

# ORACLE AUTONOMOUS DATABASE

## Ease of Use

**ORACLE Autonomous Database has a set of distinctive features which together add up to a substantial advantage in ease of use and time-to-value.**

Oracle has delivered a new version of its database that is *autonomous* and runs in the *Oracle Cloud*, on Oracle Exadata with new workload optimizations, thus combining two major advances in technology with a remarkable result:

**Oracle Autonomous Database in the cloud is now substantially easier to use than past versions of Oracle Database. I believe Oracle Autonomous Database will come to be appreciated as one of the most easily used cloud databases on the market. ●**

**W**HEREAS Oracle Database has always featured rich function and a wide array of capabilities, it has rarely been championed as easily used. For years, Oracle Database has offered the widest range of physical design options. This was one of the reasons that Oracle Database could, in a single product, deliver a database that has the ability to handle complex and demanding applications across a wide range of requirements and platforms.

In the recently released Oracle Autonomous Database in the Cloud, many of those physical database design options have disappeared under the hood. Instead of the database administrator (DBA) or the user making the indexing and tuning choices, Oracle machine learning software makes them. This dramatically simplifies the jobs of configuration, physical design, tuning and software maintenance. The DBA is liberated from a lot of drudgery, and databases and workloads will typically run better under the control of the machine learning software than they would with any economically feasible level of human effort. Using the database is easier for the application programmer or data analyst. In addition, much delay in implementation is eliminated and time-to-value is greatly reduced.

I have personally experienced the ease of use provided in Oracle Autonomous Database in a hands-on experiment described in this [webcast](#) and this [report](#). In that experiment I found it remarkably simple to create an Autonomous Data Warehouse in Oracle Cloud; load my own data into the database; compose queries; and, run them. I personally confirmed the ability of Oracle to scale up and down, delivering proportionally shorter response time as processors were added. I did all this with no recent experience of using Oracle and no professional experience as a hands-on Oracle DBA.

**Oracle's Autonomous Database has distinctive features that set it apart from other database products, a dozen of which are summarized on the following page in *Table 1*. These features jointly contribute to the product's distinctive ease of use and otherwise unavailable business value.**

Statements about Oracle Autonomous Database (ADB) in this Note also apply to Oracle Autonomous Data Warehouse (ADW).



FEATURE	BENEFIT
<b>Manageability: Ease of database creation and change, with reduced effort and skill</b>	
<b>1. AUTO INDEXING</b>	<ul style="list-style-type: none"> <li>Optimizes indexes based on observed workload and automatically adds/deletes on a continuing basis, reducing DBA effort and improving database performance.</li> </ul>
<b>2. AUTO TUNING</b>	<ul style="list-style-type: none"> <li>Optimizes system resource and performance settings on a continuing basis, reducing DBA effort and improving database performance.</li> </ul>
<b>3. AUTO PROVISIONING</b>	<ul style="list-style-type: none"> <li>Database instances are created with a single command by the user and automatically provisioned by the system. Customer defines a logical schema and begins loading data: data marts can be created immediately with a minimum of skill and effort. Increases business agility and time-to-value; reduces skill requirements and effort.</li> </ul>
<b>4. AUTO SPACE MANAGEMENT</b>	<ul style="list-style-type: none"> <li>Automatically allocates space as needed to each component of the database (e.g., the indexes, the data). Avoids service interruptions that would otherwise occur when a table runs out of storage space, while economically managing storage. Reduces DBA effort and increases data availability.</li> </ul>
<b>Security: Much better protection from errors and unauthorized access to data, with reduced effort</b>	
<b>5. AUTO PATCHING</b>	<ul style="list-style-type: none"> <li>Automatically applies patches on a timely basis while the database continues to run, increasing security, reliability and efficiency.</li> </ul>
<b>6. AUTO UPGRADE</b>	<ul style="list-style-type: none"> <li>Automatically applies new releases and upgrades on a timely basis while the database continues to run, increasing security, reliability and efficiency. Makes new capabilities available sooner.</li> </ul>
<b>7. COMPLETE DATABASE SECURITY</b>	<ul style="list-style-type: none"> <li>Mature, largely automated security that reduces the risk of unauthorized access while requiring less effort to administer; <b>includes automatic encryption of all stored data</b>, increasing security.</li> </ul>
<b>8. DATABASE VAULT</b>	<ul style="list-style-type: none"> <li><b>Even your own DBAs can't access your data</b>, unless you grant access, increasing security.</li> </ul>
<b>Performance: Consistent performance and data availability, with reduced effort and skill</b>	
<b>9. IMMEDIATE SCALING, WITHOUT DOWNTIME</b>	<ul style="list-style-type: none"> <li>An authorized user can increase or decrease the resources (e.g., processors, memory) available to the database, with immediate effect, as production workloads are running; increases enhance performance and accelerates work; saves money when the system is less busy.</li> </ul>
<b>10. NO SCHEDULED DOWNTIME</b>	<ul style="list-style-type: none"> <li>Continuously operating business processes are supported without interruption.</li> </ul>
<b>11. DATABASE OPTIMIZED HARDWARE</b>	<ul style="list-style-type: none"> <li>Exadata Hardware delivers performance and efficiency that is otherwise not available for many database workloads, enhancing reliability, throughput and performance.</li> </ul>
<b>Application Development: Rapid application development, with reduced effort and skill</b>	
<b>12. APEX</b>	<ul style="list-style-type: none"> <li>Low code, rapid development of web applications that can access databases in the cloud and on prem.</li> </ul>

**Table 1: A Dozen Features that Make Oracle Autonomous Database Easy to Use**

## About WinterCorp

WinterCorp is an independent consulting firm expert in the architecture and **strategy of the modern analytic data ecosystem.**

Since our founding in 1992, we have architected and engineered solutions to some of the toughest and most demanding analytic data challenges, worldwide.

We help customers define their data-related business interests; develop their data strategies and architectures; **select their data platforms**; and, engineer their solutions to optimize business value.

Our customers, with our help, create and implement cloud, multi-cloud and hybrid cloud architectures; they create the data foundation needed for data science, artificial intelligence and machine learning.

Our customers get business results with analytics in which their return is often ten or more times their investment.

When needed, we create and conduct benchmarks, proofs-of-concept, pilot programs and system engineering studies that help our clients manage profound technical risks, control costs and reach business goals.

We're expert with structured data, unstructured data, and semi-structured data — with the products, tools and technologies of data management for data analytics in all its major forms.

With our in-depth knowledge and experience, we deliver unmatched insight into the issues that impede scalability and into the technologies and practices that enable business success.



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## Manageability Features



### 1. AUTO INDEXING

Indexing is critical to performance on any database of significant size or complexity. This is the case for most practical applications in the enterprise. But, it is difficult-to-impossible for people to make good decisions about which columns — or combinations of columns — to index. **The indexing decisions are so difficult that some database products abandon the idea of providing indexes and claim that customers are better off without them. Sadly, this is not good for the customer: many common database queries will take hundreds or thousands of times longer, even with excellent parallelism, when indexes are not supported.**

The indexing problem is especially vexing for DBAs because **indexing choices decay over time.** That is, as the data and workload change, the optimal index choices also change. If busy DBAs have the time and skill to figure out an initial set of indexes for a database, they rarely have the time or inclination to update them as often as would be necessary to sustain optimal performance.

So, if you have the wrong columns indexed, what happens? Queries run slower AND updates run slower. You get the worst of all worlds.

With ADB, Oracle has gone in a new direction: the system automatically chooses the indexes — and updates them as frequently as necessary — based on the queries that are actually running and the data actually stored. Via the use of built in machine learning, the index choices will just get better and better over time; if the workload shifts in a new direction, the indexing will shift to match; if the distribution of data values in columns frequently used for filtering shifts in a new direction, the index choices will shift to match.

Is the machine learning algorithm for choosing indexes perfect? I doubt it. However, Oracle tests each index change against the expected workload PRIOR to implementing the change. If the change improves performance, the change is implemented, but, if performance is harmed, no change is made.

Since the typical large database now contains thousands of columns, what DBA has enough time to spend on this? In practice, the built in automated indexing is going to produce a much better result than a human for most of the customers, most of the time. The automated indexing built into ADB will save customers admin time and reduce customer skill requirements. Over time, it will save system cost, since the database will run in production more efficiently than it would if humans were making the decisions.

### 2. AUTO TUNING

Indexing is just one of many tuning decisions for the enterprise class database platform. When a database operation isn't running fast enough, what do you need to tweak? Do you have memory? Is enough allocated to the buffer cache?

Oh, this query calls an analytic function – does that require additional resources? Many events occur every day that can require tuning.

And, like with indexes, the answers are dynamic and change under changing circumstances, as workloads wax, wane and evolve. Sometimes the performance of a query is influenced by the other queries or loads running in the system.

ADB automates tuning. The decisions are automatic. Less work for DBA's and operations staff — and the system will on balance typically perform as well as, or better than, with human tuning.

## Methodology



### Purpose and Methodology for this Report

This WinterCorp Research Note describes the Oracle Autonomous Database and its significance to customers for transaction processing, query and analytics. In developing this report, WinterCorp drew on its own independent research and experience, interviewed Oracle employees, attended Oracle events and analyzed Oracle documentation and literature. Oracle was provided an opportunity to comment on the paper with respect to facts, in its capacity as the sponsor of this research. WinterCorp has final editorial control over the content of this publication and is solely responsible for any opinions expressed.



### 3. AUTO PROVISIONING

Creating a new database is remarkably simple with ADB. With a few clicks, the user can create a table. He or she then names the fields and specifies the data type of each (string, integer, date, etc.). At that point, the user can begin loading data. All this can be done with a desktop tool.

This is so much faster and simpler than the typical enterprise process of acquiring a server, getting dba time, etc, that it translates into a new degree of business agility. It is a remarkably streamlined way to get important data related tasks done.

### 4. AUTOMATED SPACE MANAGEMENT

With ADB, space allocation and management is completely automatic. As the customer loads data, additional space is allocated automatically as it is needed. Contrast this with most other database products, in which customers must estimate the space that is needed and change the space allocations as the database grows. If the customer forgets to increase space when needed, this often leads to an outage and/or loss of data. If the customer allocates more space than is needed, resources and money will be wasted. At some customer sites in which a large number of tables are in use the database, DBAs are frequently interrupted when one data structure or another runs out of space. With ADB, such interruptions will not occur.

**On Manageability Features:** I have experienced this automation directly in my hands-on experiment with Oracle ADW. I created a database and began loading data into it in minutes. This required a single command to create the database instance; and then a few statements in Oracle SQL Developer — using its graphical interface — to create the logical definition of the table and its fields. I then uploaded a spreadsheet to add data to the table. There was, as advertised, no provisioning, no indexing, no tuning and no space management. This confers a remarkable freedom, efficiency and agility on the user. •

## Security Features



### 5. AUTO PATCHING

All major software products have to be patched from time to time and database products are no exception. Patches are issued by software vendors between releases to fix bugs, correct performance problems and close security loopholes. While usually not frequent, a new patch can come out literally at any moment of any day.

**Unfortunately, even critical patches are rarely applied promptly by customers.**

A recent study found that 80 percent of security breaches are on known vulnerabilities, indicating that most would be avoided if the software was up to date. In general, the more critical the business processes that depends on the database, the greater the tendency to delay patches. Why? Because administrators fear they will disrupt or break the database. In addition, with most database products, you cannot avoid disrupting production operation. That is, with most database products YOU MUST BRING DOWN THE DATABASE TO APPLY A PATCH. But the admin fears more than that: the admin fears that the system will not come back up properly, work will be lost, databases will be corrupted, and more. Besides that, the admin often delays applying the patch because it requires

scheduling downtime, which is unpopular with the business stakeholders. Often the admin lacks critical information about the value of applying the patch; the experience of other customers with the patch; etc. And, of course, if an error is made in the process, it is likely to have negative consequences for the admin staff. So, the seemingly safer choice is to delay.

But, delays in patching actually frequently expose the database owners to security breaches, operational failures, performance problems and worse. So, to quote an old song, a critical patch often leaves the admin “between the Devil and the deep blue sea.”

**Oracle cloud customers using ADB do not have this problem because Oracle automatically applies all patches for them. Further, the patches require no downtime** (more about this point, below).

The automatic patching built into Oracle cloud ensures that patches are applied without customer effort. There is no scheduled downtime. The customer is relieved of concern about inappropriate delays in applying patches. Negative operational impacts for the customer are minimized or eliminated.

## 6. AUTO UPGRADE

Auto upgrade covers all software maintenance beyond patching: new releases, upgrades, changes in software configuration associated with these. For Oracle cloud customers, software maintenance with ADB is also automatic and also requires no downtime. This eliminates another source of time and cost for the customer, as well as eliminating or minimizing negative impact on database operations.

## 7. COMPLETE DATABASE SECURITY

Oracle Database has provided a robust set of database security capabilities for years and these are all present in ADB. So, Oracle Database has long provided column, row (sometimes referred to as “label” security), schema, view and user security.

In addition, Oracle’s automatic patching ensures that security related patches are applied promptly.

Some other key features of Oracle data security, collectively branded **data safe**, are transparent data encryption, encryption key management, privileged user and multifactor access control, data classification and discovery, database activity monitoring and blocking, consolidated auditing and reporting, and data masking.

Most customers are going to find that the data security built into ADB exceeds what they are able to provide in their own facilities.

## 8. DATABASE VAULT

In addition, via Oracle’s Database Vault, Oracle supports role separation: security can be set up so that, for example, the DBA can administer the database without having access to the data content. This closes a critical security loophole present in many other products. As a result of this role separation, Oracle personnel who are involved in supporting the Oracle Cloud do not have access to customers data, even when that data stored in the cloud that they are maintaining for the customer.

Separation of the privileges of the database owner role from the privileges of the database administrator role is actually a requirement of GDPR and other privacy regulations. Thus, Oracle database customers have an opportunity to implement compliance at a level not available with most other database products.

**On Security Features:** In my independent consulting practice I have on occasion recommended Oracle over other major database platforms primarily because of its security features. This was a situation where the customer had stringent security requirements that were met in their entirety only by Oracle. •

## Performance Features



This section covers overall system performance, including availability as well response time and throughput.

## 9. IMMEDIATE SCALING – UP AND DOWN — WITHOUT DOWNTIME

With ADB, the customer can change the resources allocated to an Oracle database, while the production workload is running. Is a workload running too slowly on 8 processors? A simple command increases the number of processors to 16, and the command takes effect immediately. Is there a lull in the workload? At any time, you can reduce the number of processors — say, from 16 to 4 — with a simple command. And, again, there is no interruption in operation of the database. Oracle is able to provide this immediate scaling as a consequence of its distinctive cluster architecture, branded RAC (Real Application Clusters). RAC has matured in widespread production use. It is thus a fully proven architecture, with distinctive capabilities for resource scaling and reliable operation.

With other widely used cloud databases, a change in number of processors would take effect only after

production is stopped; the system is taken down; the system is brought back up with a different configuration; and, production is resumed. This is a remarkably important difference if you have a critical business process depending on the database.

**On Immediate Scaling:** I experienced the immediate scaling up and down during my hands-on experiment with Oracle ADW. I also measured the effect of the scaling and saw proportional decreases in response time each time I doubled the number of processors. I doubled the number of processors 5 times between 1 and 32 and plotted the resulting curve (a straight line) in this [research note](#). •

### 10. NO SCHEDULED DOWNTIME

Most database products are not actually designed for continuous operation: the customer must typically plan for downtime on a daily or weekly basis. Sometimes when “uptime” figures are quoted, scheduled downtime is ludicrously excluded from the calculation, giving the customer the impression that no downtime is required when in fact it must be scheduled on a regular basis.

By contrast, Oracle database has for years been used in critical operations that actually must stay up, 24 hours a day, 365 days a year. With Oracle Real Application Clusters (RAC), introduced more than ten years ago, the database runs on multiple instances of the Oracle product. If one instance must be shut down, either for software maintenance or for another purpose, operation can continue on the other instances without interruption. Thus, Oracle customers can typically keep at least one instance of the database running at all times, even as software maintenance is applied or as other changes are made.

This means that a business process running on Oracle ADB can literally provide service around the clock. With most cloud database products this is impossible. Continuously operating business services are more important and more prevalent than ever in today’s increasingly connected, increasingly global enterprises. Oracle ADB enables such services to a significantly greater extent than other widely used cloud database products.

### 11. DATABASE OPTIMIZED HARDWARE

Most database products and database cloud services run on general purpose hardware. ADB is different. In

Oracle cloud and in Oracle Cloud at Customer, ADB runs by default on Exadata Engineered Systems.<sup>1</sup>

Exadata was developed by Oracle specifically to provide a hardware/software system engineered to optimize the performance of Oracle database. Exadata systems are designed by Oracle to provide the best practical mix of processing, memory, disk and network resources for database performance. Over time, the hardware has been optimized for Oracle database software and the software has been better tuned to the hardware.

A distinctive feature of the Exadata architecture is the separation of the processing tier and a highly parallel storage tier. Scans, filtering operations, aggregations and certain other operations in query processing are pushed down to the storage tier, where there is abundant I/O bandwidth and these operations are processed with a high degree of parallelism. These are some of the most time consuming operations on large tables and Oracle attributes a significant element of its performance advantage to this feature.

## Application Development

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### 12. FREE LOW CODE DEVELOPMENT TOOL

Available at no additional charge, Oracle Application Express (Oracle APEX), is a low-code, web-based software development environment that runs on Oracle.

APEX can be used to build complex web applications which can be run in most modern web browsers. It is fully supported and comes standard (at no additional cost) with all Oracle Database editions, and is therefore provided with ADB. With APEX, users with little programming experience can develop and deploy browser-based applications that access Oracle data in ADB. The user can create such applications writing little or no code.

## Other Noteworthy Features

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A few other features of Oracle Autonomous Database are worth mentioning here, because of their distinctive nature.

### ORACLE CLOUD-AT-CUSTOMER

Oracle Autonomous Database can be deployed either in the Oracle Cloud or in Oracle Cloud-at-Customer,

1. The customer can opt to run Oracle Database on commodity hardware, rather than on Exadata.

providing an option to locate autonomous databases on the customer's premises, behind the customer's firewall, but yet with all the other advantages of Oracle Cloud. This can address issues in compliance or data sovereignty, while still providing the benefits of cloud and autonomous system operation.

### SUPPORT FOR MICROSOFT AZURE CLOUD

As a result of a recently announced partnership, Oracle and Microsoft are supporting rapid communication between Oracle Cloud and Microsoft Azure. This is achieved in part via software enhancement and in part by co-locating data centers and providing a high-speed data link between them. For example, a customer can use an application or Microsoft Tool such as Microsoft Analytics running in Azure that communicates with a database in Oracle Cloud. Communication between the two clouds is designed to be seamless and highly efficient, with no delay noticeable by the customer.

### FREE TIER

Oracle has announced Oracle Cloud Free Tier which allows customers to use a certain set of services in the Oracle Cloud for free, for an unlimited time. Key services offered at present in the Free Tier include:

- Two Oracle Autonomous Databases with powerful tools like Oracle Application Express (APEX) and Oracle SQL Developer
- Two Oracle Cloud Infrastructure Compute VMs; Block, Object, and Archive Storage; Load Balancer and data egress; Monitoring and Notifications

In regard to the subject of this report, the availability of Oracle Autonomous Database, APEX and Oracle SQL Developer are of special interest. This amounts to a self-service capability for data analysts and business analysts to create their own databases and data marts in the cloud; run queries; and, build web-based applications — all without coding and without charge. Such free databases can be up to 5 TB in size.

## Conclusion



**Over the past two years, Oracle has transformed its database offering to make it much easier for users to build databases and implement database solutions in the cloud with Oracle Autonomous Database. Oracle Database retains its flexibility, power and ability to address a wide range of database problems and requirements. But now, the challenges of setting up Oracle databases, designing them, indexing them and tuning them have disappeared under the hood.**

In the early days of the automobile, people hired drivers who were also capable of repair and engine tuning at the side of the road. This was because one could rarely complete a substantial automobile trip without need of a mechanic. Few people would have imagined the cars of today, when many people own a car for years while rarely, if ever, opening the hood themselves.

Now Oracle has brought about a similar transformation in the cloud database experience. The database is much easier to drive and one does not ordinarily need to open the hood. You don't need a DBA to accompany you on the trip. For many day-to-needs of the business analyst, no physical design or tuning is required. From the DBA's perspective, this means primarily freedom from drudgery. The DBA still has an important role to play, but this role is focused more on logical design and business value and far less on opening the hood and fiddling with the engine.

**The bottom line is that Oracle Autonomous Database in the cloud now delivers distinctive ease of use and rapid time-to-value for a wide range of database requirements. ●**