

## Delivering quality components: Parasolid's drive for success

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white paper



- ▶ Like their counterparts in the manufacturing industry, application software vendors understand that the quality of the components deployed in their products is a critical factor in the success of their business. Just as aircraft manufacturers source jet engine technology from dedicated specialists, independent software vendors are increasingly sourcing best-of-breed software components to add the greatest possible value to their products.

Parasolid® software is just such a component. Developed by Siemens PLM Software, Parasolid is the world-leading 3D geometric modeling kernel that has earned a unique position at the forefront of high-end CAD/CAM/CAE/AEC, and is a key enabler in the growth of mid-range systems across a broad range of 3D applications. Underpinned by a development culture that demands continuous improvement, the Parasolid organization has spent many years anticipating and exceeding customer expectations for reliability and functionality. The results of this drive to succeed have shown beyond doubt that quality and customer focus are cornerstones for a successful world-class modeling component.

The Parasolid customer base includes established industry leaders, innovators and researchers spanning multiple 3D modeling domains, including CAD, CAM, CAE, AEC and related fields. Their decision to adopt Parasolid is driven by more than just the need for superior functional capability, and this paper explains how the value delivered through Parasolid's quality and release processes is a critical factor in enabling every Parasolid customer to be successful in their chosen markets.

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Parasolid is a key software product in Siemens' PLM Components suite of solutions, and has been deployed successfully in commercial 3D software applications for over fifteen years. Siemens uses Parasolid throughout its suite of product development applications, including NX®, Solid Edge®, Teamcenter® and Tecnomatix® software. Parasolid is also licensed to a broad community of independent software vendors (ISVs) and end-user organizations to provide the geometric modeling foundation for their added-value applications. Nowadays many of the world's leading computer-aided design, manufacturing and engineering analysis applications are Parasolid-based, and Parasolid is increasingly the modeler of choice in related applications such as architecture, metrology, inspection, reverse engineering and 3D-enabled apparatus such as CNC, medical and optical equipment.

Architected as open component technology, Parasolid comprises a comprehensive library of 3D modeling, editing and interrogation functionality that can drive the core capabilities of any 3D application. Software developers gain access to this power via Parasolid's high-performance application programming interface (API) of over 750 functions, and many Parasolid adopters have leveraged this power to create applications that are leaders in their chosen markets.

Parasolid-powered products benefit from Parasolid's unique robustness and reliability, forged over years of exposure to the extremes of industrial usage. They also share Parasolid's de facto standard open XT data format, which allows translation-free interoperability with any other Parasolid-based application. Worldwide there are upwards of two million users of Parasolid-powered applications, and an estimated 45 percent of the world's 3D CAD models are embodied in Parasolid's open XT format.

In short, Parasolid has a well-earned reputation as high-quality, reliable component software that provides customers with the functionality, flexibility and robustness they require, delivered with frequent updates which enable performance and functionality gains to be implemented as quickly and simply as possible.

As in manufacturing industries elsewhere, independent software vendors (ISVs) who develop added-value application software have embraced the concept of sourcing best-in-class software components from specialist suppliers. Whether these suppliers are partners, customers or even competitors, the benefits of licensing high-quality software components are manifold: highly specialized functionality can be integrated at lower cost, ISVs can focus on adding more value for their customers and innovative applications can be brought to market with greater speed and higher quality.

Software components are analogous to the components in your PC, camcorder or vehicle, and should meet similar quality expectations. Moreover, in many manufacturing industries the quality of core components is central to a product's fitness for purpose. For example, computer manufacturers may highlight the speed of the processors they source, but the fact that the processors are also highly robust is taken for granted. Likewise, the jet engine in an aircraft must meet stringent standards for reliability and performance, these factors being so crucial to the operation of the aircraft that quality is built into every stage of the engine's development.

In the software industry, pressure to add functionality can sometimes cause organizations to lose sight of the pivotal role that quality plays in the success of their business. By contrast, Parasolid developers have always understood the significance of software component quality; and with good reason since Parasolid is the trusted modeling "engine" of choice in many leading 3D applications.

Indeed, delivering on quality has been the key to Parasolid's success over many years. Using a straightforward integration process, application developers can quickly harness that quality to deliver rich added-value applications that build on Parasolid's proud history of reliability, usability and functionality.

*"We needed the best geometry engine; broadly-used, native CAD/CAM compatibility; and proven quality and reliability. With Parasolid, we got them all."*

*Bob Steingart  
Vice President of Marketing  
SensAble Technologies*

**Component quality lies at the heart of business success for the component developer**

## ▶ Customer quality requirements

The Parasolid team began pioneering software component quality from the outset, working in conjunction with early adopters to establish important criteria for reliability. These principles are regularly validated with Parasolid customers through formal surveys and consultations, and the results confirm that quality and reliability continue to be critical priorities.

An immediate and fundamental principle is that, in order to be an effective modeling foundation for a wide range of systems, Parasolid must be sufficiently robust to operate in a variety of application environments. Therefore, as well as being tested in isolation, Parasolid quality must be verified 'in context' using customer applications and scenarios. Interoperability between different versions of Parasolid must also be robust; when a Parasolid-powered application is updated, Parasolid must still work seamlessly with it, and vice-versa. Furthermore, the frequency of Parasolid releases must be managed to harmonize with a variety of customer release cycles and product acceptance criteria.

To address each of these requirements for Parasolid, the following maxims are specified:

### **Deliver plug-and-play releases**

When Parasolid is updated, customers can take the new version and drop it into place in their application deliverables without changing source code or recompiling. This 'plug-and-play' compatibility allows customers the option of updating their applications in turn whenever Parasolid is updated, at no rework cost. It also means that customers can plan release schedules for their own products without having to synchronize with the Parasolid release schedule.

### **Accelerate customer time-to-market**

If customers are able to develop and release their applications quickly, then everyone benefits. Parasolid reduces application time-to-market in several ways: by issuing frequent update releases, by ensuring consistent interfaces that are easy to code against, by providing appropriately packaged functionality that is easy to integrate, and by making it easy to update an application with newer versions.

### **Empower customers to own their data**

When customers integrate Parasolid into their products, they place trust in Parasolid to support them 'for the long haul'. In return Parasolid provides customers with confidence that their continuing investment in Parasolid functionality and data will be protected.

For example, it is essential for a customer's Parasolid-based applications to exchange data seamlessly even when using different releases of Parasolid. Parasolid customers must be certain that they can work with their existing Parasolid data after they have integrated an updated version, and equally they may need to read newer data into applications using earlier Parasolid versions. Therefore, it is guaranteed that the latest version of Parasolid can open any Parasolid models created using older versions, and likewise, an older version of Parasolid that is still supported in the field can open Parasolid files from newer versions.

The benefits of empowering customers to confidently 'own their data' extends to the wider community of Parasolid-based applications. Using Parasolid's open, native XT file format enables model data saved in one Parasolid-powered application to be opened in any other Parasolid-powered application from any vendor. This concept, known as the 'XT pipeline', enables Parasolid customers to enjoy the benefits and security of belonging to a broad-based community of vendors and users who can exchange model data seamlessly.

To further underpin customer ownership of their data, Siemens PLM Software has published the specification for the XT file format, providing an additional safeguard that Parasolid customers and end-users appreciate.

*"After a comprehensive evaluation of several geometric modeling options – including the development of our own in-house software – the evaluation committee overwhelmingly recommended Siemens' Parasolid as the world's best solution based on functionality, openness, quality, performance, support and industry acceptance."*

*Christian Arber  
General Manager  
Missler Software*

Parasolid protects customer investment by delivering:

- Plug-and-play releases
- Reduced time-to-market
- Customer data ownership

## ▶ Testing Parasolid

Parasolid's quality is assured through an aggressive commitment to continuous improvement. A linchpin of this strategy is the recognition that metrics are vital if the quality process is to be successfully managed. Therefore, a fundamental activity is to test heavily and repeatedly to validate quality at every stage, including cycles of monitoring and correction throughout development and release processes, together with complementary measures for improving performance.

It is well known that the cost of failure is proportional to the time between initiation and detection. Therefore, even before submitting a code change for integration testing – a comprehensive, overnight process – Parasolid developers perform preemptive testing. Parasolid's patent-pending preemptive test suite automatically selects the most appropriate tests, from an extensive suite of customer supplied tests, to exercise the code change. Those tests are run on behalf of the developer, who quickly receives a report showing any improvements and regressions. This prompt feedback enables Parasolid developers to validate code changes quickly, resulting in accelerated development of high quality software.

When developers have successfully completed preemptive testing, they submit their changes to Parasolid's full battery of over one and a half million integration tests. These tests are run every 24 hours on the latest software builds of Parasolid, across all supported platforms. Any regressions are detected and resolved immediately, a zero tolerance rule which ensures that code changes are robust before acceptance, and that they are always submitted into a production-quality environment.

In addition, Parasolid is also tested extensively on emerging platforms to eradicate problems long before the platforms become officially supported. In all, during an average major release cycle of six months, each maintained Parasolid version is subjected to over 80 million tests!

Of course, the sheer volume of tests alone does not guarantee a quality product: the tests must be the right tests. For Parasolid, a spectrum of different testing strategies aims to exercise the software intelligently at every level. This policy extends to testing Parasolid within application software to validate Parasolid quality in typical end-user scenarios. The benefits of application testing include:

- Exercising combinations of Parasolid functionality in a single application action
- Testing typical user modeling sequences, as opposed to isolated point functionality

Coverage analysis is performed regularly across the entire test suite. This involves analyzing the available tests to see how thoroughly they cover Parasolid functionality. Coverage analysis is used to identify gaps in the testing regime, and makes it possible to target particular functional areas for deeper analysis.

Continuous improvement of the Parasolid test suite is an explicit objective of Parasolid's quality management. For example, all new functionality has to be accompanied by appropriate tests. Also, every customer-reported problem that is ever fixed is added to the standard test suite and is part of Parasolid's regression testing thereafter, providing the basis for Parasolid's zero tolerance policy on regressions. Furthermore, new tests are continually being devised based on the results of coverage analysis. All these tests are run every night, on every supported version of Parasolid.

Testing in this rigorous fashion is the only way to ensure that the quality of Parasolid is maintained and enhanced.

Parasolid testing highlights:

- Preemptive developer testing
- Total coverage every 24 hours
- Multiple depths of testing
- Zero tolerance on regressions
- Customer scenarios tested
- Application performance monitored

**Parasolid's exhaustive testing and monitoring processes enable production-level quality to be maintained throughout the development and release cycle**

Test type	Description
Module	Exercise internal functionality below the API.
System	Exercise API, checking functionality and error conditions. Identify any platform differences.
Regression	Check that corrected faults do not recur. Covers all reported faults, ensuring zero tolerance on regressions.
Application	Validate actual end-user scenarios using customer-supplied tests. Combinations of API functions. Check 'plug-and-play' compatibility.
Performance	Measure performance on tasks known to be time consuming or performance critical.
Soak	Attempt to provoke run time errors by exercising random functions on a set of parts.

## ► Managing Parasolid versions

It is typical for Parasolid customers to be supporting several releases of their products simultaneously, and to be working to their own particular release cycles. This in turn means that, at any one time, several successive versions of Parasolid are in production use in the field, and must therefore be supported and maintained simultaneously. Moreover, to provide the level of flexibility customers require, certain of the latest enhancements and problem fixes may also need to be added to earlier versions.

In order to track changes and maintain quality across each released version, Parasolid has developed an effective version management strategy. Every night, several versions of Parasolid are built automatically: the development version, i.e. the version of Parasolid currently under development and not yet released, and supported maintenance versions, ready for update release if needed. The testing regimes described earlier are run every night on all builds, ensuring that each day's work has been validated by the start of the following working day. Changes and new functionality are first added to the development version, and can only be ported into the appropriate maintenance versions if they have caused no failures during overnight testing. This quality gate is backed up by equivalent testing in maintenance versions, and code will only be released when all criteria are satisfied.

Close to the release of a new version of Parasolid, the development version on which it is based is frozen and undergoes a period of critical maintenance to ensure that it is as stable as existing maintenance versions by the time it is released to customers. Ensuring the stability of new Parasolid versions from the first release gives Parasolid customers the confidence to upgrade to the latest version with minimal further testing: a simple process as no changes to their own application code are necessary.

Parasolid version management benefits customers by:

- Supporting several releases concurrently
- Ensuring stability of maintenance releases
- Ensuring stability of new releases

## ► Parasolid releases

As well as full customer releases of new Parasolid versions every six months, regular updates of all maintained versions provide Parasolid customers with performance improvements, enhancements and documentation updates. On average, an update release of each active maintenance version of Parasolid is available to customers at least once a month, and across all maintained versions update releases are made at a rate of more than one per week.

Through Parasolid's rigorous version management strategy, Parasolid customers have the confidence to update their own products using maintenance updates. Simply by dropping an update release into their application deliverables, they can provide quality updates to their own customers. Indeed, many Parasolid customers are sufficiently confident to adopt an update release of Parasolid late in their own product release cycle.

Parasolid has evolved a "release at any time" culture, underpinned by a zero tolerance regression policy across all supported versions. This means that any maintenance version can be updated at very short notice, providing a high level of customer responsiveness.

Parasolid is only released when it meets a set of strict release criteria that apply equally to new versions of Parasolid and update releases: Parasolid releases should never exhibit any performance degradations or regressions in functionality, compared with the last release. Also, all internal documentation for the release must be signed off to ensure that there is an audit trail of all changes from requirements through to release.

Plug-and-play updates enable Parasolid customers to:

- Integrate enhancements immediately
- Pass regression fixes onto their customers seamlessly
- Retain control over their own release schedules

**Specific release criteria guarantee stability of all Parasolid releases**

## ► Integrating Parasolid

Parasolid quality is a 'whole product' concept, encompassing more than just reliability and performance. It also addresses aspects of the customer's experience of working with Parasolid, such as how easy Parasolid is to integrate, and how easy it is to upgrade from one version to another. Does functionality work consistently from version to version? What is new in the latest version?

Customers integrate Parasolid into their software applications by following standard procedures that include accessing functionality via Parasolid's comprehensive API and implementing simple, pre-defined downward interfaces to provide file, memory and graphics handling capability.

Integration is primarily a once-only task, and is designed to be straightforward so that customers can be up and running quickly. The information provided to customers to help them do this is constantly reviewed and augmented where appropriate.

To enable easy implementation, new functionality in Parasolid follows strict conventions and guidelines. Parasolid's standard API, together with up-to-date, accurate documentation that includes a 'What's New' guide to the latest enhancements, ensures that Parasolid customers can adopt new functionality easily and quickly.

Parasolid is easy to use:

- Targeted training resources
- Standardized API
- Full reference documentation
- Upgrades require no changes to existing customer code

## ► Applying quality standards

To make upgrading easy, we have explained that the changes delivered in Parasolid updates never affect existing customer code, so that there are no unexpected problems. When upgrading to a completely new version of Parasolid the same plug-and-play approach applies, the only application code changes being adaptations to take advantage of specific new functionality.

Understandably, software companies are keen to assert quality credentials to their customers. Customers in turn can look to independent evidence in their assessment of suppliers, a task made easier if the component manufacturer seeks and obtains ISO9001 certification.

At its core, ISO9001 requires a company to follow properly documented processes in developing, maintaining, releasing and supporting its products. The strength of ISO9001 is its ability to demonstrate the effectiveness of good processes, and an astute ISO9001-certified company constantly monitors this effectiveness and makes improvements where necessary. As part of a wider corporate certification, Parasolid has been ISO9001 compliant since 1999, and has continued to monitor and improve processes in line with customer needs.

The revised ISO9001:2000 standard is more robust in validating how well the audited processes are satisfying the needs of the customer, and in 2001 Parasolid's parent organization became one of the first in the world to gain ISO9001:2000 compliance.

Indeed, as part of Siemens Parasolid now boasts software development processes that are certified as meeting the requirements of TickIT, the software industry-specific interpretation of the ISO 9001:2000 standard.

**ISO9001:2000 provides an independent assessment of product quality**

This paper has described how Parasolid has pioneered solutions to the key requirements for developing and delivering dependable, high-performance component software to a global customer base.

In particular, we have explained

- how to develop and maintain state-of-the-art quality processes by adapting and improving to meet the needs of customers
- how continuous testing, monitoring and control of the product development process is of central importance in ensuring quality
- how a zero tolerance approach to regressions enables Parasolid to maintain production-level quality during all phases of development
- how to develop a trust-based relationship with customers by delivering frequent plug-and-play releases of a robust, quality-engineered product

We have seen that setting new standards in component quality is a winning strategy for Parasolid, its customers and their end-users. Managing product quality in the ways we have described enables Parasolid to maintain production-level reliability throughout the development process. This in turn enables a 'release at any time' culture that delivers mutual benefit through increased responsiveness and ease of integration.

It is for these reasons that Parasolid's quality strategy is acknowledged as a critical factor in enabling Parasolid customers and their users to be successful in their chosen markets.

### **About Siemens PLM Software**

Siemens PLM Software, a division of Siemens Automation and Drives (A&D), is a leading global provider of product lifecycle management (PLM) software and services with 4.6 million licensed seats and 51,000 customers worldwide.

Headquartered in Plano, Texas, Siemens PLM Software's open enterprise solutions enable a world where organizations and their partners collaborate through Global Innovation Networks to deliver world-class products and services. For more information on Siemens PLM Software products and services, visit [www.siemens.com/plm](http://www.siemens.com/plm).

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