ABI RESEARCH COMPETITIVE RANKING

GENERATIVE DESIGN SOFTWARE SUPPLIERS

ptc

OVERALL: 76.0 | INNOVATION: 75.0 | IMPLEMENTATION: 77.0 | RANK: 2

ptc

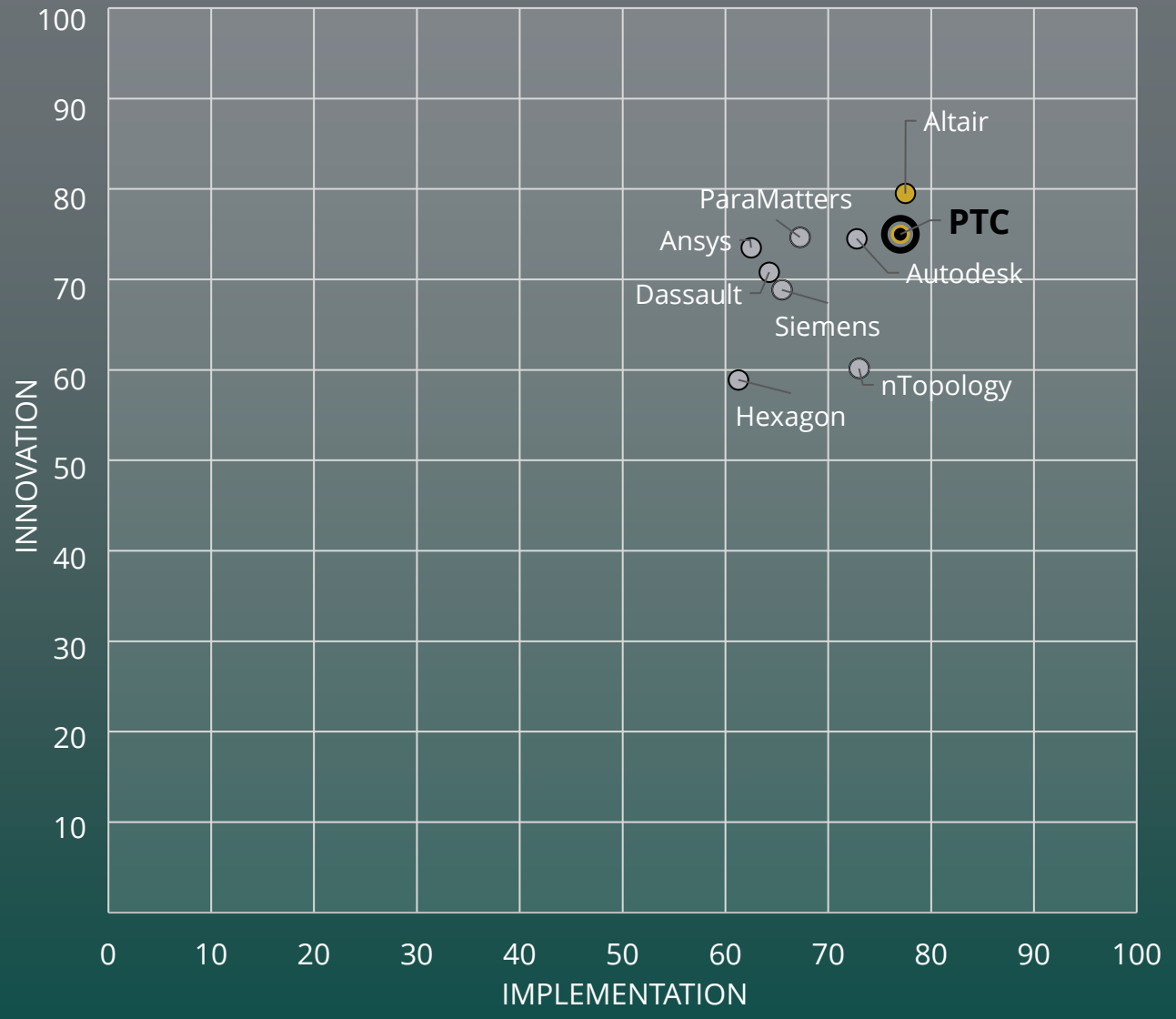
LEADER
ABIresearch.

TOP INNOVATOR
ABIresearch.

TOP IMPLEMENTER
ABIresearch.

OVERALL: 76.0 | INNOVATION: 75.0 | IMPLEMENTATION: 77.0 | RANK: 2

PTC INNOVATION *VERSUS* IMPLEMENTATION FOCUS



INNOVATION

INNOVATION SCORE: 75.0

INTRODUCTION

PTC acquired Frustum for its generative design technology in 2018 for approximately US$70 million and has since made the technology available within its CAD application, Creo, via the on-premises Generative Topology Optimization (GTO) and cloud-based Generative Design Extension (GDX). GTO and GDX look to help customers autonomously create optimal designs from a set of design goals and constraints, preferred materials, and manufacturing processes.

INNOVATION

Creo users can define the boundary within which optimized geometry can exist and cannot, as well as what geometry needs to be preserved in the final design. In terms of KPIs, users can specify design objectives and manufacturing processes, including 3D printing (a user can define the build direction and critical angle to minimize supports), milling (a user can specify the extrude direction and extrude angle), and, lastly, casting/forging/molding (a user can specify the type of parting line to be created and the draft angle).

Creo uses a mesh to generate designs. The granularity of that mesh can be controlled by adjusting the element size used in the optimization. Furthermore, once a design is generated in Creo, users have two options: 1) create a tessellated model, which can be used to send to a 3D printer; or 2) reconstruct the model into rich BREP geometry. The BREP geometry can be done at four different resolution levels, allowing the model to be further edited and analyzed downstream by running additional simulations or applying lattice structures to the optimized shape with Creo's lattice tools. Creo includes a set of standard materials from Ansys Granta, which users can leverage within GTO and GDX. Users can use their own materials libraries with CAE validation capabilities also available.

On the simulation front, PTC continues to expand its partnership with Ansys through tools like Creo Simulation Live and Creo Ansys Simulation to make it easier to do simulation within CAD. These tools bring simulation into the early steps of the design process. All loading and constraints leveraged in the generative optimization are reused in these downstream simulations to improve the workflow and evaluate the same conditions.

INNOVATION

ptc

INNOVATION SCORE: 75.0

Setting up the definitions for ranges can be completed in a matter of seconds. The amount of time to actually compute the designs depends on the complexity and number of designs. But by leveraging elastic high-performance compute in the cloud, the designs can be optimized simultaneously and without bogging down the user's computer. In some cases, it is a matter of minutes for all the designs to compute.

Users do not need knowledge of equivalent solutions to use Creo and only need to understand the design requirements. Traditionally, Creo is used on-premises with Creo installed on the user's local machine (certified hardware offered by PTC's hardware partners). However, in recent years, new certifications have become available, allowing users to stream Creo through a browser via AWS AppStream and Microsoft Azure Virtual Desktop. PTC has introduced a set of new cloud solutions, such as AR Design Share and GDX, which takes advantage of high-performance computing in the cloud. Users can connect their on-premises installation to the cloud to take advantage of these solutions. Creo is not available as a mobile application.

Creo is at the core of PTC's digital thread offering, as the product design information developed in Creo can be shared across the organization to interact with other solutions, assets, and people. Creo enables enterprise-wide connectivity and contemporary technologies, including AR, and it supports enterprise digital twins projects.

Major Creo releases are delivered every year. Maintenance releases are delivered every quarter. GDX, being cloud based, can be updated very quickly—even weekly—to address customer issues, and is generally enhanced quarterly with new functionality and/or performance improvements.

IMPLEMENTATION

IMPLEMENTATION SCORE: 77.0

Creo has more than 100,000 users, and one of the biggest installed bases in this study, with customers like Volvo, Jacobs, HPE COXA, Cummins, and Vectrona using PTC to support their generative design goals. Creo is sold in all major and emerging regions via direct and indirect sales.

PTC's global partner ecosystem leads the way when it comes to GTM strategy, consisting of 700+ partners, including technology partners, Global System Integrators (GSIs), resellers, and consultants. PTC focuses on developing partnerships that can support particular use cases, have industry expertise, or have a regional focus. There are more than 200 global technology partners that extend PTC's capabilities into their solutions, including Microsoft, AWS, Dell, Matterport, and RealWear.

PTC provides tutorials, and consulting services through several different channels, including a Marketplace, the PTC Community, and PTC University. PTC offers structured training and certifications through PTC University via its customer-facing education subscription.

Specific to Creo, PTC offers more than 600 self-paced tutorials for Creo Parametric, 37 Virtual Instructor-Led courses (with live instructors and product labs), 7 Specialization Badges, and 2 Certifications. In total, this represents more than 100 hours of content. In 2021, PTC launched the new "video guides," which are visual step-by-step tutorials that demonstrate end-to-end implementations of real industrial use cases. PTC Community members can also engage directly with other developers, ask questions, and submit ideas to PTC subject matter experts, or PTC University for certifications.

CRITERIA AND METHODOLOGY

VENDOR MATRIX

Methodology: After individual scores are established for innovation and implementation, an overall company score is established using the Root Mean Square (RMS) method:

$$Score = \sqrt{\frac{innovation^2 + implementation^2}{2}}$$

The resulting overall scores are then ranked and used for percentile comparisons.

The RMS method, in comparison with a straight summation or average of individual innovation and implementation values, rewards companies for standout performances.

For example, using this method, a company with an innovation score of nine and an implementation score of one would score considerably higher than a company with a score of five in both areas, despite the mean score being the same. ABI Research believes that this is appropriate as the goal of these matrices is to highlight those companies that stand out from the others.

RANKING CRITERIA

Leader: A company that receives a score of **75 or above** for their overall ranking

Mainstream: A company that receives scores **between 60 and 75** for their overall ranking

Follower: A company that receives a score of **60 or below** for their overall ranking

Innovation Leader: A company that receives a score of **75 or above** for their innovation ranking.

Implementation Leader: A company that receives a score of **75 or above** for their implementation ranking.

INNOVATION CRITERIA

The innovation criteria focus on how the vendor's generative design solution supports the product design process.

Project Start: Setting the criteria for creating a new item or amending an existing design.

- Evaluation of the range of design constraints, such as setting boundaries for where a component needs to be accommodated in the overall product, that can be incorporated by the vendor's algorithms to produce the design options.
- The key production criteria that the solution can accommodate, such as specific materials, the manufacturing processes (2.5-axis and 3-axis, 5-axis milling, additive manufacturing, Design for Additive Manufacture (DfAM)), and the cost considerations.

Generating the Design Options:

- When creating the initial design, can the user work with mesh or lattice structure designs? Can the solution automatically smooth the design to lower distortions and defects, and improve manufacturability? Does the solution validate the design's geometry from an engineering perspective?
- Furthermore, vendor solutions also need to provide simulation capabilities, such as Finite Element Analysis (FEA), evaluate vibrations and electromagnetics, etc., as part of verifying the performance levels.
- Historically, generating options would take many hours, but today, thanks to high performance computing design, times are down to minutes. Vendors need to illustrate their solutions' performance levels.

INNOVATION CRITERIA

Solution Accessibility:

- Software suppliers are increasingly lowering the barriers to entry for using their solutions. Vendors offering generative design solutions that can readily be used by, for example, a recent graduate will be looked upon favorably, as opposed to a solution that requires knowledge of using equivalent solutions.
- Designers no longer work in a set location. Vendors need to support designers who might be traveling, for example, by making their solution available via cloud platform(s), as well as on-premises. In addition, those vendors that support users with a mobile app will score well.

Utilizing Selections:

- Vendors will score highly if their solutions integrate and exchange designs and data with traditional Computer-Aided Design (CAD) software, PLM software, Internet of Things (IoT) platforms, simulation software, collaboration tools, etc. This includes other solutions available from the vendor and also third parties to ensure interoperability for the customer.
- Also under consideration is whether the vendor's solution supports a customer's efforts to create a digital thread and share product information across the organization (engineering, manufacturing, quality control, distribution, customer service) and other software applications, such as a Manufacturing Execution System (MES), Manufacturing Operations Management (MOM), a Quality Management System (QMS), and Customer Relationship Management (CRM).
- Finally, vendor solutions that can turn the geometric designs into a VR or Augmented Reality (AR) experience, whereby engineers can further test and understand the design from different perspectives or support the creation of a digital twin of the product will score highly.

Update Frequency:

- Software development moves fast, and designers will want new capabilities to be available as quickly as possible. Vendors that can frequently iterate their solution will score well.

IMPLEMENTATION CRITERIA

Current Usage Levels and Revenue:

Vendors will score well if they can show a growing installed base for their generative design solution(s).

Industry Expertise:

Vendors need to show that their solution is being used by multiple sectors and share some notable customers.

Geographic Spread:

Vendors need to demonstrate that their solution is available to designers around the world.

Go-to-Market (GTM) Strategy:

Vendors that can both engage directly with customers directly and have an extensive partner network will score well. A partner network both validates the solution(s) and offers a broader route to market.

Educational Initiatives and Value-Add Services:

Can customers start using the solution out of the box and get more out of it with experience? Does the vendor provide resources, tutorials, and consulting services to enable users to get the most benefit from the generative design tools?

Published August, 2022

157 Columbus Avenue, 4th Floor
New York, NY 10023
Tel: +1 516-624-2500
www.abiresearch.com

ABI Research is a global technology intelligence firm delivering actionable research and strategic guidance to technology leaders, innovators, and decision makers around the world. Our research focuses on the transformative technologies that are dramatically reshaping industries, economies, and workforces today. ABI Research's global team of analysts publish groundbreaking studies often years ahead of other technology advisory firms, empowering our clients to stay ahead of their markets and their competitors.
+1.516.624.2500 in the Americas, +44.203.326.0140 in Europe, +65.6592.0290 in Asia-Pacific or visit www.abiresearch.com.