address it
- Start small, prove the value, and grow from there
- Add automation over time to streamline processes and better manage change
- Integrate to PLM as usage matures to better manage technical communications in the full context of the product

About the Author

Jim Brown is the President of Tech-Clarity, an independent research and consulting firm that specializes in analyzing the true business value of software technology and services. Jim has over 20 years of experience in software for the manufacturing industries, with 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, manufacturing, and others. Jim is passionate about improving product innovation, product development, and engineering performance through the use of software technology and social computing techniques.

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