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RESEARCH

OFFERING OVERVIEW

The Automation Imperative Materialized: Oracle Autonomous Database

How Oracle's Latest Database Innovations Allow the Enterprise to Become Autonomous

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EXECUTIVE SUMMARY

This Offering Overview examines the Oracle Autonomous Database. The report describes the underlying market trends, introduces the vendor and presents key differentiators for Oracle's offering. The report continues with an analysis of strengths and weaknesses of the vendor and concludes with a set of tangible and actionable recommendations for CxOs.

Business Themes

New C-Suite	Data to Decisions	Technology Optimization

ABOUT ORACLE'S AUTONOMOUS DATABASE

Overview

Oracle has a unique vision among those in this technology vendor field, creating the largest integrated "chip-to-click" integrated hardware and software offering—one that ranges from the silicon (the "chip") to the user (the "click") in software-as-a-service (SaaS) offerings. More recently, in the summer of 2018, Oracle announced its plans to deliver the Oracle Autonomous Database.

A few months later, Oracle released the first versions of Oracle Autonomous Database at Oracle OpenWorld 2018 (see Figure 1). Oracle's goal is to automate the operation of its database to a level where it becomes "self-driving," effectively managing itself. This is a radical departure from

Figure 1. Larry Ellison Announced the Oracle Autonomous Database on August 7, 2018

Source: Constellation Research

the human-operated administration of a database by database administrators (DBAs). Advances in compute, machine learning (ML) and the cloud enabled Oracle to develop the world's first Autonomous Database.

The benefits of an autonomous software offering (especially in a software category that is mission critical, like a database) are clear: Software is available 24/7, and unlike DBAs, it does not take a vacation, get sick or have bad days at work. Most importantly, it's always secure in its operation.

Surprisingly, that compelling vision has solicited practically no response from Oracle's competitors in the database field, creating a multiyear lead for Oracle in this important innovation area.

Market Definition

Since the 1950s, databases have remained not only central to computing but also a foundational layer for enterprise software. The persistent nature of enterprise software requires that the information captured must be available after the user's session. Databases ensure and deliver this persistence.

Moreover, databases must allow software and users to access and process information; how they accomplish this is a key area of differentiation between database providers. At their core, databases organize a collection of data objects, including schemas, tables, queries, reports and views.

With the advent of the cloud, deployment options now reflect the shift of IT loads from on-premises to the cloud. As a result, the availability of next-gen databases in the public cloud will become more attractive as enterprises shift next-generation applications.
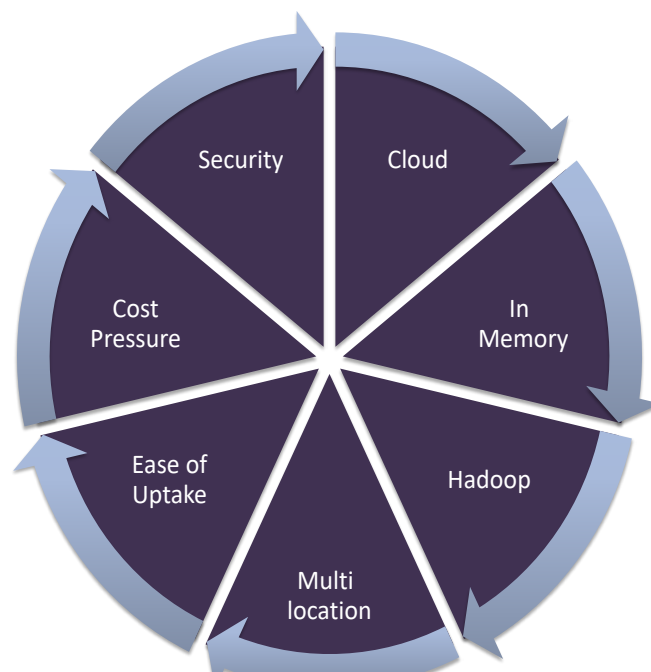
Constellation's conversations with clients show us that database choices matter. Why? Switching databases is hard and expensive, and doing so often poses a risk to business continuity. Leaders must make wise decisions about databases that provide a long-term return on investment, reduce overall operating costs and deliver on enterprise agility.

Market Trends

Constellation has identified seven key market trends for next-generation databases (see Figure 2):

1. **Enterprises expect cloud deployment options.** Customers expect their vendors to have a cloud deployment option. How this is delivered does not matter. For example, offering cloud-native options, using third-party infrastructure-as-a-service (IaaS), delivering on vendor-run cloud infrastructure or even relying on the infrastructure of a partner are all valid options. Remarkably, all vendors—except for those offering the two-cloud native options—make their databases available as on-premises products. Notably, the Hadoop-centric database vendors have been the slowest to offer public cloud deployments, relative to the start date of their first commercial offerings. CxOs expect elasticity of cloud resources and flexibility of licensing models.

2. **New designs support in-memory computing.** Moore's Law has not only made hard disk drives cheaper but also lowered the cost of random-access memory. The result: Enterprises can run large parts or, in some cases, the complete transactional enterprise resource planning (ERP)

Figure 2. Seven Market Trends Defining Next-Gen Databases.

Source: Constellation Research

databases of large multinational enterprises in memory. Performance benefits include the ability to process information in real time. Traditional vendors keep a subset of data in (expensive) memory. Consequently, how memory is managed, accessed and consumed is where the vendors differ. Hadoop-based vendors use Apache Spark and Hive. Traditional relational database management system (RDBMS) vendors use memory sparingly and in an organic fashion, moving data to an in-memory database when beneficial for system performance or placed in memory by system administrators. In-memory vendors take a more radical approach and place the entire system in memory at all times. Meanwhile, cloud-based vendors, given the novelty of their offerings, have not shared their in-memory philosophy; however, given the use cases, Constellation expects the uptake of in-memory options to be similar to that of traditional RDBMS vendors.

3. **Options must co-exist and integrate with Hadoop.** Hadoop has profoundly changed the data storage and retrieval market while massively transforming enterprise best practices for analytics. For the first time, enterprises can store all of their electronic information in one place, without knowing what they want to analyze and remaining commercially viable. In addition, data storage and retrieval architecture can bridge data silos.

4. **Globalization and regulation increase requirements for multiple locations.** Enterprises are more global than in the past and must act globally more than ever. With limitations in performance and statutory requirements regarding data residency, database vendors can no longer pass the buck to the customer to solve this challenge. Customers expect solution offerings to support multiple locations where their databases can be operated, either through their own infrastructure or a partner's.

5. **Implementation plans assume ease of deployment.** Enterprises need to move faster and cannot afford to be slowed down. The speed, ease of deployment and time to go live are key differentiators for database vendors. Critical success factors include helping customers to use a new product effectively, partnering closely with customers during first implementations and making their product easier to deploy. The application of automation based on ML and artificial intelligence (AI) will improve implementation success.

6. **Open source options increase cost pressures on everyone else.** With the rise of mostly open source, cloud-based databases, the cost pressure on the other vendors has increased. Vendors see themselves forced to justify the license costs of their traditional databases when the base version of an open source–based database is free. And the revenue potential and wallet share for the add-ons that can be licensed in the open source market are not the same as for the traditionally expensive database licenses. All traditional database vendors can already see the pressure on their license prices. Constellation expects this trend to continue.

7. **Security remains paramount to clients.** Enterprise-grade use requires a set of security capabilities to prevent data breaches and cyberattacks to avoid potential liability challenges for an enterprise. But enterprises also are ready to experiment and evaluate when only limited security concepts are available; Hadoop databases are an example. In the end, the value of insight gleaned from data often trumps security. However, large-scale and production deliveries require an acceptable set of security capabilities. To an increasing degree, enterprises expect security capabilities to be automatically deployed. Finding the right balance between insight and security is key for CxOs.

The Automation Imperative

Human history is characterized by ingenuity in inventing tools and machinery to automate necessary activities with the purpose of improving living conditions. The manual labor component in the automation equation has been continuously decreasing over the centuries, with the biggest leaps in the last decades. Digitalization has been more than well described and touted as the Fourth Industrial Revolution. Traditional drivers for higher levels of automation have been the cost of labor, the inability of humans to perform tasks from a physiological perspective and, more recently, by unavailability or scarcity of talent. The automation equation may be viewed in yet another way in the light of "black swan" events such the SARS-CoV-2 pandemic.

So, let's look at the two dimensions that define the automation decision space:

- **Affordability.** The required investment into automation needs to be affordable and "pay for itself" after a reasonable time of operation compared with the cost of human labor for the same task.

- **Quality.** The quality of an automated process needs to be comparable. It is defined by marketability and continuity on the lower end and by affordability at the high end.

CxOs make decisions about automation every day, guided by affordability (asking: "Can we pay for this? Does this investment have a payback?") and quality (asking: "Is this better or worse than what our employees can deliver? And, if worse, is it still marketable?") (see Figure 3).

When events such as a pandemic happens, the automation range expands in all directions as a result:

- **Higher/same affordability and higher/same quality:** These automation projects should have been done already, often a long time ago, but the enterprise did not get to them. These are the fabled "skeletons in the closet" that should and could have been addressed in the past.

    Example: Replace layered, uncontrolled wired network infrastructure with Wi-Fi.

Figure 3. The Automation Imperative Quadrant

Source: Constellation Research

- **Lower affordability and higher/same quality:** These automation projects are defined by affordability. The affordability equation changes when human labor is not available for the task.

  Example: Get automatic dishwashers into commercial kitchens to replace human dishwashers.

- **Higher/same affordability and lower quality:** These automation projects are defined by marketability and acceptance of the result. This is the traditional automation thrust of enterprises, fueled by the need to reach higher efficiency levels.

  Example: Use an electronic assistant to answer customer service questions versus a human operator.

- **Lower affordability and lower quality:** These automation projects are still affordable to an enterprise but yield lower quality. They are still justified as they provide a marketable product/service or ensure and guarantee uptime. Often, the ROI is created over volume.

  Example: Mass production of cheaper/lower-grade toys.

So, what determines the overall number of solutions that can span enterprises' candidates for an automation project? Because all investments require capital, it is naturally determined by capital on hand and expected cash flow that can replenish and grow that capital on hand. Naturally, CxOs will flock toward investments in automation that provide high affordability and high quality. However, in a people-challenged world during a pandemic, it is important to consider the less-affordable automation projects as well, especially if they offer the potential to keep the business going. Consider an office- or facility-cleaning robot that is able to keep a people workspace open at any given or wanted time that an enterprise needs the space.

A closer look at Oracle Autonomous Database and the solutions powered and enabled by the offering are clearly in the high-affordability and high-quality range. The additional cost of Oracle Autonomous

Database is negligible compared with the cost of personnel handling the task. That affordability becomes even more valuable when considering that the COVID-19-related absence of human DBAs can bring an enterprise to a screeching halt. For CxOs, it means that adopting Oracle Autonomous Database is a "no-brainer" project. The benefits occur not only from automating the database-related tasks but also from freeing up scarce and costly resources for more challenging and innovative alternative work.
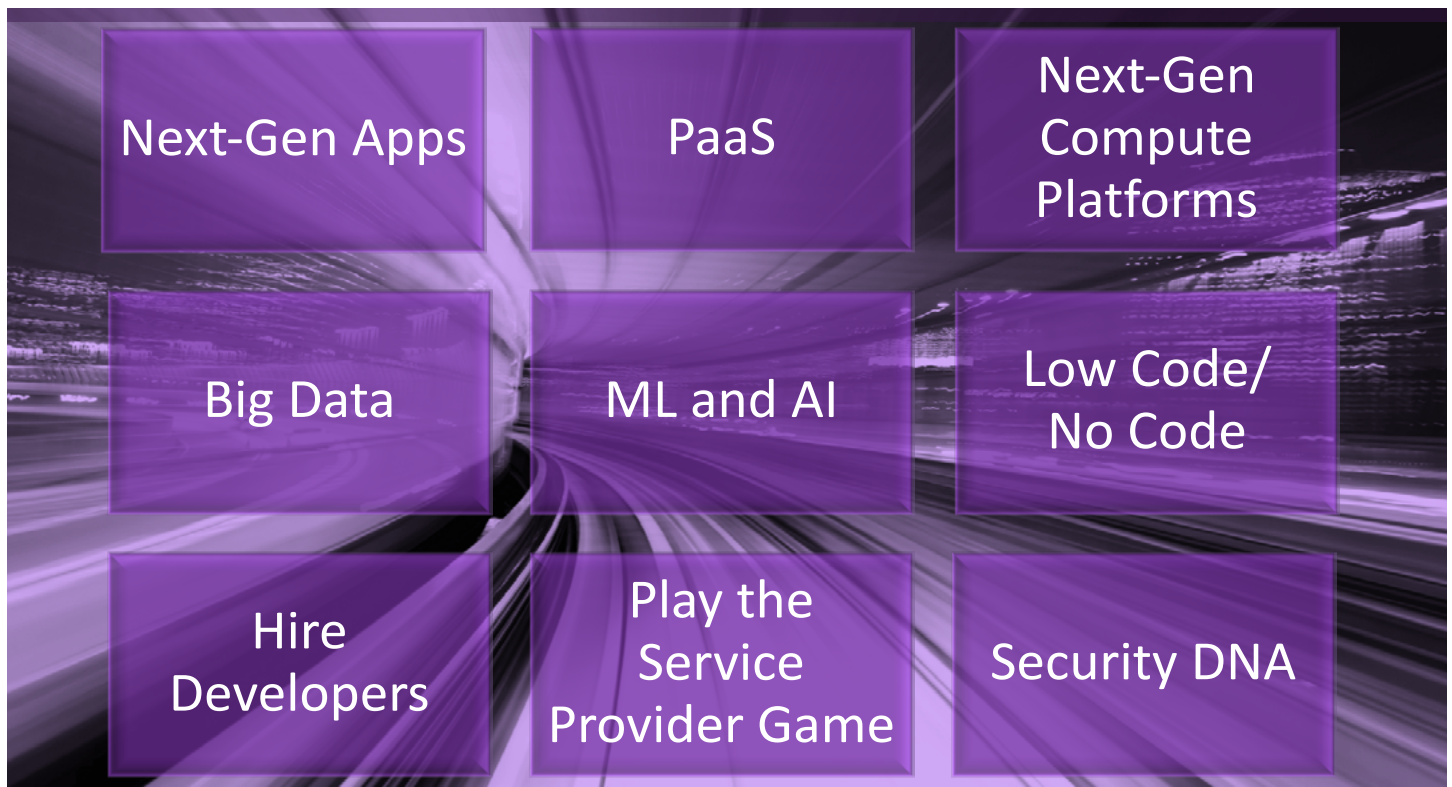
Finally, the autonomous automation capabilities of the Oracle Autonomous Database make the database IT services outsourcing market obsolete. Now CxOs do not have to rely on external service providers for crucial database management services but can take advantage of the built-in native automation capabilities of Oracle Autonomous Database. This not only benefits an enterprise with budget savings, it also reduces the operational complexity of the database operations.

Oracle Enables Enterprise Acceleration Through Autonomous Means

Enterprises need to move faster than ever before, an effect we refer to as Enterprise Acceleration. Oracle as the vendor enables all nine drivers to Enterprise Acceleration. With Oracle Autonomous Database, it enables specifically the following ones (see Figure 4):

• **Next-gen apps.** Enterprises need to take advantage of technology progress and build next-generation applications. The Oracle Autonomous Database supports key database enablement to accelerate the development of these new applications.

• **PaaS.** Enterprises utilize platform-as-a-service options to build their next-generation applications. The Oracle Autonomous Database is part of the Oracle PaaS offering and supports that process.

• **Next-gen compute platform.** Enterprises need workload portability across the public and private cloud as well as on-premises platforms. In combination with Oracle Exadata and Oracle Cloud Infrastructure, Oracle Autonomous Database is powered by a next-gen compute platform.

Figure 4. The Nine Drivers for Enterprise Acceleration in IT

Next-Gen Apps	PaaS	Next-Gen Compute Platforms
Big Data	ML and AI	Low Code/No Code
Hire Developers	Play the Service Provider Game	Security DNA

Source: Constellation Research

- **ML/AI.** Oracle Autonomous Database is both a consumer and enabler for ML/AI processes. In its automation capabilities, the product is a consumer of ML/AI—in its compute, data storage and retention capabilities. Through its built-in machine learning services, Oracle Autonomous Database enables customers to build and test ML/AI models quickly, delivering the important data side of any ML/AI project while keeping key relational data inside the database.

- **Low code/no code.** Next to a long list of general programming languages, Oracle Autonomous Database has Application Express (APEX) built in natively, giving enterprises a low-code alternative to classic programming work.

- **Big data/analytics.** Oracle Autonomous Database offers native integration to Hadoop and object storage services, thus creating a data lake for analytical purposes that covers relational and nonrelational/object data.
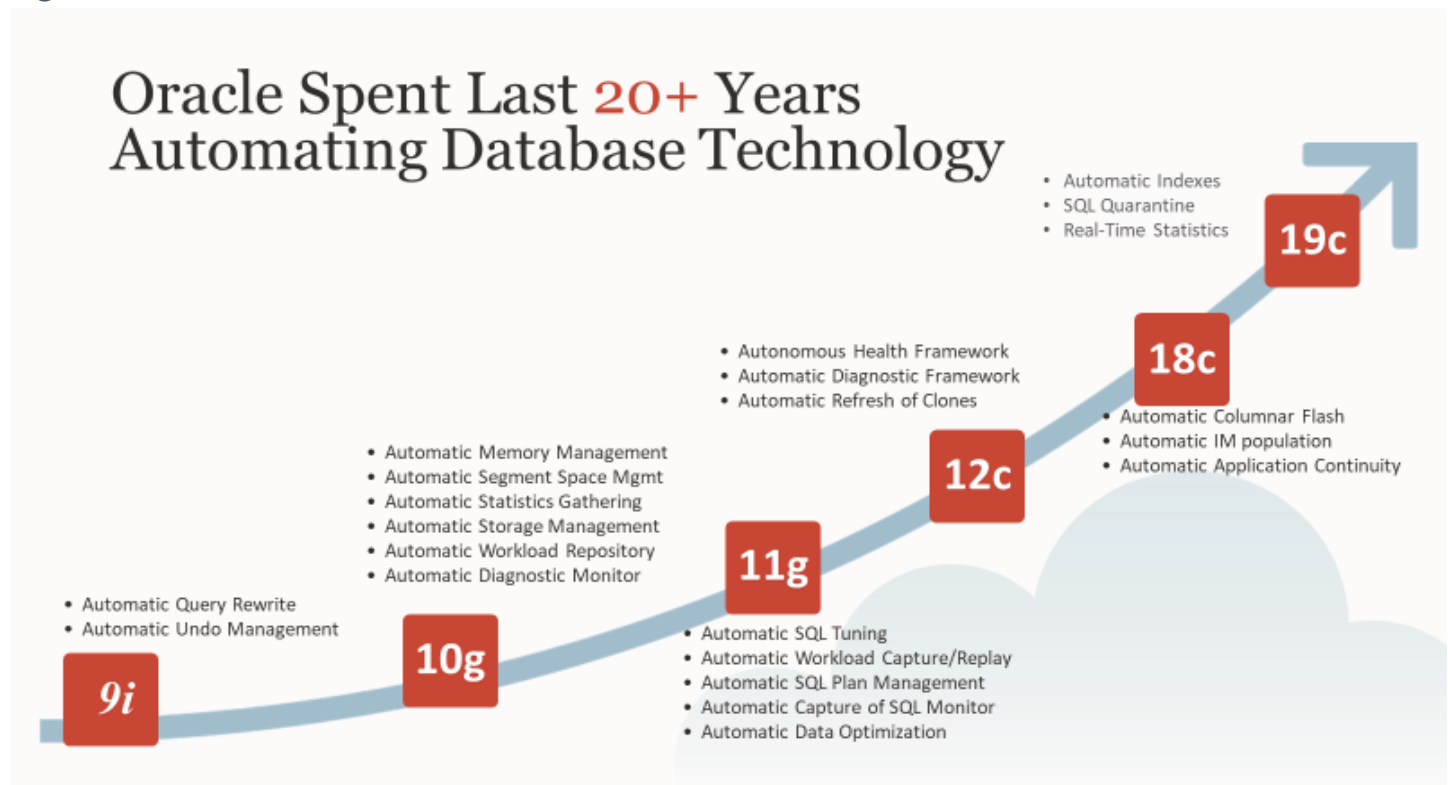
- **Security DNA.** Security is paramount in the connected world that sees peaks of industrial espionage and state-organized data breaches. Oracle Autonomous Database automates all key and core security processes and patches that matter for the database.

FUNCTIONAL CAPABILITIES

An Innovation Track Record

Oracle did not become the RDBMS leader overnight. Instead, it has innovated on architecture, management and deployment of databases for over 40 years. Today, Oracle customers can benefit from that investment, as Oracle Autonomous Database in its turn benefits from the automation created over the last two decades (see Figure 5).

Figure 5. Oracle's 20-Year Database Automation Track Record

Source: Oracle

It all started with Oracle 9i, when Oracle introduced an automated query-rewrite capability. With this then unheard-of ability, Oracle was rewriting and, with that, tuning slow-running database queries. Equally unheard of was undo management, at its core a conflict with the transactional consistency of relational databases, but Oracle pulled off the feature first in the space. Over decades, Oracle added an increasing number of capabilities that effectively have helped DBAs and their enterprises to lower the total cost of ownership (TCO) of the Oracle Database. With its recent emphasis on an autonomous vison, Oracle has gone back and reimagined manual-only available capabilities as API-based functionality, driven by AI/ML imbued with Oracle's best practices, and made this available to be used by software, creating a large arsenal of functionality that can be triggered by autonomous control of the whole database.

One milestone that stood out from Constellation's perspective was the introduction of automated indexing, allowing software to tune the database. The value of this capability became instantly clear when large Oracle NetSuite databases tuned over a 24-hour span performed better than similar databases tuned manually over a 20-year period.

If it were not for the decades of innovation, Oracle would not have been able to deliver the Oracle Autonomous Database so fast and with such extensive functional coverage.
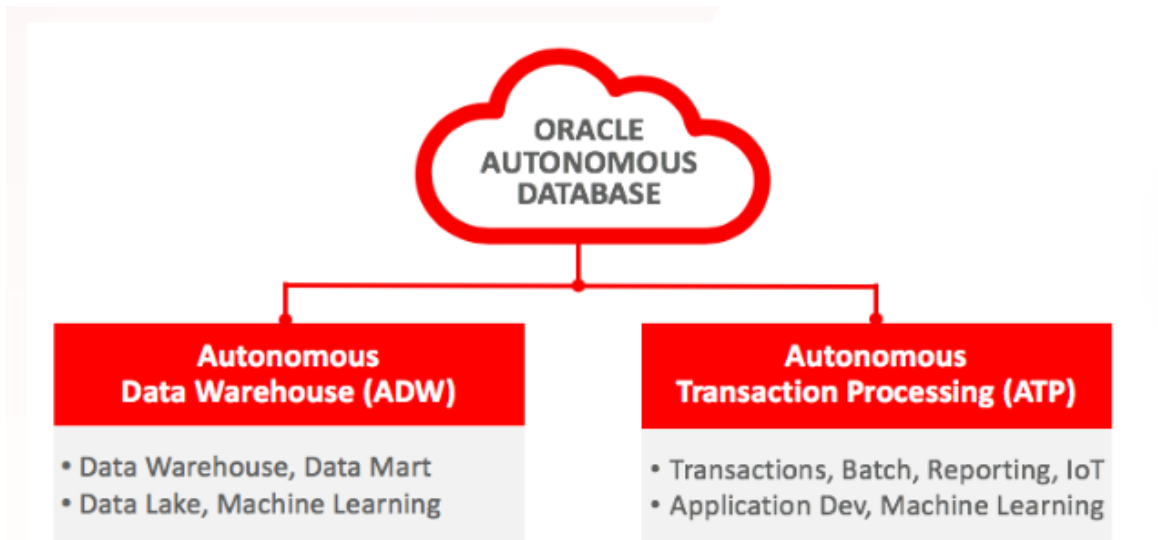
One Database for All Enterprise Loads

Enterprise loads have always been about transactional and analytical loads. Traditionally, Oracle (like the combined industry) has come from automating transactional loads. But in the last dozen years, Oracle has vastly expanded its support into the analytical space.

Today, the Oracle Autonomous Database spans across both domains (see Figure 6):

- **Autonomous Data Warehouse (ADW).** With this offering, Oracle enables data warehouse and data mart analytical loads. More recently, it has added support for data lakes, which form an important and key platform for machine learning, effectively providing the data to fuel ML.

Figure 6. Oracle Autonomous Database: Two Offerings

Source: Oracle

- **Autonomous Transaction Processing (ATP).** The traditional transaction OLTP database that allows batch and reporting use cases and powers Internet of Things (IoT) scenarios. It supports application development and provides the important system of record data for ML.

The ability to run all the critical enterprise database loads—from analytical to transactional loads—in autonomous fashion, as well as support for ML, Graph, IoT, JSON and more, sets the Oracle Autonomous Database apart in the market for databases right now. Would you rather have nine specialized databases, each with its own separate security profile and management learning curve, or a single database that operates with all types of datasets autonomously? The Oracle Autonomous Database is built upon a converged database, meaning companies can run time series–type processing without having to invest in separate databases, separate servers, storage systems, management tools, floor space, power, cooling, conduits and more.
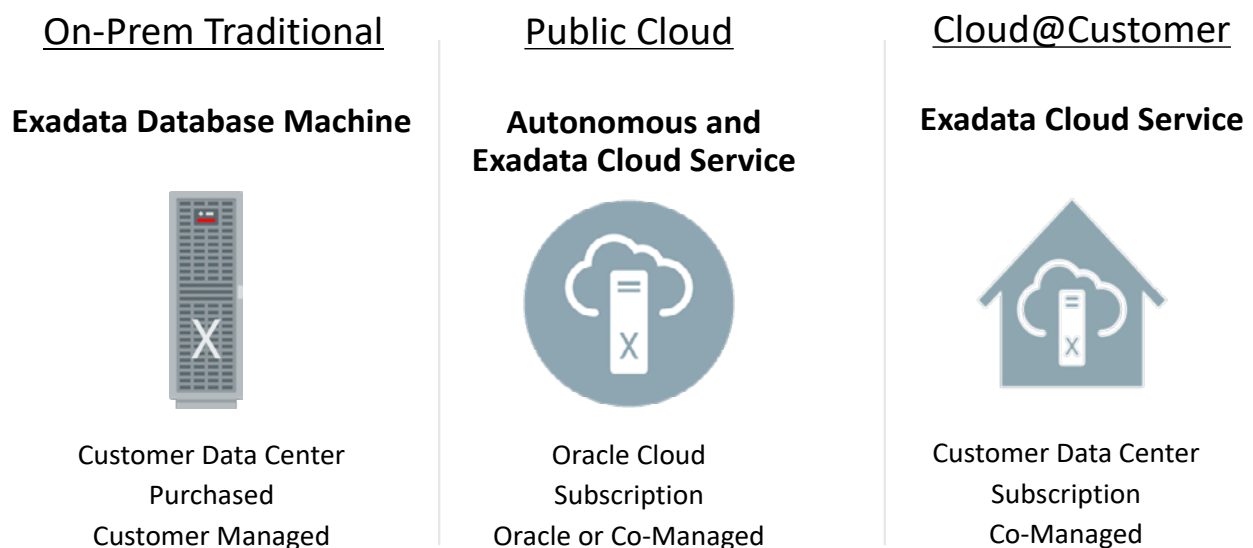
Deployment Flexibility

CxOs want deployment flexibility, allowing them to deploy data and software assets onto different platforms from on-premises to the cloud. This gives their enterprises freedom of choice that is often

needed from both statutory/legal and commercial perspectives. Nothing is worse for an enterprise than being locked into a deployment form that no longer delivers benefits.

Oracle offers three different forms of deployment for Autonomous Database (see Figure 7):

- **On-premises:** Oracle Database on Exadata Database Machine. This is the traditional way of operating IT—purchase hardware, licenses and in-house decisions on support and maintenance, typically performed by employees. This approach has served enterprises well for many decades. It still delivers value for many enterprises around the world. Oracle has currently enabled certain features from Autonomous Database, such as the aforementioned automated indexing, to run exclusively on on-premises Exadatas.

- **Cloud@Customer:** Autonomous Database on Exadata Cloud@Customer. With its Cloud@Customer service, Oracle has bridged the benefits of cloud with local deployments. Enterprises still want to operate in their local data centers, usually motivated by performance reasons, statutory demands and solidified traditional best

Figure 7. Oracle Choice of Deployment for Oracle Autonomous Database

On-Prem Traditional	Public Cloud	Cloud@Customer
Exadata Database Machine	**Autonomous and Exadata Cloud Service**	**Exadata Cloud Service**
Customer Data Center	Oracle Cloud	Customer Data Center
Purchased	Subscription	Subscription
Customer Managed	Oracle or Co-Managed	Co-Managed

Source: Oracle

practices. However, by offering to manage or co-manage the resource and by offering a subscription, Oracle created new value for these customers: They do not have to pay capex anymore, and they can rely on Oracle to manage their Oracle Database infrastructure and further benefit from the automation in the Autonomous Database. This was previewed by Oracle at OpenWorld 2019 and is not yet available.

- **Public cloud:** Autonomous Database on Exadata Cloud Service. In this public cloud deployment, Oracle runs the Oracle Autonomous Database on an Exadata-backed Oracle Cloud Infrastructure (OCI), offered as a subscription service. Typically, Oracle manages the complete infrastructure but also allows the customer the take the lead and offer a co-management model. In either case, Oracle has no visibility into customer data; the customer manages the data and schema.

Constellation assumes that Oracle's experience in managing database loads as a service via the Oracle Cloud@Customer offering was a major motivator to invest more into autonomous database management services. Not only was Oracle motivated to provide a high-quality, highly reliable database management service, it was also motivated to provide that at competitive costs. This is likely to have triggered the realization that self-driving, autonomous databases are superior for customer experience and TCO. This unique situation creates extra motivation for Oracle to operate the Oracle Autonomous Database in a reliable and cost-effective way. These mechanics are key for CxOs to understand when they make database choices.

Autonomous Architecture Delivers Exponential TCO Reductions

A traditional problem of IT has been the sizing of compute infrastructure to run workloads optimally. Traditionally, enterprises had no choice but to either not allow for usage peaks or to size their hardware to the usage peak. Both were compromises, with the former resulting in subpar customer/ employee experience, and the latter in capex sunk into overprovisioned hardware.
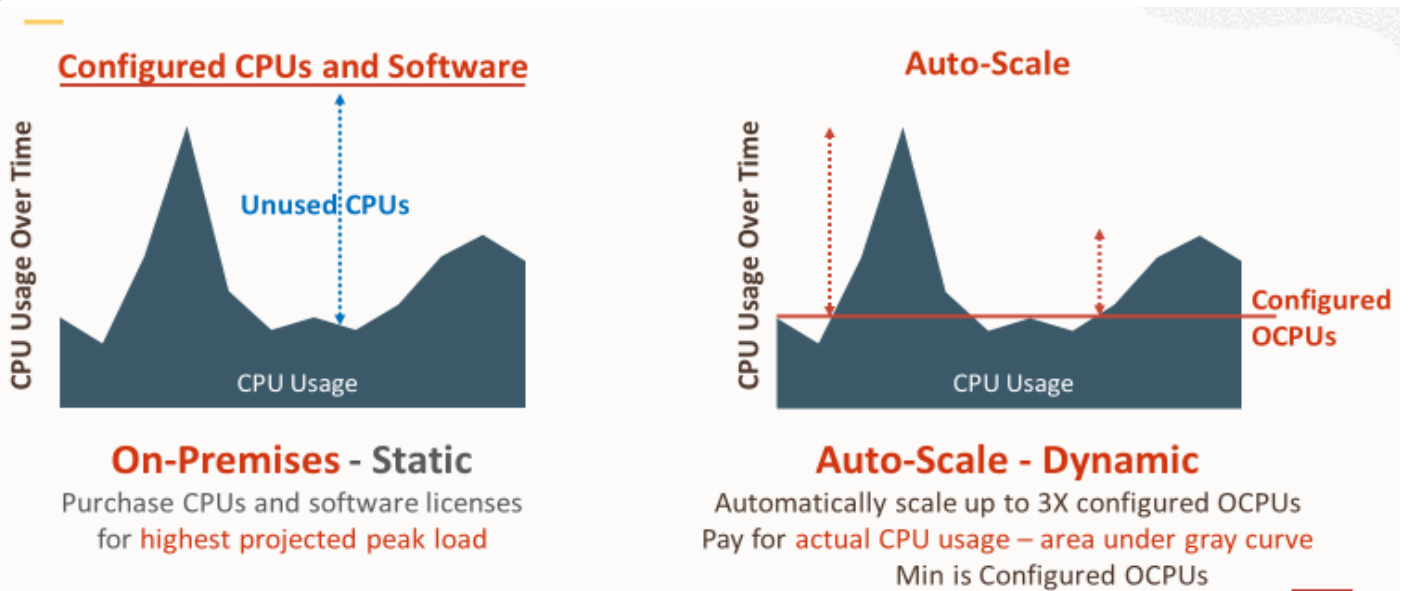
The automation capabilities of Oracle Autonomous Database put an end to this dilemma: In combination with the highly scalable Oracle Exadata infrastructure, this allows workloads to scale substantially. CxOs still have to pick a number of Oracle Compute Units (OCPUs), but they can be

more conservative in looking for average loads to size them correctly. Loads that peak beyond the OCPU level are handled by the Oracle Autonomous Database elastically all the way to 3x the OCPU capacity. Enterprises still have to pay for the extra usage, but when picking the number of OCPUs carefully, this setup can result in substantial savings compared with an overprovisioned system. OCPU level drops back down when the peak usage is over. In either case, there is no downtime (see Figure 8).

With this approach, Oracle effectively offers the best of two worlds: provisioning for average workloads while paying for peak usage. The pay-per-use aspect is what CxOs value, as they often cannot foresee the peak usages of their enterprise. Ideally, the peak usage is also associated with a revenue event/the value creation of the enterprise, so it funds the additional cost for the extra capacity.

Oracle would not be able to offer this technical and commercial elasticity if it were not able to run Oracle Autonomous Database in a highly automated way for customers. It also helps that the Exadata platform on which these loads run was specifically designed as a scale-out architecture that can handle the peak usage without performance degradation.

Figure 8. True Pay per Use with Oracle Autonomous Database

Source: Oracle

Customer References

Oracle has numerous customers for the Oracle Autonomous Database. Here are a few of them:[1]

- **Agea halves TCO for Data Warehouse.** The largest newspaper of Argentina switched to Oracle Autonomous Data Warehouse and saw a reduction of TCO by 50%. Time-to-market for campaigns is now hours, down from four days. The switch allowed Agea Clarin to gain US$2 million in revenue over 18 months.

- **CERN Openlab accelerates science with Oracle Database.** The European Laboratory for Particle Physics, CERN, uses the Oracle Autonomous Database to support the control systems of its Large Hadron Collider. CERN now sees the database scale up faster by a factor of 10x, and Kubernetes scale up by a factor of 3x. CERN also developed a cloud-native app for 75,000 users in 75 days on the platform. And all that with zero resources spent on database management.

- **Kingold accelerates insights.** The Chinese property developer reduced its data warehouse timelines from 3–6 months down to a few weeks. Complex reports now run in 41 seconds instead of 12 minutes. The new autonomous database strategy has empowered the organization to become more data-driven.

- **Mestec innovates with Oracle Autonomous Database.** The independent software vendor, which specializes in manufacturing execution systems (MES), saw a 50% productivity increase in its factory automation processes. Using Azure Interconnect between Azure and Oracle increased performance by 600%. CPU and other hardware and labor costs were halved.

- **TaylorMade saves big on reporting.** The golf equipment maker moved a 1 TB database out of its on-premises ERP solution and reduced costs by 40%. It has also seen a 40x performance improvement for reporting workloads. And all this while IT staff members were freed up from database management tasks and could focus on higher-value work projects.

PRICING

Oracle offers pay-as-you-go as well as monthly flex pricing for both Oracle Autonomous Data Warehouse as well as Oracle Autonomous Transaction Processing:

Autonomous Data Warehouse on Shared Infrastructure

PRODUCT	PAY AS YOU GO	MONTHLY FLEX	METRIC
Oracle Autonomous Data Warehouse	$2.5202	$1.680133	OCPU per hour
Oracle Autonomous Database – Exadata Storage	$222.00	$148.00	Terabytes storage capacity per month

Autonomous Data Warehouse on Dedicated Infrastructure

PRODUCT	PAY AS YOU GO	MONTHLY FLEX	METRIC
Oracle Autonomous Data Warehouse - Dedicated	$2.5202	$1.680133	OCPU per hour
Oracle Cloud Infrastructure - Database Exadata Infrastructure - Quarter Rack - X8	$27.2178	$18.1452	Hosted environment per hour
Oracle Cloud Infrastructure - Database Exadata Infrastructure - Half Rack - X8	$54.4355	$36.290334	Hosted environment per hour
Oracle Cloud Infrastructure - Database Exadata Infrastructure - Full Rack - X8	$108.8709	$72.5806	Hosted environment per hour

For Autonomous Data Warehouse on Dedicated Infrastructure:

- Minimum term for subscription to Database Exadata Infrastructure is 48 hours.
- Minimum OCPU purchase is 1 OCPU per database node and up to the maximum number of OCPUs per rack.

Autonomous Data Warehouse Bring Your Own License (BYOL)

PRODUCT	PAY AS YOU GO	MONTHLY FLEX	METRIC
Oracle Autonomous Data Warehouse	$0.4839	$0.3226	OCPU per hour
Oracle Autonomous Data Warehouse - Dedicated	$0.4839	$0.3226	OCPU per hour

If you run Oracle Database Enterprise Edition and the required options listed below, then your BYOL requirements are as follows:

- For 1-16 OCPUs of Oracle Autonomous Data Warehouse:

  - For each supported Processor license of Oracle Database Enterprise Edition plus Options: Multitenant, you may activate up to 2 OCPUs of the BYOL Cloud Service.

  - For every 25 supported Named User Plus licenses of Oracle Database Enterprise Edition plus Options: Multitenant, you may activate 1 OCPU of the BYOL Cloud Service.

- For 17 OCPUs or more of Oracle Autonomous Data Warehouse:

  - For each supported Processor license of Oracle Database Enterprise Edition plus Options: Multitenant and Real Application Clusters, you may activate up to 2 OCPUs of the BYOL Cloud Service.

- For every 25 supported Named User Plus licenses of Oracle Database Enterprise Edition plus Options: Multitenant and Real Application Clusters, you may activate 1 OCPU of the BYOL Cloud Service.

Autonomous Transaction Processing on Shared Infrastructure

PRODUCT	PAY AS YOU GO	MONTHLY FLEX	METRIC
Oracle Autonomous Transaction Processing	$2.5202	$1.680133	OCPU per hour
Oracle Autonomous Transaction Processing - Exadata Storage	$222.00	$148.00	Terabytes storage capacity per month

Autonomous Transaction Processing on Dedicated Infrastructure

PRODUCT	PAY AS YOU GO	MONTHLY FLEX	METRIC
Oracle Autonomous Transaction Processing - Dedicated	$2.5202	$1.680133	OCPU per hour
Oracle Cloud Infrastructure - Database Exadata Infrastructure - Quarter Rack - X8	$27.2178	$18.1452	Hosted environment per hour
Oracle Cloud Infrastructure - Database Exadata Infrastructure - Half Rack - X8	$54.4355	$36.290334	Hosted environment per hour
Oracle Cloud Infrastructure - Database Exadata Infrastructure - Full Rack - X8	$108.8709	$72.5806	Hosted environment per hour

For Autonomous Transaction Processing on Dedicated Infrastructure:

- Minimum term for subscription to Database Exadata Infrastructure is 48 hours.
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Oracle Autonomous Transaction Processing	$0.4839	$0.3226	OCPU per hour
Oracle Autonomous Transaction Processing - Dedicated	$0.4839	$0.3226	OCPU per hour

If you run Oracle Database Enterprise Edition and the required options listed below, then your BYOL requirements are as follows:

- For 1-16 OCPUs of Oracle Autonomous Transaction Processing:

  - For each supported Processor license of Oracle Database Enterprise Edition plus Options: Multitenant, you may activate up to 2 OCPUs of the BYOL Cloud Service.

  - For every 25 supported Named User Plus licenses of Oracle Database Enterprise Edition plus Options: Multitenant, you may activate 1 OCPU of the BYOL Cloud Service.

- For 17 OCPUs or more of Oracle Autonomous Transaction Processing:

  - For each supported Processor license of Oracle Database Enterprise Edition plus Options: Multitenant and Real Application Clusters, you may activate up to 2 OCPUs of the BYOL Cloud Service.

- For every 25 supported Named User Plus licenses of Oracle Database Enterprise
  Edition plus Options: Multitenant and Real Application Clusters, you may activate 1
  OCPU of the BYOL Cloud Service.

Constellation can provide price benchmarking for clients on request.

ANALYSIS AND OBSERVATIONS

Constellation sees the following strengths and weaknesses for the Oracle Autonomous Database (see
Figure 9):

Strengths

- **Innovation lead with Autonomous Database approach.** Oracle has a major lead in
  the drive to move to an autonomous database architecture that so far has not been
  answered by its typical competitors. Starting on the database side and continuing
  to the overall technology stack, the traditional competitors of Oracle have failed to
  develop a vision and strategy to match Oracle's, including AWS, Microsoft, IBM, SAP,
  Teradata and others.

- **Proven product with tangible TCO.** Oracle has shown that the Oracle Autonomous
  Database delivers tangible advantages in TCO, while showing maturity in its core
  offering, having been in production for over three years. The maturity and functional
  capability with its built-in multimode, multitenant and multiworkload architecture
  (ADW, ATP) combined with the autonomous capability delivers the superior TCO for
  Oracle Autonomous Database.

- **Large customer base.** Oracle is the market leader for RDBMS and has a large
  customer base to convert to the Oracle Autonomous Database. This is revenue, scale
  and market share that is Oracle's to monetize in the coming years, while enjoying at
  best only lackluster competition from its traditional competitors.

Weaknesses

- **Not (yet) a fully autonomous stack.** Just as it is valuable for enterprises to use the Oracle Autonomous Database, it also is critical that the overall software technology stack of an enterprise becomes autonomous. Uptime and security of the database are critical, but when users can't get to their application because their not-yet-autonomous application server is down, it's still a business disruption.

- **Inertia of old best practices.** For over four decades, Oracle has created and shaped the position of the DBA, and it has in turn fostered habits that are not trivial to end and replace. Therefore, Oracle must now effectively advocate and evangelize the need to move to autonomous software platforms, taking into consideration the human aspect of the transformation. Oracle can help organizations shift the role of the DBA into more strategic projects and leave the database tuning to the built-in AI and ML of its Autonomous Database.

- **Specialized databases gain.** The Oracle Database delivers significant synergies as a converged database that spans not only relational but also NoSQL, big data, document, graph and other database models. The generalist nature of the Oracle Database is a key benefit factor for customers, but Oracle needs to make sure that all the key emerging database disciplines are leading or close in functionality compared with competitors that are following a specialized database product strategy (that is, one specialized database for each database use case/discipline).

Figure 9. Oracle Autonomous Database's Strengths and Weaknesses

STRENGTHS	WEAKNESSES
· Innovation lead with Autonomous Database approach · Proven product with tangible TCO · Large customer base	· Not (yet) a fully autonomous stack · Inertia of old best practices · Converged, but is it the best in every database category?

Source: Constellation Research

RECOMMENDATIONS

Constellation has the following recommendations regarding the Oracle Autonomous Database:

1. **Accept the automation imperative.** Enterprises need to look at automation to increase their productivity and efficiency. The shift from specialized operations to self-driving software is in full swing, and Oracle is a pioneer in this move to autonomous. Enterprises have never scaled through people but by using tools and automation. This creates the automation imperative—that is, if a process can be automated, it should be—regarding IT operations, where CxOs need to look at any automation option that is at their disposal. Fast economic turns likely accelerated by pandemic outbreaks increase the pressure to automate and strengthen the automation imperative even more.

2. **Oracle Database customers should evaluate Oracle Autonomous Database—and sooner rather than later.** Existing Oracle Database customers won't have a difficult time deciding whether to adopt the Oracle Autonomous Database. Nonetheless, they are advised to perform a cost-benefit analysis. The uncertainties around talent availability and the constant technical skills challenge should make this an easy business case for Oracle Autonomous Database.

3. **Non-Oracle Database customers need to do a cost-benefit analysis for a potential switch to Oracle.** Given the slow (or no) response by Oracle's traditional database competition on the innovation of autonomous database operations, non-Oracle customers should consider a move to Oracle Autonomous Database. An analysis naturally needs to include the cost of migration, cost for new licenses and cost of long-term operations. Constellation believes that Oracle has the chance to prevail as a winner in most cases, with application rewrite costs likely being the deal maker or showstopper.

4. **CxOs need to consider Exadata.** Oracle has spent a lot of time designing and manufacturing the ideal database platform to run the Oracle Database: Oracle Exadata Database Machine. The Exadata platform needs evaluation by CxOs who use the Oracle Database, no matter which deployment form: on-premises, on Oracle Cloud Infrastructure or with Oracle Cloud@Customer. Purpose-built hardware always beats general do-it-yourself hardware platforms from the likes of HPE, IBM, Dell EMC and Hitachi, among others.

5. **Practice commercial prudence.** As always, CxOs need to practice commercial prudence when it comes to platform decisions. One-time costs, ongoing costs and lock-in effects are the key areas of consideration before making platform decisions. Database platform decisions are no exception to the consideration of commercial prudence in all phases of the buying, adoption and usage cycle. Another consideration is the potential savings as outsourced services to operate and maintain Oracle Databases become obsolete by the adoption of Oracle Autonomous Database. This not only benefits an enterprise with budget savings but also reduces the operational complexity of the database operations.

Expect Level 4 Autonomous Enterprises to Emerge in 2023
R "Ray" Wang, Principal Analyst and Founder

Constellation identifies five levels of autonomous enterprises and predicts when these cognitive apps will deliver full autonomy (see Figure 10):

Level 1 Autonomous Enterprise: Basic Automation. In this level, the system can provide basic task and workflow automation.

- **When?** Today.
- **Includes:** Basic process automation tools such as business process management, manual instrumentation and control, and intelligent workflow automation.
- **Who's in control?** Humans are still in control and guide many manual steps.

Level 2 Autonomous Enterprise: Human-Directed. Level 2 enables human-directed automation of business processes.

- **When?** Current state of the art.
- **Includes:** Robotic process automation, process-mining tools, journey orchestration tools, ML algorithm and natural language processing.
- **Who's in control?** Humans direct major decisions; minor decisions automated over time with some effort in training.

Level 3 Autonomous Enterprise: Machine Intervention. Level 3 delivers automation with occasional machine intervention.

- **When?** The next big thing in 2020.
- **Includes:** Cognitive applications, neural networks, GANs models, contextual decisions and next best actions.
- **Who's driving?** Humans still on standby but can be hands-off for periods of time.

Level 4 Autonomous Enterprise: Fully Autonomous. Level 4 presumes that the machines can deliver full automation but not sentience.
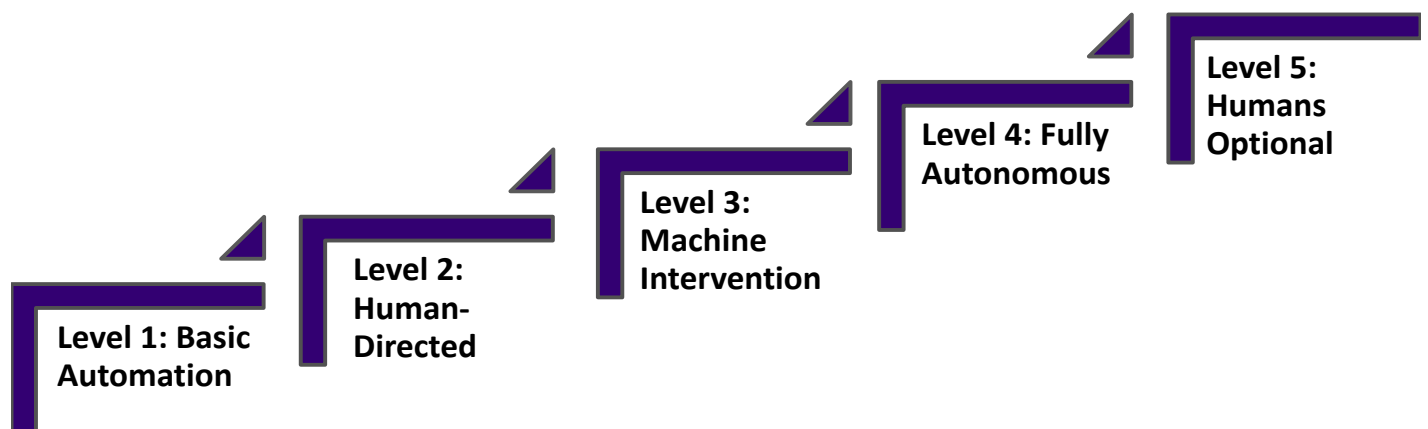
- **When?** Sometime in 2023.
- **Includes:** AI-driven smart services, full automation, self-learning, self-healing and self-securing.
- **Who's driving?** Machines are fully automated.

Level 5 Autonomous Enterprise: Humans Optional. Level 5 achieves full sentience and humans may no longer be needed.

- **When?** 2030.
- **Includes:** Fully autonomous sentience, empowering precision decisions at scale.
- **Who's driving?** Humans fully optional.

Constellation sees Oracle Autonomous Database achieving an autonomous level between level 3 and 4.

Figure 10. Understand the Five Levels of Autonomous Enterprises

Source: Constellation Research

RELATED RESEARCH

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ENDNOTES

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Holger Mueller is vice president and principal analyst at Constellation Research, providing guidance for the fundamental enablers of the cloud, IaaS, PaaS, with forays up the tech stack into big data, analytics and SaaS. Holger provides strategy and counsel to key clients, including chief information officers (CIO), chief technology officers (CTO), chief product officers (CPO), investment analysts, venture capitalists, sell-side firms and technology buyers.

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