Kisaco Research

Kisaco Leadership Chart

Kisaco Leadership Chart on Engineering Application Lifecycle Management Solutions 2020-21: IBM

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Michael Azoff

Kisaco Research View

Motivation

The application lifecycle management (ALM) solution market has evolved considerably since it first emerged as a distinct software suite of capabilities some two decades ago. The topic addresses the need to manage the software development lifecycle, and for non-trivial projects or product development that needs to scale across dimensions of technology complexity on one hand and numbers of developers on the other – up to multiple teams spread geographically with hundreds and possibly thousands of developers. ALM solutions provide the transparency into the development effort and help manage work across the whole lifecycle with an integrated set of tools that allow traceability of work items, from requirements to test cases and deployed code. Increasingly ALM is becoming indispensable in safety-critical and highly regulated environments, helping provide the verification, validation, and auditing necessary for compliance.

As digital transformation drives more software into advanced engineered products the need for ALM has grown in the engineering industries. Other highly regulated industries such as finance and life sciences also need ALM to govern their software development in order to manage risk. As a consequence, the use of ALM in these sectors has grown, and with it the special demands of engineering manufacturing and high regulation that does not exist in the other main market for ALM, enterprise IT.

This report focuses on ALM for advanced engineered product development and for satisfying the regulatory demands of software development in safety-critical environments, comparing side by side five top ALM vendor solutions, and presenting our findings in the Kisaco Leadership Chart (KLC).

Key findings

- The demand for ALM in advanced engineered product development and highly regulated industries is rising with digital transformation that businesses are undertaking, resulting in greater software content: the switch from mechanical and electronic hardware to software in products is a continuing strong trend.
- Highly regulated industries are improving their auditing processes for software rich systems and products, and this increases the burden on producers to comply with the quality standards. ALM has an important role to help producers meet these demands.
- End to end traceability of work items at multiple levels of granularity, full auditing of changes and ownership of changes, and compliance report templates to ease regulatory management are now standard engineering ALM offerings.
- We are seeing risk management become a standard feature in engineering ALM, allowing better control over elements of software development associated with risk in regulated industries.
- The need for engineering ALM to deal with compliance has led to interest in such solutions within enterprise IT for businesses also operating in highly regulated industries.
- ALM split between enterprise IT and engineering some years ago with the rise of agile adoption. Enterprise IT started embracing agile project management solutions in place of ALM with the rise of agile: these are essentially ALM solutions geared for

agile (and hybrid) development and lack the refinements needed in engineering. Today agile adoption is ubiquitous in engineering, so that gap has closed with enterprise IT, though support for hybrid processes is still necessary in engineering.

- Engineering ALM providers can switch off advanced engineering features and consequently cater for diverse markets, from engineering to enterprise IT.

Engineering ALM: technology and market landscapes

The impact of agile and free open source tools on ALM

The use of agile practices and methodologies is now standard across engineering firms, having spread from its mainstream adoption in enterprise IT. However, almost every organization has its own custom implementation, and in engineering it is common to find hybrid processes combining the V-model and agile. Engineering ALM needs to meet the requirements of agile practices: iterative development, backlogs, user stories, unit testing, Kanban boards, and more. The V-model entrenches disciplines that are core to the engineering world: the left side of the V is essentially the “what is needed” in requirements, specifications and designs at increasing degrees of granularity to the bottom of the V, and the right side is the corresponding “how to test what is built”. The correspondence between the two arms is the verification and validation process and is core to auditability and traceability necessary for compliance.

Where the industry “went wrong” in the past is to view the V-model as a linear build process, i.e. flattening the V and following the linear path from left to right. It is wrong because it gives you a ‘big bang’ waterfall process. Using waterfall today, by the time you have specified and planned a large advanced engineering product from head to the tiniest bolt, the technology will have progressed, and the product will be outdated by fast paced digital and agile rivals.

We find agile engineering teams typically combine the V-model verification and validation process with agile iterative development, as well as other advanced techniques, from various forms of simulation (X-in-the-loop and multi-simulation) to digital twin development.

After agile revolutionized and disrupted ALM in the enterprise IT mass market, there was another market disruption: free open source and low-cost tools. The mass developer community embraced open source, and this led to a hollowing out at the top end of the ALM market: a number of players disappeared or were acquired by Micro Focus. Today open source and low-cost core developer tools dominate the market across both enterprise IT and engineering, in particular there is acceptance of open source tools across all industries.

Where ALM is thriving is in meeting the specialized needs in engineering and high regulated industries. And these tools mostly integrate with core developer tools rather than replicate them – the market is far more open and ALM solutions are built to work in heterogenous tool environments.

The adoption of agile in engineering is being helped with frameworks like Scaled Agile Framework (SAFe), and Large Scale Scrum (LeSS) which provide the kind of structure to agile work that engineering firms favor. All the ALM solutions participating in the KLC support the latest SAFe edition out of the box.

The components of an engineering ALM solution

Many of the core* components in ALM have not altered since the practice started, and this is because ALM follows the software development lifecycle and what needs to be done has not changed much, it's more how it's done that has changed. Figure 1 shows our segmentation of the ALM technology stack. The newest component is risk management, providing a full management and traceability of risk related work items throughout the lifecycle. In some industries (e.g. pharmacology) the emphasis of ALM is focused on risk management and this aspect drives the development process.

Figure 1: The ALM space targeting engineering and regulated industries

Source: Kisaco Research

The regulated industries benefit from the risk management, end-to-end traceability, out-of-the-box compliance reports, and overall governance available in ALM. In addition, engineering requires more refinement in requirements: the gathering and definition process is more involved and requires improved support, the sheer scale of large engineered products with thousands of requirements versions needs a separate variations and parameters management tool. This refinement also supports better re-use of work items and increasingly we see support for product line engineering.

Support and integration with popular modelling and simulation tools is also a feature in engineering ALM, and integration with PLM is another essential for large scale advanced software-hardware product manufacturing.

Finally, ALM solutions today do not replicate the popular third-party core developer tools market, rather they integrate with them.

*Note, when we mention core developer tools, we refer to the everyday tools that developers use, whereas ALM is essentially tools for managing development and used by team leaders, project/product managers, and so forth.

The next phase for ALM

Cloud native computing

Software development has continued to evolve from agile with DevOps and more recently microservices deployed in containers and using Kubernetes to manage containers. DevOps has most relevance in the enterprise IT space but is beginning to impact the engineering space as products can carry whole computer systems and deployment of code is no longer just for electronic control units. DevOps from a practical viewpoint automates the deployment process, so that pipelines (hundreds and even thousands) feed code, whether for traditional client-server designs or microservices, into production. This automation is designed to reduce manual labor and error and speed up the delivery of code from dev-test into production.

Built on the foundation of agile and DevOps automation, such continuous integration, continuous testing, and continuous deployment, opens the way to build software applications with microservices. Microservices is not always the answer to how to build next generation systems. The paradigm was created by the born on the cloud Internet giants who needed an approach to software development that could scale rapidly to millions of online users, was robust to failure, and could be rapidly swapped into production without needing to shut down operations. In engineered products the case for microservices, with its considerable overheads, needs to be made and evaluated against more traditional software architectures, but the option is being explored.

Containerization of code (whether traditional or microservices) is becoming more popular in engineering and has the benefit of de-coupling an application from its infrastructure. The orchestration and management of containers is done largely by Kubernetes today (it has won that battle) but many organizations should shy away from using the raw open source version of Kubernetes, as it is rapidly evolving, and will be safer using a tool that is wrapped around Kubernetes (e.g. OpenShift or VMware Tanzu) and which comes with a degree of assurance for enterprise readiness.

Machine learning

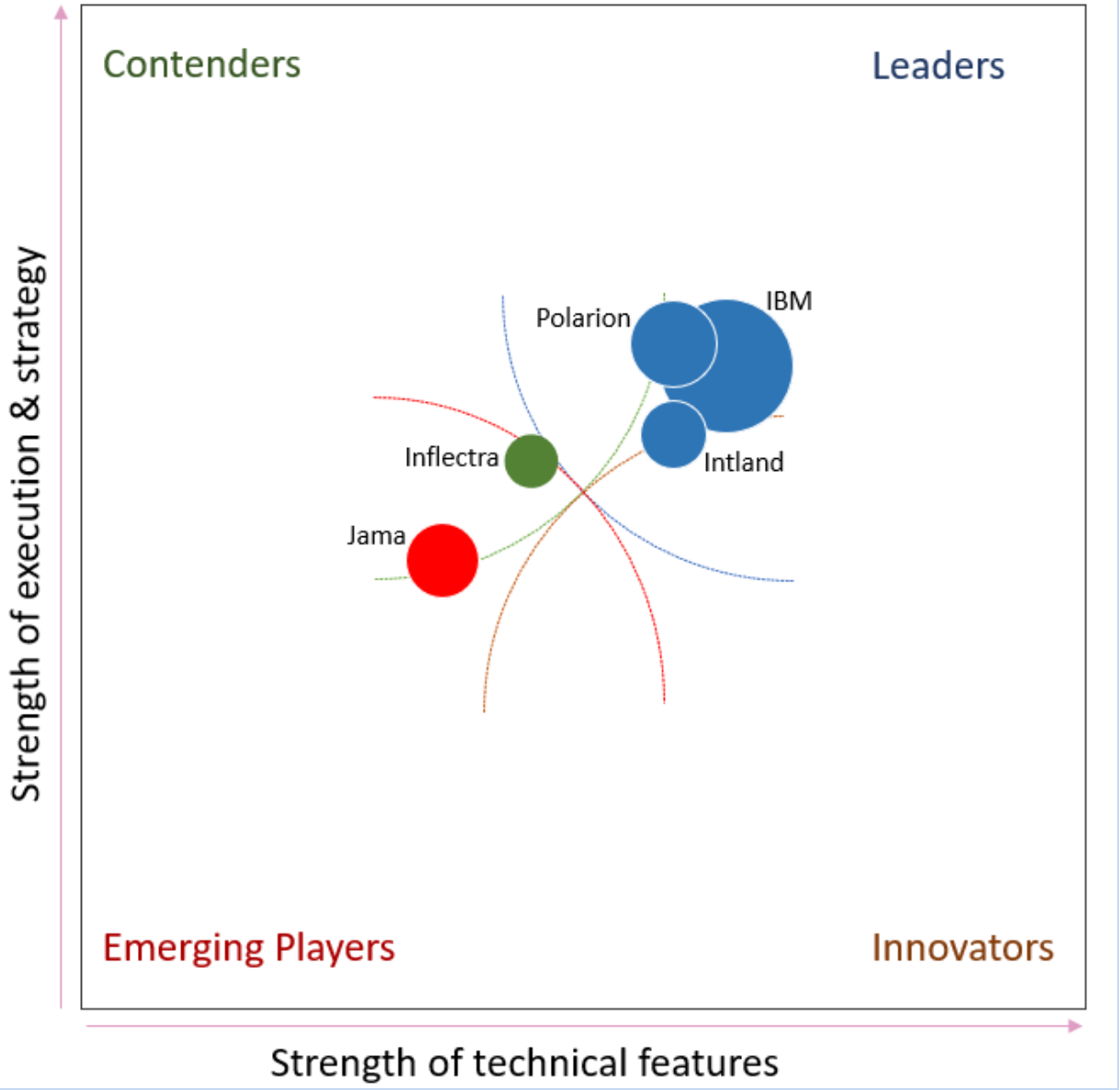
Machine learning (ML) encompasses a wide range of algorithms, such as deep learning which is the most successful and popular today. ML builds models based on data and a natural starting point for applying ML to ALM is in requirements. Errors in requirements that are not picked up early can lead to increasing costs the later in the lifecycle they are detected. The worst and most expensive scenario is for the customer to detect such errors. ML models trained to detect badly formed requirements is a strong candidate for using this technology and a number of vendors and third-party providers already have this or are exploring it in research and development. Other applications for ML include querying requirements (using intelligent search) and automating aspects of test case management. Expect to see this area of ALM grow in the near term.

Solution analysis: vendor comparisons

KLC on Engineering ALM Solutions 2020-21

We developed a comprehensive questionnaire to compare participating vendor ALM solutions largely based on the technology stack shown in Figure 1. The rows in our questionnaire were weighted according to their importance and the vendor responses scored.

Figure 2: KLC on engineering ALM solutions 2020-21



Source: Kisaco Research. Circle size is representative of market share.

The KLC comprises three dimensions in a classic industry analyst chart format: the horizontal axis represents the technical strength of features, the vertical axis represents the strength of market execution and strategy, and the circle size represents a normalized market impact measured by revenue.

The KLC is shown in Figure 2 and Figure 3 tabulates our ranking. We ranked IBM as a Leader, it scored exceptionally well in our analysis, offers all the features we assessed out of the box, and has a strong approach to executing in its target market.

Figure 3: KLC on engineering ALM solutions 2020-21: ranking of vendors

Leader	Contender	Emerging Player
IBM	Inflectra	Jama Software
Intland		
Siemens Polarion		

Source: Kisaco Research

Vendor analysis

IBM, Kisaco evaluation: Leader

Product: IBM Engineering Lifecycle Management (ELM). Available as SaaS and on-prem.

IBM founded in 1911 and led today by CEO Arvind Krishna, is based in Armonk, New York. It has been a leader in the ALM market since it ventured into the space with acquisitions of Rational Software in 2002 and Telelogic in 2007. Its latest offering, named Engineering Lifecycle Management (ELM), is targeted at the advanced systems and software development and highly regulated industries with specific needs that do not exist in enterprise IT. The size of the software component in advanced products is growing exponentially, and with that the structure, size, adaptiveness, and resiliency of the architecture increases driving industries demand for integrated compliance for safety-critical applications, product requirements running into hundreds of thousands of components, and capability to manage exponentially growing test cases. The need to have transparency into development and traceability of work items from product inception to delivery to meet auditing and reporting needs is an additional driving force for adoption of ELM.

IBM targets three main industries: aerospace and defense, automotive, mechatronics, plus the public sector and government. The supply chain across these industries is deep and complex, and IBM recognizes the importance of being able to integrate with the diverse tooling to be found across these environments. Many adjacent industries are also adopting the IBM ELM portfolio as the complexity of the products they develop continues to increase. One example is the financial sector which has seen additional compliance and regulation standards increase the complexity of their software projects.

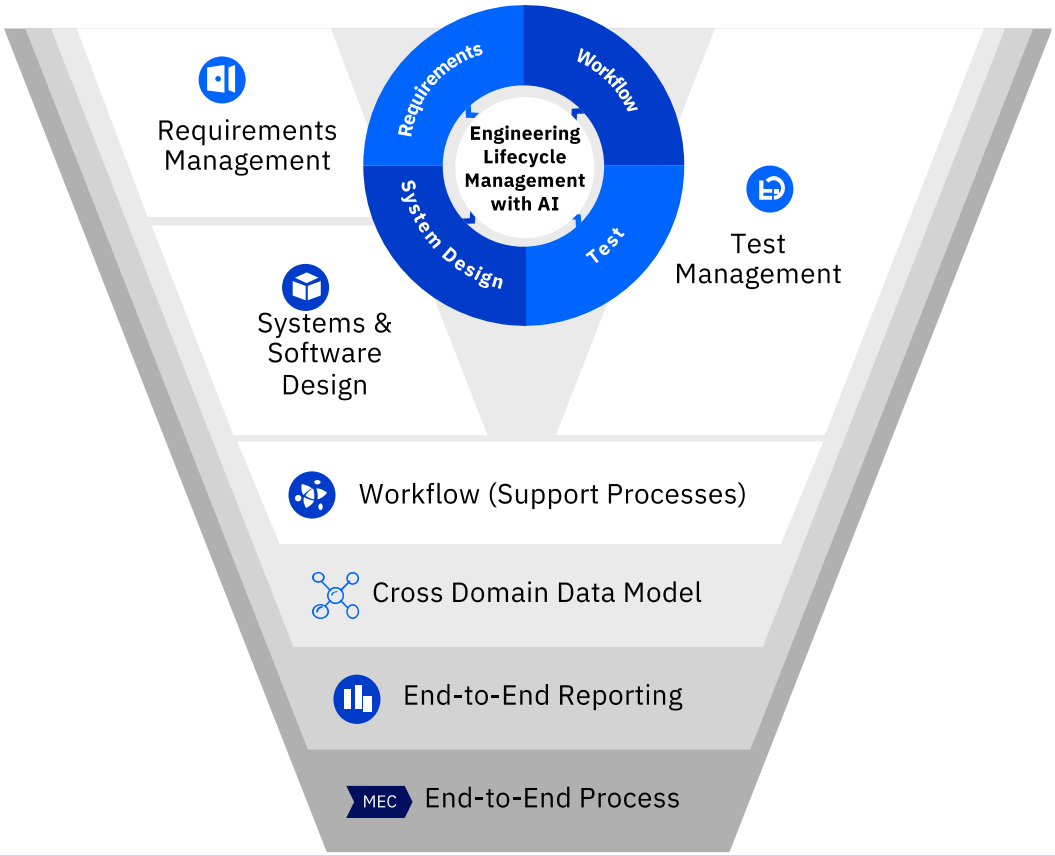
IBM ELM is focused on assisting systems engineers working across hardware, software, and mechatronics (mechanical and electronics), with the traditional disciplines associated with V-model engineering, combined with modern agile/DevOps practices and processes (see Figure 1) – IBM talks about multi-modal DevOps in this context of hybrid processes. ELM goes beyond traditional ALM in exploiting data for insights into project and product development, and artificial intelligence (AI) technology is being harnessed for this purpose. Its first foray in this direction is use of AI for insight into requirements in an ELM tool called IBM Engineering Requirements Quality Assistant (RQA), first

launched in 2018 and leverages Watson natural language processing. Available on the IBM cloud and with OpenShift deployment on-prem.

For its automotive customers IBM has ELM Automotive Compliance, an out-of-the-box tailoring that consists of pre-defined assets to simplify tool adoption, usage, and proofing compliance. An important aspect of this compliance tooling is that it is used on a daily basis and not just for auditing occasions. The support for ASPICE has over 80 reports related to the audit.

IBM has also introduced a global configuration management (GCM) capability. GCM assembles configurations within ELM and across IBM tools, pulling together product configuration streams and baselines from contributing tools, such as Engineering Workflow Management, Engineering Test Management, Engineering Systems Design Rhapsody, and Engineering Requirements Management DOORS Next. These configurations relate to requirements, designs, tests, source code, and other global configurations for a specific component release or product version, helping manage versions and variants across product lines. The value of GCM is directly related to the complexity of the products being developed and the number of product versions/variants that can reuse base development work. GCM can scale across installations supporting tens of thousands of engineers. The ability to scale product lines and reuse previous engineering work saves the company time and money.

Figure 4: IBM ELM combines engineering V-model disciplines with agile iterations



Source: IBM

IBM is making deployment of its platform easier through use of OpenShift and containerization. IBM is seeing more adoption of cloud native technology (microservices, containers, and Kubernetes) within its customer base, as more businesses progress along their digital transformation journey. Digital

transformation is enabling organizations to become more agile, working at speed, while still being compliant and robust in their processes. ELM has support for SAFe v5.0 which is popular in the engineering communities for the structure it introduces in working with agile methods.

The latest ELM V7 release highlights include enhancements to the user interface, scalability improvements in DOORS Next, as well as enhanced integration with DOORS 9.7.1. IBM has extensive tool capability in model-based systems engineering (MBSE) and enhancements have been made to MBSE as well as integration with ELM.

The AI/Watson based tool RQA works as a plug-in to DOORS and DOORS Next. It scans requirements and flags poorly written and ambiguous requirements as good, bad, or indifferent, helping catch errors in requirements early in the engineering process. The non-profit International Council on Systems Engineering (INCOSE) publishes guidelines on requirements and RQA reviews requirements against these guidelines, e.g. detecting compound requirements. Getting requirements right the first time saves considerable costs by reducing re-work and correction further down the lifecycle. There is a thumb rule (based on research by Barry Boehm) of multiply by a factor of 10 every time an error passes from requirements to dev/test, and from dev/test to deployment. So, catching errors in the requirements authoring stage is a considerable cost saver. The latest enhancement of RQA is identifying duplicate requirements and conflicting requirements. As a tool based on AI, it has been pre-trained by IBM on its own data out-of-the-box, and this has been used successfully with customers. There is also a model enhancement option for training RQA with customer use cases. RQA has an opt-in feature that allows customers to teach Watson and suggest improvements to AI responses.

IBM continues to develop AI capabilities and is working with organizations like INCOSE in their FuSE Vision 2025 and AI4SE projects to deliver the most meaningful capabilities to the ELM environment. Examples of such research with potential productization include extending RQA to matching test cases against requirements, to auto-generate test cases out of requirements, and using machine learning on operational data to identify anomalies and bring them into the design process.

Kisaco Assessment

Strengths

- IBM continues its leadership position in ALM with its focus on engineering and highly regulated industries. The re-branding of the product suite with focus on engineering has helped position IBM. The digital transformation overtaking nearly every business has created a need for ALM in software-centric products, especially where compliance has added significant management burdens. IBM has ceased this opportunity admirably.
- IBM is leveraging its expertise in AI, drawing on the wealth of experience and technologies from the IBM Watson and Cognitive divisions. The first AI for ALM product to emerge is RQA and we can expect more AI based automation to help developers raise high quality in their practice.
- IBM ELM is designed for large scale enterprise and industrial development, supporting hundreds and thousands of developers across multiple teams and geographies. It is also open in how it plays and integrates with other products in the eco-system, making it easy to fit into existing environments and supply chains.

Weaknesses

- The challenge of having multiple products in a large portfolio with many names to remember is no doubt a sales & marketing challenge – this has always been the case with IBM so perhaps the customer base is used to it by now. However, we recommend a more streamlined portfolio.
- Continuing the above theme, for the purpose of clarity, we recommend IBM documenting which products are legacy, and which are new generation. Especially what has been re-architected and providing lifetimes and support information. Having a central document or site for this information would be helpful.
- IBM ELM scored faultlessly across our questions assessing it for the KLC. If we look at how the industry is shaping, where IBM may face more competition is in the spreading of easier style product adoption techniques, commonly found in the enterprise IT sector and there is evidence of this approach now in engineering industries.

Appendix

Vendor solution selection

Inclusion criteria

In general, the KLC is not designed to exhaustively cover all the players in a market but a representative set of the leading players. Kisaco also invites smaller, possibly niche vendors that have innovative solutions and are on a fast growth path. With this flexibility we consider each participant on its merits as a good fit to the KLC topic.

The criteria for inclusion of a vendor product in this report are as follows:

- Vendor has an offering fitting the topic of application lifecycle management.
- There are two categories of vendor that are considered for inclusion in this evaluation:
    - Vendor has significant market share relative to peers and is either a recognized leader in the market or has the potential to become one.
    - The vendor is a niche player or an emerging player with outstanding market leading technology.

Exclusion criteria

We exclude products that are heavily geared towards ALM in enterprise IT. We exclude products that are not ready for the market and have no customers or are recently launched with few customers.

Methodology

- Vendors complete a comprehensive capability questionnaire in a spreadsheet, covering the three dimensions of the KLC. The resultant matrix of responses is appropriately weighted and scored, and these scores are plotted to produce the KLC.
- We hold comprehensive briefings with all participating vendors, including product demonstration.
- Supplemental information is obtained from vendor literature and publicly available information.

Definition of the KLC

The KLC spans three assessment dimensions.

Technical Features

Kisaco Research has developed a series of features and functionality that provide technology differentiation between the leading solutions in the marketplace.

Market execution and strategy

Kisaco Research reviews the capability of the solution and the vendor's performance in executing its strategy around key areas such as vision of the business, go-to-market strategy, customer engagement, and market execution.

Market share

Market share is a metric normalized to the market leader and is based on the solution's global revenue. Where revenue data is unavailable, Kisaco provides a representative estimate.

Kisaco Research ratings

- **Leader:** This vendor appears in the top right of the KLC chart and has established a significant market position with a product that is technologically advanced compared with peers and its market execution is strong.
- **Innovator:** This vendor appears in the bottom right of the KLC chart and has established a significant technological lead compared with peers but may be still early in its market execution.
- **Contender:** This vendor appears in the top left of the KLC chart and has established an excellent record executing on its market vision. The product is technically strong compared with peers but may be still early in its development.
- **Emerging player**: This vendor appears in the bottom left of the KLC chart and has a strong enough product to have participated in the KLC. The vendor may be still in early stages of establishing itself in the market, or it may be a niche player with a product aimed at a narrower range of customers.

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Author

Michael Azoff, Chief Analyst

michael.azoff@kisacoresearch.com

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CONTACT US

www.kisacoresearch.com
Michael.azoff@kisacoresearch.com

