IoT & Digitalization

SPARK Matrix™: Product Lifecycle Management (PLM), Q3 2023

Market Insights, Competitive Evaluation, and Vendor Rankings

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Executive Overview

This research service includes a detailed analysis of global Product Lifecyle Management (PLM) market's dynamics, vendor landscape, and competitive positioning. The study provides competition analysis and ranking of the leading Product Lifecyle Management (PLM) market's vendors in the form of SPARK Matrix™. This research provides strategic information for technology vendors to better understand the market supporting their growth strategies and for users to evaluate different vendors capabilities, competitive differentiation, and market position.

Market Dynamics and Overview

Product lifecycle management (PLM) consists of software solutions that support organizations through all the product lifecycle stages, from conceptualization to designing, building, marketing, support, maintenance, and retirement. A holistic PLM solution supports enterprise-wide requirements for engineering designs & development, manufacturing workflows, and managing consistent product information. The solution enables organizations to collaborate amongst internal and external stakeholders responsible for specific product lifecycle processes.

The comprehensive nature of PLM is enhanced by leveraging industrial digitalization and implementing new technologies tailored to specific industry needs. The PLM platform is designed to seamlessly integrate these technologies, enabling automated workflows for product and process management by effectively utilizing data and advanced tools. This platform is capable of handling large volumes of product data across multiple teams operating in different geographical locations, resulting in a centralized repository accessible across the enterprise. Such accessibility facilitates efficient decision-making throughout the organization.

The PLM market is dynamic, and companies are concentrating more on cloud deployment to spread remote working. The PLM industry trends enable managing demand with the right quality, resource optimization, product traceability & sustainability, and quick product development. This paves the way for vendors to pursue new alliances, partnerships, and inorganic & organic growth strategies, increase their global presence, and introduce new capabilities.

The modern “Green PLM” adds environmental protection-related functionality to the traditional PLM system. Advanced PLM solution is considered as a core technology platform for managing smart, connected, and complex product development processes in the digital age. Industrial companies are looking at PLM solutions with key capabilities, namely integrated data management, distributed collaboration, and seamless integration with enterprise systems such as manufacturing execution systems (MES), enterprise resource planning (ERP), supply chain management (SCM), artificial intelligence, and internet of things (IoT) for a holistic strategy towards building a connected enterprise.

Based on the understanding of the PLM market, a detailed description of the requisite key capabilities is given below:

- **Multi-CAD Solutions:** Multi-CAD solutions encompass a range of applications for designing, analysing, and simulating products & production environments. These solutions integrate various tools such as computer-aided design (CAD), mechanical CAD (MCAD), electrical CAD (ECAD), computer-aided engineering (CAE), computer-aided manufacturing (CAM), electronic design automation (EDA), simulation, and analysis to facilitate collaboration among stakeholders. The multi-CAD capability in PLM provides visualization tools that enable users to view and analyse different CAD data from native CAD systems, suppliers, and partners. This feature is particularly useful for stakeholders or team members who are not engineers, as it allows them to understand and give feedback on CAD designs without using native CAD applications.

- **Product Data Management (PDM):** A PDM platform offers a centralized and secure repository for product data, ensuring that all stakeholders have access to up-to-date, accurate information including multi-CAD data, models, requirements, process information, and documentation. Advanced PDM platforms incorporate role-based access control, allowing different stakeholders to access and interact with specific product information and features based on their roles. By integrating a PDM platform, organizations establish a collaborative PLM environment that promotes innovation and information sharing across different domains.

- **Digital Manufacturing Solutions:** A digital manufacturing solution consists of integrated application suites that facilitate the seamless transition of the product from design to manufacturing processes. The solution empowers organizations to conduct sophisticated modelling, simulation, and analysis of manufacturing processes and the plant environment. By analysing the plant environment, it assesses the layout, equipment, resources, assembly lines, and material flow. Manufacturing & planning engineers can also validate process designs and optimize operational performance for improved efficiency by leveraging this solution.

- **Bill of Material Management (BOM) Tools:** The Bill of Materials (BOM) is a precise inventory of all the necessary items needed to manufacture a product. It encompasses detail of materials essential for manufacturing, packaging, and supporting specific product parts intended for customer delivery. Companies

manufacture products based on customer requirements by taking into account specific inclusions and optional features for each part. The BOM holds a vital role in organizations as it manages product part information, encompassing details about suggested component changes from the engineering department, such as required raw materials, assemblies, sub-assemblies, stock units, product testing validation, and information related to contract manufacturers and suppliers. Choosing a suitable BOM management tool is highly significant for manufacturing companies, as it integrates with PLM to ensure continuous availability and update of essential information throughout the organization.

- **Configuration Management:** Configuration management helps organizations manage the product family and system configurations throughout the PLM to govern BOM, document identification, and workflow changes. It also manages structured complex configuration processes to increase flexibility and reduce errors.

- **Change Management:** Throughout the stages of the product lifecycle, from development and manufacturing to end-of-life, change management capability exerts control over alterations, designs, objects, and records. Change management capability provides organizations the ability to monitor and control the required changes, enhancing visibility and traceability across the enterprise.

- **Requirements Management:** Requirements management enables organizations to define, manage, verify, & validate ideas, and meet stakeholders' needs at every level of the product lifecycle. By having a comprehensive understanding of evolving requirements, stakeholders can effectively assess the impact of proposed changes and verify test results against the requirements of the product. This enables enhanced product quality and compliance throughout the lifecycle.

- **Quality and Compliance:** Quality management capability helps maintain the design quality of every product and process across organizations. Additionally, it automates downtime resolution with closed-loop corrective & preventative actions and exacts root cause analysis to identify & control problems for the affected items. It also helps to fulfil compliance & regulatory requirements and set standards for various industries. Integrating quality management with compliances, such as regulatory compliance & labelling compliance, into the PLM process helps in the better management of product quality in the lifecycle

of manufacturing the product. This reduces problems that might occur in the later stage of the product cycle and helps reduce expenses due to the cost of quality.

- **Supply Chain Collaboration:** The suppliers can collaborate with PLM systems using the supply chain collaboration capability. This would help the original equipment manufacturers (OEMs) to exchange product lifecycle information and improve real-time visibility on the status of the product component. The inclusion of analytics helps process a large amount of transactional and supplier interaction information. Digital simulation in global operations helps gather information on production bottlenecks and identify supply chain issues. The agile interface simplifies the process of collecting information from suppliers and importing different forms of data available in multiple formats. The enhancement of supply chain processes with different integrations enables the PLM systems to go beyond the traditional role of product development support.

Competitive Landscape and Analysis

Quadrant Knowledge Solutions conducted an in-depth analysis of the major product lifecycle management (PLM) vendors by evaluating their products, market presence, and value proposition. The evaluation is based on primary research, expert interviews, analysis of use cases, and Quadrant's internal analysis of the overall PLM market. This study includes an analysis of key vendors, namely Aras, Autodesk, Dassault Systemés, Duro, Oracle, PTC, Propel, SAP, and Siemens.

Aras, Autodesk, Dassault Systemés, Siemens, and PTC are the top performers and 2023 technology leaders in the global product lifecycle management (PLM) market. These companies provide a comprehensive technology portfolio with the breadth and depth of solutions to support a variety of industry-specific and customized user-specific use cases. Many of these players are also frontrunners in providing modern & open architecture, comprehensive out-of-the-box capabilities, country-specific compliance, easy-to-use configurable user interface and dashboard, centralized repository, advanced analytics, and integration & interoperability with product lifecycle management solutions.

Dassault Systemés, PTC, and Siemens are the top three performers in the global product lifecycle management market and have been positioned as the SPARK leaders therein. Apart from these vendors, Autodesk and Aras are among the leaders in the global product lifecycle management market.

Dassault Systemés's PLM software suite provides a comprehensive range of solutions for product data management, change management, cost management, bill of materials management, and requirements management. The software stands out due to its ability to centralize data management, ensure robust change control, and foster collaborative design practices. The software empowers organizations to effectively manage end-to-end product costs while aligning them with their business strategies. The software's extended capabilities include supporting sustainable product production, integrating with AI & ML technologies, and leveraging the 3DSwymer collaboration platform. Additionally, it enables seamless data flows, improved supply chain connectivity, and accelerated product innovation on the 3DEXPERIENCE platform.

PTC's PLM software portfolio, including Windchill and Arena, offers comprehensive solutions for organizations aiming to achieve end-to-end digitalization and efficient product development. Windchill+ stands out with its cloud-based approach. It

leverages new features like SaaS & closed loop model to optimize traditional Windchill capabilities and establish a digital thread throughout the product lifecycle. This enables businesses to make informed decisions based on unified, real-time information. Arena, on the other hand, streamlines development processes by integrating quality management into its cloud-based PLM solution, enabling seamless collaboration and enhanced product control. PTC's PLM offerings are known for their comprehensive features that equip companies with the tools to drive innovation, accelerate time to market, and improve profitability. Notably, PTC's focus on model-based systems engineering, digital thread, augmented reality, and visual engagement enhances collaboration, compliance management, and sustainability efforts.

Siemens's PLM software, Teamcenter, enables organizations to streamline their product lifecycle processes and optimize operational efficiency. With a focus on unified decision-making and a wide range of capabilities, such as product data management, multi-CAD management, change management, multi-domain Bill of Materials (BOM) management, software design management, quality & compliance management, product configuration, service lifecycle management, simulation process & data management, supplier management, and engineering collaboration, the software empowers businesses to effectively manage complex product lifecycles. Its strengths lie in its ability to centralize data, integrate computer aided design from different platforms, and support key areas such as model-based system engineering, product visualization, generative AI collaboration, sustainable product development, and product cost management.

Autodesk's Fusion 360 Manage with Upchain is a robust cloud-based PLM & product data management (PDM) platform that seamlessly integrates process and product-related data with its intuitive user interface. It ensures easy business processes and third-party integration for rapid product development and visibility. The platform's extensive multi-CAD data management, centralized data processing, & open API integration features and its advanced capabilities in additive manufacturing, generative design, & simulation aids the organization with effective product development. The highlighted key functions include new product introduction, BOM management, design collaboration, change management, quality management, and supplier collaboration while providing valuable dashboards and mobile access for streamlined review processes.

Aras Innovator, Aras's PLM platform, with product data management (PDM) capabilities, allowing organizations to establish a unified digital thread by leveraging a service-oriented architecture (SOA). Aras Innovator is a web-based platform that

effectively manages product development, manufacturing, quality compliance, and supply chain operations. Its resilient model, comprising a modeling engine, platform services, repository, applications & clients, and connectors, enables flexible customization without relying on hard-coded customizations. Aras's emphasis on model-based systems engineering, digital thread functionality, real-time customization, mobile compatibility, and sustainable production systems further distinguishes it in the PLM market.

Oracle and SAP have been positioned as the strong contenders in the 2023 SPARK Matrix™ of the product lifecycle management (PLM) market. The strong contenders have a significant presence over multiple geographical locations and have capabilities that match the current PLM market needs. The other key vendors captured in the 2023 SPARK Matrix™ include Propel and Duro. These companies are rapidly growing in the PLM solution market.

Oracle's Fusion Cloud PLM offers closed-loop quality processes in a centralized database and enables the integration of data from enterprise resource planning (ERP) & supply chain management (SCM) for product commercialization. The built-in predictive analytics and digital assistance support 3D modeling & digital twins, enabling proactive decision-making for the organizations.

SAP's PLM solution focuses on customer-centric individualized requirements, enabling faster product design and development by integration with the supply chain. Collaborative product data management, portfolio & project management, bill of materials (BOM) management, innovation management, collaborative development, documentation management, and change management are some of the most important elements and functionalities of the PLM solution from SAP.

Propel's collaborative PLM solution has a cloud-native architecture and an enterprise-wide integration framework that helps organizations with the timely delivery of products. The primary capabilities offered by Propel's PLM solution include BOM management, quality management system (QMS), supplier management, and CAD integration.

Duro's PLM software facilitates efficient management and utilization of product data and processes, such as CAD tool synchronization and seamless design sharing. Duro's PLM enables the organization to swiftly compare revisions, detect duplicates, and prevent errors, enhancing data integrity & overall efficiency.

The global PLM market has many strong contenders, and that number is bound to increase in the near future. With continuously evolving global technology scenarios, faster digitization as well as digitalization, and compelling developments happening around the cloud infrastructure, the vendors need to keep up with the evolving requirements and customer needs. The long-term effects of the COVID-19 pandemic on how businesses operate around the world have opened endless possibilities for growth and solutions that can make a real impact on the global PLM market. Therefore, it's a great opportunity for companies that provide product lifecycle management platforms to use the current situation to come up with new ideas and make themselves even stronger in the market.

Key Competitive Factors and Technology Differentiators

Many PLM vendors provide comprehensive functionalities that support different use cases; however, their technology and customer value proposition may differ depending on customer size, industry vertical, geographical location, and organization-specific needs. Some of the key competitive technology differentiators for product lifecycle management solutions are:

- **Green PLM:** The increasing emphasis on sustainability is driving businesses to optimize production processes and reduce environmental impact. This shift has encompassed various aspects, such as addressing CO2 emissions, product's environmental impact, compliance with environmental regulations, and achieving product circularity through material selection & reuse. In response to these challenges, the adoption of product lifecycle management (PLM) software has emerged as a strategic solution. A PLM solution should optimize production lines and facilitate sustainability initiatives by providing visibility into different stages of production and enabling data-driven decision-making. Green PLM principles should enhance sustainability efforts by incorporating eco-design practices and calculating environmental impacts early in the product development stage. Users should identify PLM vendors that empower them to meet market demands for environmentally responsible products while maximizing operational efficiency, positioning them for long-term success in a sustainability-driven market.

- **Augmented and Virtual Reality (AR/VR) Capabilities:** PLM vendors should be capable of incorporating augmented and virtual reality (AR/VR) capabilities to enhance the interaction between companies, their product design, and information development. The integration of VR/AR functionalities can significantly benefit users by improving time to market and enhancing product engineering, design, and development processes. When evaluating PLM vendors, users should prioritize vendors demonstrating VR/AR capabilities that align with their organization's specific requirements. Additionally, it is important to consider the value provided by vendors relative to their costs when making a selection.

- **Model-Based Enterprise Strategy with Digital Twin and Digital Thread:** PLM vendors should provide a robust tool that enables the creation of a

digital twin for both products and production processes to support users in their digital transformation journey. Digital twins are used as informational and behavioural models that understand, simulate, predict, and optimize the performance of a product and production system. The digital twin should capture changes from concept to development, manufacturing, & service, establishing a consistent digital thread throughout the product lifecycle. PLM vendors should also facilitate the creation and maintenance of a digital thread to ensure that information remains up-to-date and synchronized throughout the product's lifecycle. Digital thread facilitates the collaboration of product engineering with manufacturing engineering for creating a consistent 3D model that is integrated with a digital twin of products and production. Leading PLM vendors support model-based engineering with digital twin and digital thread strategies, although the effectiveness of their solution capabilities may vary. The users should assess the capability of potential PLM vendors, based on their requirements, for effective product simulation & testing in virtual space and select accordingly.

- **Service Engineering:** Service engineering is crucial in improving service planning, design for serviceability, and optimizing asset operations. By implementing a service engineering solution, users should be able to streamline and optimize various aspects of their service processes and increase efficiency & customer satisfaction. Key to this solution is the establishment of a digital thread that connects all service-related information across the extended value chain. This digital thread encompasses critical data such as technical documentation, initial configurations, spares information, and service processes. Product manufacturers create this information and make it available to the relevant service organizations, ensuring that everyone involved has access to accurate and up-to-date details. Therefore, end users should look for service engineering capability while selecting potential PLM vendors.

- **Additive Manufacturing:** Additive manufacturing allows the creation of a physical object from a digital model. Such an approach has numerous advantages over conventional methods. With the help of additive manufacturing, users should be able to initiate the manufacturing process and create 3D models of component design using CAD. This would help users understand the different layers of product design and lifecycle in a standardized way. It will help users assess the wide spectrum of potential environmental impacts, such as requirements of raw materials in product manufacturing. It further aids users by providing freedom of design, customization, single-

step manufacturing, lead time reduction, risk mitigation, and ease of access. Additionally, it provides liberty for product innovation, helping create larger components with an increase in the speed of product manufacturing and product launch. The users should assess and select the PLM vendors that offer more value addition based on their additive manufacturing capabilities.

- **Integrated BOM Management:** Companies face difficulties in maintaining consistent product data throughout the product lifecycle. Traditionally, different teams would create separate records for engineering, manufacturing, and service information, making it challenging to manage. To overcome this, companies were required to combine all this information into a single record. Users should look for vendors that build a unified BOM by synchronizing and integrating engineering BOM (EBOM) with manufacturing BOM (MBOM) & service BOM (SBOM) to ensure a consistent product definition throughout the design, development, manufacturing, and service stages. PLM solution Vendors should offer integrated BOM management with a single centralized source for all product information across the organization's departments and external stakeholders. This would help users clearly understand their product throughout its life cycle, from the early stages of concept development to when it is released and during after-sales services. Therefore, integrated BOM management is among the essential value proposition that users should evaluate while selecting a PLM vendor.

- **Out-of-the-Box Applications and Functionalities:** PLM is a mature solution but often requires customization, leading to long implementation cycles, increased costs, and limited flexibility for future changes. To address this, PLM vendors offer configurable and out-of-the-box applications that reduce customization needs and cater to specific organizational requirements. These solutions incorporate best practices, industry collaborations, and out-of-the-box functionalities to lower implementation costs and speed up time to market. Users should identify PLM vendors that can strike a balance between customization and out-of-the-box capabilities. The next generation of PLM is expected to drive technology adoption and market growth through comprehensive solutions, including open APIs for seamless integrations. Companies should evaluate PLM vendors based on their proven, industry-specific, out-of-the-box functionalities to facilitate widespread PLM adoption and enhance the overall technology ownership experience. Out-of-the-box functionalities should be a key consideration for the users when selecting PLM vendors to meet specific requirements.

- **Technology Integration and Interoperability:** The scope of PLM solutions have evolved beyond design and build processes. It now encompasses integrated data management and the execution of product development processes from concept to retirement within a collaborative framework. An essential aspect that sets PLM vendors apart is their ability to seamlessly integrate multiple CAD tools and enterprise applications such as manufacturing execution system (MES), enterprise resource planning (ERP), customer relationship management (CRM), supply chain management (SCM), and human capital management (HCM). This integration should be capable of facilitating the unification of product and process data across domains and locations. However, PLM vendors' capabilities may differ in providing system integration and interoperability with upstream business systems and downstream technologies. Therefore, it is crucial for users to evaluate their requirements and the integration capabilities of potential PLM solutions, considering the value they provide relative to their cost.

- **PLM Analytics:** Enterprise organizations are increasingly assessing PLM's capabilities in intelligent reporting, rich dashboards, natural language processing (NLP), and advanced analytics for end-to-end program management, such as design, change management, traceability, cost, and quality. PLM vendors differ significantly in their analytics capabilities. Additionally, PLM vendors are investing in advanced analytics, AI, and ML technologies for predictive insights throughout the product lifecycle. Users could utilize built-in analytics or external tools for reporting with the help of PLM vendors that enhance data access, reporting, and analytics to unlock business value from comprehensive product information. Users should evaluate PLM vendors based on analytics offerings for valuable insights and cost-effectiveness.

- **IoT Evolution in the PLM Landscape:** The Internet of Things (IoT) system is a complex and dynamic system of devices, with challenges such as connectivity (real-time), security, and protocols. Rising complexity makes it difficult for PLM experts to work seamlessly with present IoT systems using the current PLM products. PLM vendors should have solutions that are more favourable from the end customer's point of view and that provide the highest value relative to their cost. Therefore, end-users should give preference to vendors investing more and working on improved solutions while evaluating potential PLM vendors for selection.

- **Mode of deployment:** PLM vendors are focusing on building robust cloud capabilities to address implementation challenges and attract new markets. Users are evaluating the value and capabilities of vendors in providing cloud-based software as a service (SaaS) and hybrid PLM deployments. While on-premises deployments still dominate the industry, cloud deployment is gaining traction in emerging markets, non-traditional industries, and small to medium-sized businesses. Cloud deployment aligns with the connected enterprise vision and offers advanced visualization, analytics, personalization, and remote features. Users should evaluate vendors based on the vendor's expertise in carrying out cloud-based deployment.

- **Vendors' Expertise and Domain Knowledge:** Users should assess vendors based on their expertise, domain knowledge, and ability to address unique business challenges and industry-specific requirements. Understanding a vendor's in-depth industry knowledge, such as emerging trends and influencing factors, is crucial. Users should consider factors such as ease of use, comprehensiveness of the offering, flexibility to adapt to market changes, regulatory compliance, and cost transparency. Vendors should demonstrate the ability to uncover unmet requirements, bridge technology & service gaps, and have a track record of successful large-scale deployments.

- **Vendor's Product Strategy and Roadmap:** The goal of PLM solutions is to create a digital thread that connects the entire enterprise and provides value to all stakeholders. By enhancing product traceability and collaboration with the supply chain, PLM solutions support sustainable product development. End users should assess vendors based on their roadmap and strategies to ensure alignment with their business processes and ultimate goals. Vendors prioritizing the improvement of PLM solutions to meet evolving customer requirements, technological advancements, and industry needs should be preferred.

- **Pricing Model:** To reduce costs, users should evaluate PLM solutions based on their competitive pricing models. This is one of the major considerations that all vendors must consider to gain a competitive advantage over their competitors. Users should assess vendors that provide a flexible pricing structure and offer the highest value relative to cost.

SPARK Matrix™: Strategic Performance Assessment and Ranking

Quadrant Knowledge Solution's SPARK Matrix™ provides a snapshot of the market positioning of the key market participants. SPARK Matrix provides a visual representation of market participants and provides strategic insights on how each supplier ranks related to their competitors, concerning various performance parameters based on the category of technology excellence and customer impact. Quadrant's Competitive Landscape Analysis is a useful planning guide for strategic decision makings, such as finding M&A prospects, partnerships, geographical expansion, portfolio expansion, and similar others.

Each market participant is analysed against several parameters of Technology Excellence and Customer Impact. In each of the parameters (see charts), an index is assigned to each supplier from 1 (lowest) to 10 (highest). These ratings are designated to each market participant based on the research findings. Based on the individual participant ratings, X and Y coordinate values are calculated. These coordinates are finally used to make SPARK Matrix

Technology Excellence	Weightage
Integrated BOM Management	7%
Multi-CAD Solutions	7%
Product Data Management (PDM)	10%
Change & Configuration Management	10%
Quality & Compliance Management	8%
Digital Manufacturing Solutions	10%
Supply chain collaboration	8%
Service engineering	7%
Competitive Differentiation Strategy	10%
Application Diversity & Use Cases	8%
Integration & Interoperability	10%
Vision & Roadmap	5%

Customer Impact	Weightage
Product Strategy & Performance	20%
Market Presence	20%
Proven Record	15%
Ease of Deployment & Use	15%
Customer Service Excellence	15%
Unique Value Proposition	15%

Evaluation Criteria: Technology Excellence

- **Integrated BOM Management:** The ability to synchronize Bill of Materials (BOM) seamlessly across different departments within an organization to improve efficiency & accuracy in product development.

- **Multi-CAD Solutions:** The ability to Integrate multi-CAD tools, such as computer-aided design (CAD), Mechanical CAD (MCAD), Electrical CAD (ECAD), Computer-Aided Engineering (CAE), Computer-Aided Manufacturing (CAM), Electronic Design Automation (EDA) and others for stakeholder collaboration.

- **Product Data Management (PDM):** The ability to manage & link all product-related data and enable internal & external teams to provide product development updates, submit ideas, and receive real-time feedback. Manage all CAD tools in one environment, ensuring that there is no missing or misinterpreted information.

- **Change & Configuration Management:** The ability to manage, communicate, and track changes along with desired configuration across the enterprise.

- **Quality & Compliance Management:** The ability to maintain the design quality of every product across organizations and integrate the quality with regulatory compliance for better management of the product quality.

- **Digital Manufacturing Solutions:** The ability to integrate the application suits and support the transition of product design into manufacturing processes.

- **Supply Chain Collaboration:** The ability to collaborate the suppliers with PLM systems which would help the original equipment manufacturers (OEMs) to exchange product lifecycle information and improve the real-time visibility for knowing the status of the product component.

- **Service Engineering:** The ability to automate and integrate the whole service lifecycle along with maintenance, repair, and operation.

- **Competitive Differentiation Strategy:** The ability to differentiate from competitors through functional capabilities and/or innovations and/or GTM strategy, customer value proposition, and such others.

- **Application Diversity and Use Cases:** The ability to demonstrate product deployment for a range of industry verticals and/or multiple use cases.

- **Integration & Interoperability:** The ability to offer a product and technology platform that supports integration with AI/ML and multiple technologies and provides prebuilt out-of-the-box integrations and open API support and services.

- **Vision & Roadmap:** Evaluation of the vendor's product strategy and analysis of the key planned enhancements to offer superior products/ technology.

Evaluation Criteria: Customer Impact

- **Product Strategy & Performance:** Evaluation of multiple aspects of product strategy and performance in terms of product availability, price to performance ratio, excellence in GTM strategy, and other product-specific parameters.

- **Market Presence:** The ability to demonstrate revenue, client base, and market growth along with a presence in various geographical regions and industry verticals.

- **Proven Record:** Evaluation of the existing client base from SMB, mid-market and large enterprise segment, growth rate, and analysis of the customer case studies.

- **Ease of Deployment & Use:** The ability to provide superior deployment experience to clients supporting flexible deployment or demonstrate superior purchase, implementation and usage experience. Additionally, vendors' products are analyzed to offer user-friendly UI and ownership experience.

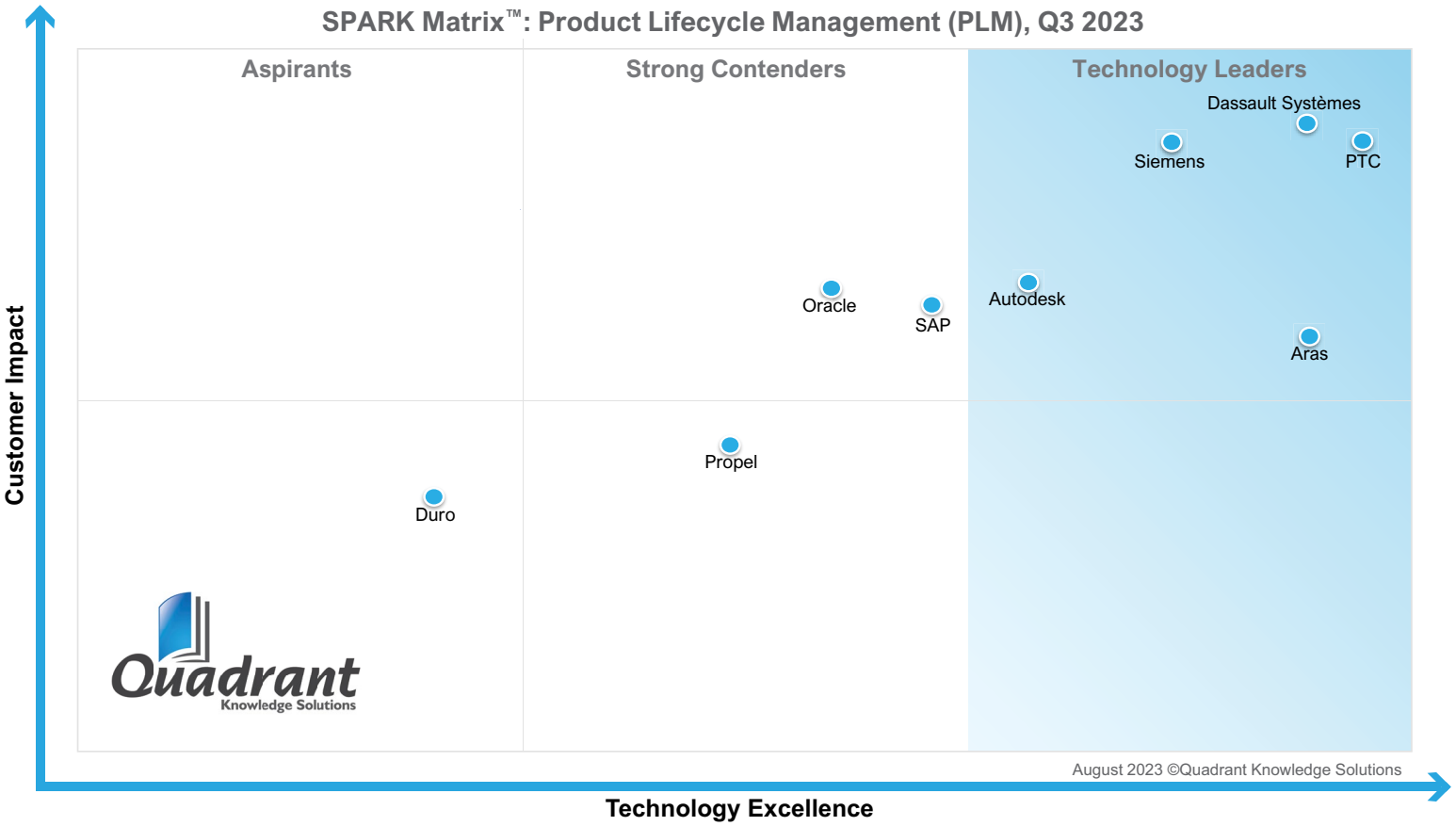
- **Customer Service Excellence:** The ability to demonstrate vendors capability to provide a range of professional services from consulting, training, and support. Additionally, the company's service partner strategy or system integration capability across geographical regions is also considered.

- **Unique Value Proposition:** The ability to demonstrate unique differentiators driven by ongoing industry trends, industry convergence, technology innovation, and such others.

SPARK Matrix™: Product Lifecycle Management (PLM), Q3 2023

Strategic Performance Assessment and Ranking

Figure: 2023 SPARK Matrix™
Strategic Performance Assessment and Ranking)
Product Lifecycle Management (PLM)



Vendor Profiles

Following are the profiles of the leading Product Lifecycle Management vendors with a global impact. The following vendor profiles are written based on the information provided by the vendor's executives as part of the research process. Quadrant research team has also referred to the company's website, whitepapers, blogs, and other sources for writing the profile. A detailed vendor profile and analysis of all the vendors, along with various competitive scenarios, are available as a custom research deliverable to our clients. Users are advised to directly speak to respective vendors for a more comprehensive understanding of their technology capabilities. Users are advised to consult Quadrant Knowledge Solutions before making any purchase decisions, regarding data governance solutions technology and vendor selection based on research findings included in this research service.

PTC

URL: https://www.ptc.com/

Founded in 1985 and headquartered in Boston, Massachusetts, USA, PTC is a software development company with a comprehensive portfolio that includes computer-aided design (CAD), product lifecycle management (PLM), application lifecycle management (ALM), service lifecycle management (SLM), industrial internet of things (IIoT), augmented reality (AR), and the digital thread. PTC offers PLM solutions such as Windchill, Windchill+, and Arena.

PTC's Windchill can be delivered as a SaaS-based or on-premises solution with an open architecture, enabling modern enterprise application integration and orchestration. The solution offers traceability and change control, such as control of design & manufacturing partners, suppliers, regulators, and customers, throughout the lifecycle. The solution is designed with a high level of automation and interoperability, helping global businesses & external partners collaborate across disciplines, functions, divisions, & geographies and connecting everything that matters in real-time.

PTC's enhanced SaaS-based cloud-native solution for PLM, Windchill+, is created with the help of new technologies that provide end-to-end digitalization. Windchill+ transforms traditional Windchill with its comprehensive capabilities and optimizes it with all the benefits of cloud computing and services.

Arena, a cloud-native PLM software from PTC, is purpose-built for fast-moving startups or companies. Arena streamlines development with an in-built quality management system (QMS) that provides a single system for quality and product improvement. Other capabilities of Arena include product record control that helps enterprises to manage mechanical, electrical, and software designs. Its change management feature facilitates the fast approval of modifications associated with advanced, new, and existing products. Windchill and Arena has helped PTC improve the newer & older products in its portfolio and helped it become more profitable.

PTC's acquisition of Codebeamer, an application lifecycle management (ALM) platform with a standardized requirement, risk, & test management system, enables it to simplify complex products and software engineering at scale. Furthermore, the acquisition of Onshape, a cloud-native CAD platform with

integrated data management, provides better automation of digital thread and advanced generative design & AI capabilities.

PTC also acquired ServiceMax, a platform built on Salesforce. ServiceMax captures extensive customer information and delivers a comprehensive end-to-end experience to original equipment manufacturers (OEMs) and their serviced customers.

The key features and capabilities of PTC's PLM offerings include product data management (PDM), configuration management, change management, secure collaboration, product design management, manufacturing engineering, supply chain management, Quality, Risk and Compliance, Model-Based Systems Engineering (MBSE), Requirements, Validation, and Verification, Extended Enterprise Collaboration, Integration to business applications, Portfolio and Program Management, project management & execution, product lifecycle governance, simulation data management, platform management, requirements & validation tools, enterprise digital rights management (EDRM) & IP Security, model-based systems engineering, product cost & profitability management, multi-CAD (computer-aided design) & ECAD (electrical computer-aided design) data management, and supply chain collaboration.

PTC's PLM solutions enable companies to focus & invest in new product development, introduce processes to speed time to market, and increase profitability. PTC has also extended its SaaS strategy capabilities by introducing the PTC Atlas platform, which was used to build its Plus and Onshape products

Analyst Perspective

Following is the analysis of PTC's capabilities in the global product lifecycle management (PLM) market:

- Windchill and Arena are enterprise PLM software with SaaS and quality management systems (QMS) capabilities catering to different market segments. Windchill provides unified views to manage multi-MCAD (mechanical computer-aided design) data in a single place by integrating Creo, Creo+, SolidWorks, AutoCAD, and other CAD tools. Additionally, it helps enterprises leverage digital technologies to innovate products and solutions.

- PTC's Creo, a fully integrated 3D CAD solution, allows engineers to seamlessly conceptualize, design, analyze, and validate products. Creo

features technologies that empower design engineers to simulate and optimize products by weight, performance, cost, and sustainability. Using a wide variety of materials and manufacturing processes, Creo benefits multiple departments, including the engineering department. Its model-based approach replaces its 2D drawings with fully annotated 3D models that streamline the manufacturing, inspection, and service of parts & assemblies. Creo architects its products using a single common source of truth and avoids data translation & multiple CAD file creation. One of the key strengths of Creo is its ability to provide rich surfacing capabilities.

- PTC is actively building capabilities to support the growing adoption of model-based definition (MBD) strategies and digital thread expansion. PTC also offers advanced tools that assist design engineers during the product design process. Creo supports the manufacturing industry's growing needs in electrification and encompasses full integration with electronic computer aided design (ECAD) and mechanical computer aided design (MCAD) disciplines. The integration enables seamless collaboration with schematics for comprehensive electronic system design.

- PTC also enables industrial companies with greater speed and agility to create a digital thread. It provides organizations with an efficient, sustainable, and compliant environment for SaaS incorporation.

- Some of the differentiators of PTC's PLM software include its software-driven innovation, model-based digital thread, platform strategy, Industry 4.0, service lifecycle management, environmental sustainability, and SaaS benefits.

- PTC PLM's software-driven innovation provides tools to manage the agile development process for software in the context of a product bill of material, which encompasses physical and digital components. This creates a seamless integration of ALM and PLM capabilities, enabling the end users to effectively manage software and hardware elements while ensuring traceability throughout the development process.

- PTC PLM's model-based digital thread enables product models to be reused in downstream processes, versions, and configurations, by linking together to provide traceability and change control.

- The platform strategy of PTC's PLM solution efficiently reuses modules in the product and information about each module across engineering, manufacturing, & service. Additionally, every module of PTC's 3D assembly model carries its own manufacturing and service information.

- PTC PLM's Industry 4.0 capability, through Windchill manufacturing process management (MPM), generates the manufacturing bill of material that matches the order. It also generates a bill of operations, including 3D step-by-step instructions that can be augmented onto the product using PTC's Vuforia AR technology for operations carried out in the factory.

- PTC uses its ThingWorx digital performance management (DPM) software to monitor the manufacturing process and identify inefficiencies. The DPM uses IoT techniques to collect data from various sensors and control systems throughout the factory. Organizations can improve the productivity of their factories using this data. It also enables organizations to produce more products in fewer shifts.

- PTC PLM's service lifecycle management, using ServiceMax, delivers a closed-loop model-based digital thread across the product lifecycle, from the initial idea through a lifetime of use in the field. This includes information about each product's configuration, prior issues, previous maintenance, and parts replacements. ThingWorx IoT allows ServiceMax to monitor product fleets, enabling it to be more predictive and preventative.

- The environmental sustainability of PTC's PLM solution redirects the sustainability focus upstream. It enables companies to enhance their engineers' awareness of the drivers of the environmental footprint in their design, such as their choices of materials, suppliers, and manufacturing and operating processes.

- The SaaS benefits of PTC's PLM include its Windchill+, enabled with self-service and centralized identity management abilities. It saves the time required by organizations in validating software & integrations and designing & innovating. Windchill+ can be used by any new employee or supplier without hardware & software preconditions, does not require upgrades or patches, and is secure. It also enables working on the same data from multiple locations simultaneously.

- From a geographical perspective, PTC has a presence in North America, Europe, and Asia. From an industry vertical perspective, PTC caters to various industries, such as aerospace & defense, automotive, electronics & high-tech, government, industrial manufacturing, durable consumer goods, and medical devices.

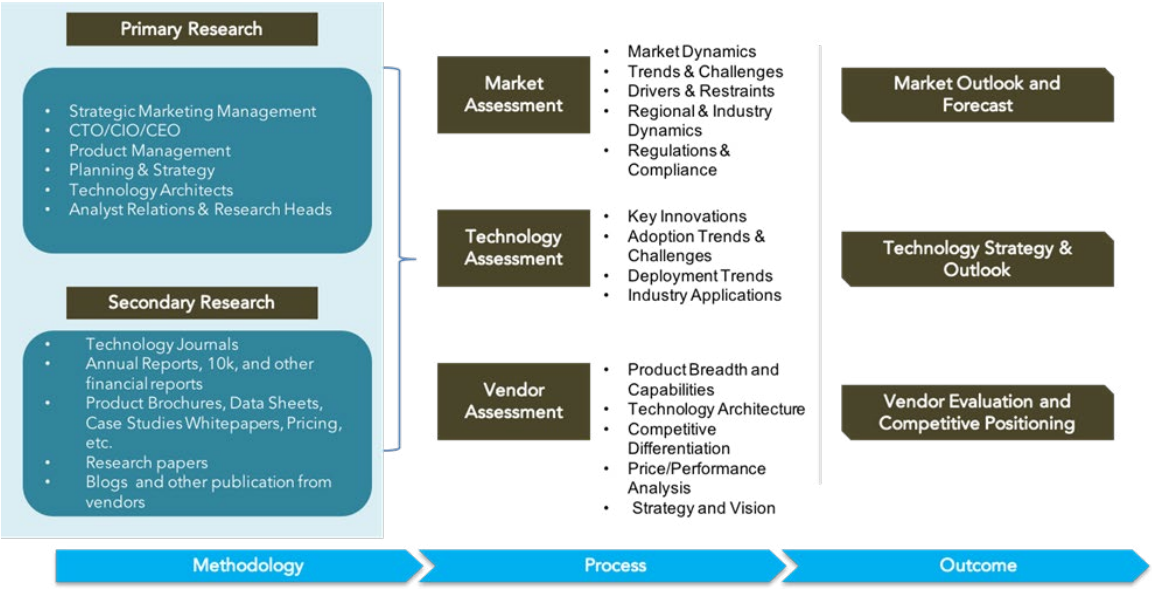
- Some of the top use cases of PTC's PLM platforms include designing complex products, improving collaboration, lowering the time to market, and offering automated solutions for effective decision-making.

- Some of the challenges that PTC helps solve include managing product data and reducing the complexities of design, manufacturing, and services to cater to customer-specific requirements. PTC gives customers the 'Power To Create' more eco-friendly products, solutions, and supply chains by driving sustainable improvements across its engineering, manufacturing, and service processes.

- The future roadmap of PTC prioritizes leading the PLM market to SaaS, digital thread & closed-loop PLM, and software-driven transformation. PTC plans to invest a significant portion of its revenue in research & development processes and support organic innovation. PTC has acquired companies such as Onshape, Arena, and ServiceMax to accelerate its SaaS leadership. PTC has also acquired Codebeamer to focus on software-driven innovation. In addition, PTC has plans to improve its product, Arena, by further integrating it with Onshape, thus improving the connectivity & integration capability to allow data flow more seamlessly between Arena and other systems, updating the document management capabilities that work with modern cloud solutions, making application improvements to support a global workforce such as localizations & languages, improving supply chain capabilities to help product teams make better decisions throughout the product lifecycle, and adding quality management system (QMS) capabilities that provide new product information (NPI) design controls & mitigate risk.

Research Methodologies

Quadrant Knowledge Solutions uses a comprehensive approach to conduct global market outlook research for various technologies. Quadrant's research approach provides our analysts with the most effective framework to identify market and technology trends and helps in formulating meaningful growth strategies for our clients. All the sections of our research report are prepared with a considerable amount of time and thought process before moving on to the next step. Following is the brief description of the major sections of our research methodologies.



Secondary Research

Following are the major sources of information for conducting secondary research:

Quadrant's Internal Database

Quadrant Knowledge Solutions maintains a proprietary database in several technology marketplaces. This database provides our analyst with an adequate foundation to kick-start the research project. This database includes information from the following sources:

- Annual reports and other financial reports
- Industry participant lists
- Published secondary data on companies and their products

- Database of market sizes and forecast data for different market segments
- Major market and technology trends

Literature Research

Quadrant Knowledge Solutions leverages on several magazine subscriptions and other publications that cover a wide range of subjects related to technology research. We also use the extensive library of directories and Journals on various technology domains. Our analysts use blog posts, whitepapers, case studies, and other literature published by major technology vendors, online experts, and industry news publications.

Inputs from Industry Participants

Quadrant analysts collect relevant documents such as whitepaper, brochures, case studies, price lists, datasheet, and other reports from all major industry participants.

Primary Research

Quadrant analysts use a two-step process for conducting primary research that helps us in capturing meaningful and most accurate market information. Below is the two-step process of our primary research:

Market Estimation: Based on the top-down and bottom-up approach, our analyst analyses all industry participants to estimate their business in the technology market for various market segments. We also seek information and verification of client business performance as part of our primary research interviews or through a detailed market questionnaire. The Quadrant research team conducts a detailed analysis of the comments and inputs provided by the industry participants.

Client Interview: Quadrant analyst team conducts a detailed telephonic interview of all major industry participants to get their perspectives of the current and future market dynamics. Our analyst also gets their first-hand experience with the vendor's product demo to understand their technology capabilities, user experience, product features, and other aspects. Based on the requirements, Quadrant analysts interview with more than one person from each of the market participants to verify the accuracy of the information provided. We typically engage

with client personnel in one of the following functions:

- Strategic Marketing Management
- Product Management
- Product Planning
- Planning & Strategy

Feedback from Channel Partners and End Users

Quadrant research team researches with various sales channel partners, including distributors, system integrators, and consultants to understand the detailed perspective of the market. Our analysts also get feedback from end-users from multiple industries and geographical regions to understand key issues, technology trends, and supplier capabilities in the technology market.

Data Analysis: Market Forecast & Competition Analysis

Quadrant's analysts' team gathers all the necessary information from secondary research and primary research to a computer database. These databases are then analyzed, verified, and cross-tabulated in numerous ways to get the right picture of the overall market and its segments. After analyzing all the market data, industry trends, market trends, technology trends, and key issues, we have prepared preliminary market forecasts. This preliminary market forecast is tested against several market scenarios, including the economic most accurate forecast scenario for the overall market and its segments.

In addition to market forecasts, our team conducts a detailed review of industry participants to prepare a competitive landscape and market positioning analysis for the overall market as well as for various market segments.

SPARK Matrix: Strategic Performance Assessment and Ranking

Quadrant Knowledge Solutions' SPARK Matrix provides a snapshot of the market positioning of the key market participants. SPARK Matrix representation provides a visual representation of market participants and provides strategic insights on how each supplier ranks in comparison to their competitors, concerning various performance parameters based on the category of technology excellence and customer impact.

Final Report Preparation

After finalization of market analysis and forecasts, our analyst prepares necessary graphs, charts, and table to get further insights and preparation of the final research report. Our final research report includes information including market forecast; competitive analysis; major market & technology trends; market drivers; vendor profiles, and such others.

Client Support

For information on hard-copy or electronic reprints, please contact Client Support at

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