VIRTUAL INSTRUMENTS

FAQ

WorkloadWisdom FAQ

General

Q: What is storage performance testing? How is it different than storage performance monitoring?

A: Storage performance monitoring tools, which can be software or hardware based, are used to monitor the performance and availability of production storage systems. They are usually deployed in a persistent fashion and alert storage admins to failures or other performance issues after a problem has occurred. They are reactive solutions that can help storage managers discover performance bottlenecks. The best monitoring tools sometimes discover problems before users do.

Storage performance validation and testing products, such as WorkloadWisdom from Virtual Instruments, are used in a pre-production environment, by generating a load on the storage network and measuring performance, to optimize the performance, reliability, and cost-effectiveness of storage systems. Storage performance validation and testing replaces the guesswork in purchasing, deploying and configuring storage systems. The goal of storage performance validation products is to proactively avoid performance problems as opposed to monitoring tools, which react to problems

Q: What is WorkloadWisdom?

A: WorkloadWisdom is an easy-to-use software platform with a web-based graphical user interface (GUI) that is used to (1) Acquire and characterize production workload performance data (2) create workload models, (3) configure and administer tests, and (4) generate performance analytics. It runs on a Virtual Machine and can be installed in minutes. For more information, refer to: https://www.virtualinstruments.com/workloadwisdom/

Q: What does WorkloadWisdom do?

A: Two things: First, WorkloadWisdom provides a combined software and hardware solution for storage workload acquisition, workload modeling and performance analytics. The product suite empowers IT organizations to control storage costs and mitigate risk. With the ability to accurately emulate real-world application workload behavior, WorkloadWisdom enables storage engineers and architects to make intelligent deployment decisions regarding networked storage infrastructure.

Second, for storage operations professionals, we provide a hardware-based solution (VirtualWisdom Performance Probe) that captures real-time production data used to speed troubleshooting by generating a highly accurate workload for analysis and replay in a test lab or vendor support organization. This capture / analyze/ replay capability dramatically accelerates storage performance problem identification and resolution.

Q: How is WorkloadWisdom different from other Storage Performance solutions?

A: WorkloadWisdom is an integrated storage performance analytics solution that spans the performance needs of both the engineering teams that own their storage testing labs to the storage operations teams that run the production storage environment. It's a vendor-independent solution that enables performance analysis across any file (NAS), block (SAN) or object based storage system and vendor. The combination of our components offers a comprehensive and detailed workload characterization, both via a real-time and historical data sources. Our unique ability to analyze I/O patterns that recognize workload components and their impact on storage performance is essential for understanding the performance drivers of large scale IT infrastructure. Overall, we simplify the storage performance planning process and accelerate performance troubleshooting.

Q: Did WorkloadWisdom used to be called SwiftTest or Load DynamiX?

A: Yes. We changed our name in late 2013 to better describe what we do and to avoid confusion with the OpenStack Swift architecture. And in 2016, we merged with Virtual Instruments. More recently, we changed the name of the product to WorkloadWisdom.

Q: Who typically uses WorkloadWisdom?

A: The users of WorkloadWisdom are typically either storage architects and storage engineers at Global 2000 IT organizations or QA, performance, development and support engineers at storage and network technology vendors.

Q: Can you list some companies which use your products?

A: WorkloadWisdom is used by virtually all the storage technology vendors including EMC, NetApp, HP, IBM, Dell, HDS, Pure, and Oracle as well as nearly all privately-held storage solution companies. We are also used in the pre-production labs of enterprise IT organizations within GE, Cisco, Cox Communications, ExxonMobil, LinkedIn, and ADP, and of Service Providers like Go Daddy, T-Mobile, IBM/Softlayer and FireHost. We're found in all industries including telecommunications, healthcare, manufacturing, finance, government, and services. For further information on reference customers, contact your Virtual Instruments sales representative.

Q: Why do companies use WorkloadWisdom?

A: Initially, WorkloadWisdom was created to empower storage engineers, architects, and managers with the critical insight they need to make more intelligent decisions about storage infrastructure – to optimize the performance and cost of storage systems. Our storage performance analytics solution combines the industry's deepest and most accurate simulation of networked storage workloads with the ability to generate the most demanding workloads available, capable of stressing the storage infrastructure of today's largest physical, virtual and cloud environments.

Widespread adoption of virtualization, explosive data growth, changing application workloads, and the introduction of new flash-based and software defined storage technologies are reshaping the data center. The only constant in the data center is change. The underlying networked storage infrastructure must also evolve to keep the company running efficiently. Without proactively managing this changing environment, application response times will be unpredictable, outages will occur, and storage costs will spiral out of control. As GoDaddy reports, the savings by using WorkloadWisdom can be substantial, upwards of 50 – 60% of your storage budget.

WorkloadWisdom empowers you to address these key challenges so that you can proactively and confidently introduce change into your data centers, while ensuring the fastest possible remediation of performance problems. For specific use cases and solutions, refer to:
http://virtualinstruments.com/solutions/storageperformance/

Q: How and where are Virtual Instruments products sold?

A: Our products are sold and supported around the world by combination of direct and indirect sales channels. For the name of a representative or reseller nearest you, please email info@virtualinstruments.com

Q: How is WorkloadWisdom licensed?

A: Our product bundles are primarily licensed by the number of ports on the Workload Generation Appliance, and the protocols supported. The appliances support 1GbE, 10GbE, and 4/8/16Gb FC, from 2 – 8 ports per appliance. Protocols supported include: SMB, NFS, CIFS, iSCSI, Fibre Channel, FCoE, HTTP, OpenStack Swift and Cinder, SNIA CDMI, and Amazon S3. You may move the appliance to any environment, use any amount of storage capacity, and model any number of servers and applications (workloads), and there are no additional license fees. There are also no user-based license fees.

Q: Do you offer a professional services option?

A: Yes. For companies who don't own a WorkloadWisdom solution, yet want to evaluate networked storage systems from different vendors, we and a number of our authorized partners offer performance testing and validation services. The professional services offering, a division of Virtual Instruments, is ideal for validating a storage purchase or understanding the capacities and limits of an existing storage system; and especially useful for companies who don't possess storage testing expertise or pre-production test labs. WorkloadWisdom develops the test plan, executes the tests, and delivers a report with detailed analysis and recommendations, usually within a few weeks. We can run your vendor Proof of Concept (POC) and cut your evaluation time down from months to weeks.

Q: How can I see a demo of WorkloadWisdom?

A: There are three ways to see how our products work. There are a number of short video demos found at: http://www.virtualinstruments.com/resources/, or go to http://www.virtualinstruments.com/request-demo/ and complete the demo request form, or email info@loaddynamix.com with your request for a live demo. A representative will get back to you typically within hours. We do demos over WebEx or in-person, depending on your requirements and location.

Q: How do customers cost-justify WorkloadWisdom?

A: The primary economic benefits of WorkloadWisdom come from five areas: (1) operations efficiency, (2) storage cost optimization, (3) risk mitigation, which allows you to innovate faster, (4) greater adherence to performance and availability SLAs, and (5) greater application availability. Most customers justify the purchase of WorkloadWisdom by the savings in reduced storage expenditures and the financial benefit of fewer outages, and increasingly faster remediation of storage related problems, where the payback can be measured in weeks or months, and the savings are measured in millions of dollars. Others justify the WorkloadWisdom purchase because we eliminate the need to purchase and provision a large number of servers and VMs in order to test storage arrays at scale, under a full workload. For a complete explanation and more information, refer to our ROI Whitepaper. Additionally, our case studies provide customer quotes on the benefits of their WorkloadWisdom deployments.

Q: Are there industry analysts who follow Virtual Instruments?

A: Yes, Virtual Instruments is well-known by nearly every storage industry analyst. Analysts at Gartner, 451 Research, IDC, Storage Switzerland, Demartek, Evaluator Group, Taneja Group, Storage Strategies Now, Neuralytix and others know our products and the unique value that our products brings our customers. You can find some of the more relevant industry analyst reports here: http://www.loaddynamix.com/resources/

Q: What is your relationship with storage and technology vendors?

A: We work very closely with nearly every storage vendor, including the majority of the newer flash (AFA), hybrid (HFA), and software defined storage (SDS) vendors. These vendors experience tremendous value from using WorkloadWisdom for QA, development, performance engineering, POC acceleration and troubleshooting. They use us to test “real-world” applications at extreme scale to find bugs and scalability issues in their products before their customers do. When the company was founded, our primary customers were storage vendors. For more information on how the vendors use us, see: http://www.loaddynamix.com/tech-vendors/

Increasingly, the storage vendors bring WorkloadWisdom into their customers and prospects to prove the performance capabilities and value of their products relative to legacy and competitive products.

Q: Is WorkloadWisdom a software or a hardware solution?

A: It is both. WorkloadWisdom software is an easy-to-use software platform with a web-based graphical user interface (GUI) that is used to (1) characterize and create workload models, (2) configure and administer tests, and (3) analyze results. It runs on a Virtual Machine and can be installed in minutes. Enterprise works in tandem with our 2RU Workload Generation Appliances. The appliances are used to generate traffic based on workload models and access patterns that have been configured by WorkloadWisdom software or our more sophisticated Test Development Environment (TDE). The appliances are purpose-built devices with a software and hardware architecture that has been specifically engineered to cost-effectively generate massive traffic loads that can test the performance and scalability limits of any storage system, including the highest-end flash or hybrid storage systems. A lower performance software-only version of the load generator, referred to as the Virtual Series is also available. For a high level description of the software and hardware, please refer to: http://virtualinstruments/.com/products

Products

Q: What is the WorkloadWisdom Appliance?

A: WorkloadWisdom appliances are purpose-built devices with a software and hardware architecture that has been specifically engineered to cost-effectively generate massive traffic loads that can test the performance and scalability limits of any storage subsystem, including the highest-end flash or hybrid storage systems. More detailed information can be found in our Solution datasheet IT organizations or in our Appliance datasheet for Technology Vendors.

Q: Is there a software-only or virtual version of the WorkloadWisdom Appliance?

A: Yes, The WorkloadWisdom Virtual Series load generation appliance complements our 2RU physical appliances by helping to significantly improve time-to-market and/or product quality by enabling all engineers and developers to conduct basic performance testing with their own dedicated virtual appliance. WorkloadWisdom-V uses the same software GUI, same workflow, same statistics, same Projects and same API used by the WorkloadWisdom physical appliances. Engineering, Support, Technical Marketing, and QA can share test Projects, test results and scripts. It can be installed on any modern x86 server running VMware ESXi 5.1 or above. As the Virtual Series does not run on our purpose-built appliances, it offers lower performance than the hardware-based load generation appliances.

Q: Does WorkloadWisdom offer a High Availability (HA) version of the appliances?

A: The Workload Generation Appliances are designed to run at all times, 24 x 7 x 356 in a pre-production environment. Since these are lab solutions, in order to maintain a very efficient price point, there are no special production HA features such as dual-network connections or redundant power supplies. Nevertheless, if one port on an appliance fails, any available additional port can be used.

Q: What are the different load generation appliance configurations appropriate for IT organizations?

A: They are mostly differentiated by port count (2, 4, or 8 ports) and physical connection (FC or Ethernet). The best place to find this answer is the Datasheet for IT organizations.

Q: What is the WorkloadWisdom Test & Development Environment (TDE)?

A: Specifically built for power-users at both Technology Vendors and Enterprise IT customers, the WorkloadWisdom TDE is a highly functional custom user interface for workload modeling, test development, and test administration. The application includes sample tests and wizards and built-in statistics and graphs. Through the TDE, client and servers can be emulated at scale for HTTP, SMB, NFS, iSCSI FC, CDMI, OpenStack Swift and Cinder, and Amazon S3 protocols. TDE tests can now be imported directly into WorkloadWisdom Enterprise for test administration, which will be an easier to use environment for less experienced users. For more details, please refer to: http://www.virtualinstruments.com/tech-vendors-tde/

Q: Which storage arrays does WorkloadWisdom work with?

A: The WorkloadWisdom platform works with any block, file, or object storage array, or switch, or vendor, which supports these protocols: iSCSI, NFS v2/v3/v4, SMB v1/v2/v3, HTTP, HTTPS, CDMI, Fibre Channel, VTL, NPIV, FCoE, Amazon S3, and OpenStack Swift and Cinder. This represents over 99.5% of networked storage devices. Storage vendors include but are not limited to EMC, HP, IBM, NetApp, Cisco, Oracle, HDS, Nexenta, Pure Storage, Nimbus Data, Solidfire, Panasas, Tegile, Cleversafe, Overland Storage, Dell, XIO, Fujitsu, Nimble Storage, Violin, Kaminario, Coho Data, Pi-Coral, HGST, and Tintri.

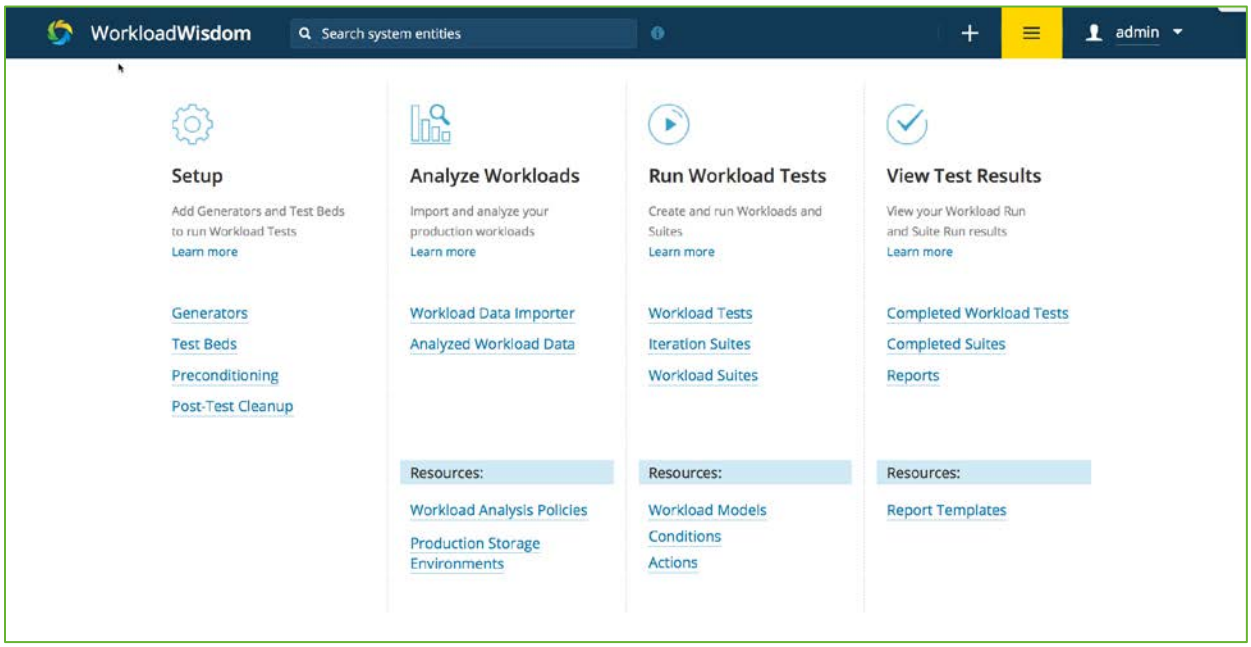
Product Functionality and Usability

Q: What does your interface look like, CLI or GUI?

A: Both. Tailored for novice to advanced users, WorkloadWisdom offers two different levels of user interfaces that provide the ultimate flexibility for test configuration, results interpretation, and collaboration.

First, WorkloadWisdom offers an intuitive web GUI built for all user levels that is easy to understand and use. It enables comprehensive workload modeling and dramatically simplifies the test administration and execution process. WorkloadWisdom controls multiple WorkloadWisdom appliances that can be leveraged

by defined user groups across multiple development, support, technical marketing, and QA organizations across the globe.



WorkloadWisdom dashboard GUI

The WorkloadWisdom Test Development Environment (TDE) uses a graphical interface designed for the advanced user that enables complex test configuration development including sample tests and wizards, content libraries, and extensive built-in reports that are updated dynamically during testing. Of course, a CLI is available as well.

Q: How easy or complex are WorkloadWisdom products to use?

A: WorkloadWisdom is a simple web-based GUI that any storage engineer or IT architect can use. The other GUI, called our TDE, offers more depth and is designed for storage engineers who are very knowledgeable in networked storage protocols. In either case, we generally allocate 2 – 3 days of training to completely familiarize customers with these products.

Q: How important is workload modeling?

A: Standard benchmarks can offer some guidance in comparing or profiling the performance of shared storage systems. But IT infrastructures and storage networks are extremely complex constructs, and react very differently to the varying I/O profiles of different applications, or even the same application. For instance, there is no single I/O profile for Oracle database-based applications. One Oracle LUN may be heavily sequential write intensive and other LUNS may be heavily random read intensive, and that's only two out of many parameters that define an I/O profile. Accurate modeling allows you to make intelligent decisions that directly affect risk, budget, and time to market. Everything else is just guessing. Using these tools, our customers report that they achieve a highly accurate workload model that can be used to cut storage costs by up to 60%. Refer to Figure 1 of the Go Daddy case study as an example of how accurate this can be.

Q. How do I create a workload model that emulates my application?

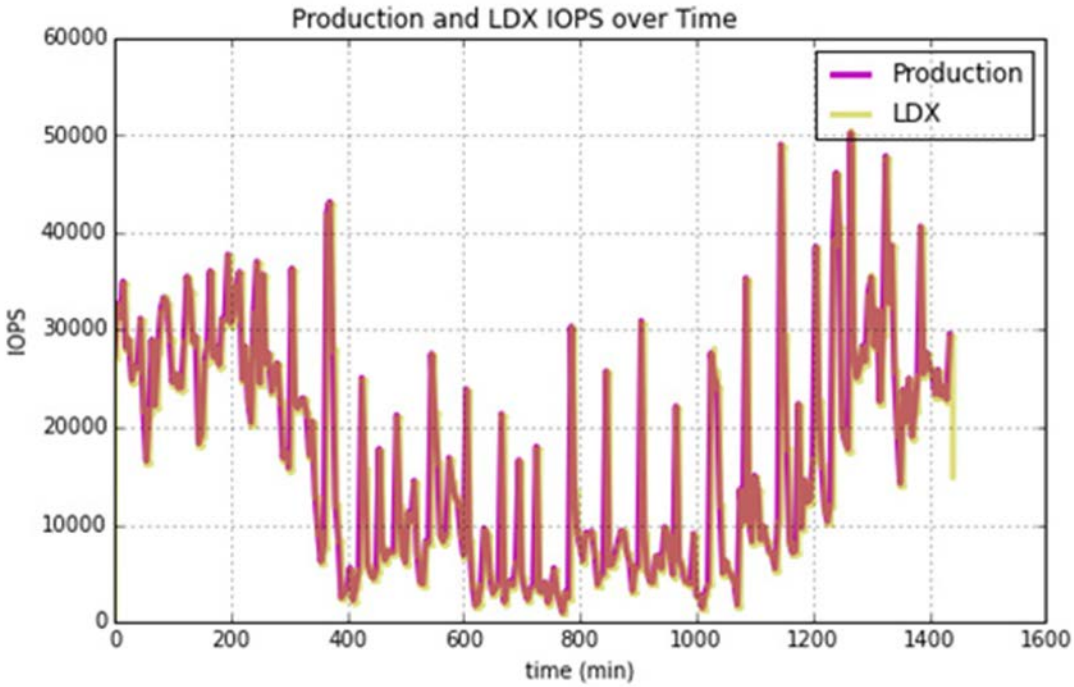
A: WorkloadWisdom offers a completely unique solution to this long-time vexing challenge. A workload model can be created from your production environment via our Workload Data Importer feature of WorkloadWisdom, or via VirtualWisdom Performance Probe. We've taken what was a time consuming, error prone process, and reduced it to a program. All array management software, and many SRM tools, track historical data like read/write ratios, block/file distribution, random/sequential ratios and more, and can output that data in text or CSV files. Traditionally, it took a lot of work to parse those files into

something that's understandable or which a workload emulator like WorkloadWisdom could use. Now, a Workload Data Importer and Workload Analyzer program does all that hard work in minutes, and you wind up with a great view of your workload profile. The Importer programmatically imports any production array I/O data from the storage array logs, entering the I/O profile into the Workload Analyzer. When you have I/O profiles of hundreds of LUNs, it isn't humanly digestible or meaningful. The Workload Analyzer takes that data and makes it useful by taking those profiles of hundreds of LUNs and boils them down to a handful of workload behaviors that are understandable to storage professionals, and yet still representative of the data. This is combined into a composite workload model which maintains the diversity of the different behaviors while enabling them to be run as a single workload.

Additionally, for green field environments, WorkloadWisdom offers representative starting points for all protocols and many applications, which you can easily edit via the GUI.

Q: How realistic are your workload models?

A: We are proud to state that our models set the standard for realism. One of our earliest customers, GoDaddy, using an earlier version of WorkloadWisdom, found a 98% correlation between the model and production workloads. In mid-2015, another customer produced this graph, showing an even higher degree of correlation.



Q: What protocols do you support?

A: WorkloadWisdom supports all file, block and object-based networked storage protocols. Specifically: iSCSI, NFS v2/v3/v4, SMB v1/v2/v3, HTTP, HTTPS, CDMI, Fibre Channel, VTL, NPIV, FCoE, OpenStack Swift, OpenStack Cinder, and Amazon S3.

Q: Do you work in a virtualized environment?

A: Yes, both server and storage virtualized environments. The WorkloadWisdom platform can generate an I/O profile representative of a complex virtual server environment and we can present that profile to any storage virtualizer that supports the iSCSI, NFS, SMB, HTTP, CDMI, Fibre Channel, FCoE, OpenStack Swift and Cinder, and Amazon S3 protocols. The vast majority of our customers use us in highly virtualized environments.

Q: How do I model a virtualized app, when several apps may be sharing a LUN?

A: It's becoming quite common for VMware ESXi customers to deploy with NPIV (N Port ID Virtualization). This offers the ability for each virtual server to see its own storage, even when sharing LUNs with other server / applications. WorkloadWisdom uses NPIV to split out the I/O profiles of each application workload and create realistic models for each.

Q. Does WorkloadWisdom work with converged products?

A: Very often, it does. In all cases we validate storage performance, not complete system performance. Here are the use case details …

1. Converged systems with ports exposed: same functionality and use cases with any system using std protocols. Example: NetApp's (a WorkloadWisdom Customer) FlexPod.

2. Converged systems with physical ports that are not externally accessible: usable for std use cases via WorkloadWisdom-V which can drive IP traffic over virtual Ethernet ports. Example: Nutanix, who is a WorkloadWisdom customer.

3. Converged systems which do not generate traffic over virtual Ethernet ports are not supported today but are being actively researched by WorkloadWisdom R&D. Yes; first, for converged systems with switch or storage ports that are exposed. These systems are integrated and may even be pre-racked, but the physical network connections (FC, Ethernet) are designed to be exposed such as typically found in VCE vBlock and NetApp FlexPod. The WorkloadWisdom appliances can be directly connected to the switch or storage ports for fully featured storage performance testing and validation. Second, many hyper-converged systems use standard protocols like NFS, and for those we rely on our VM version which does not require access to a physical port.

Q: How do you handle Flash array testing?

A: WorkloadWisdom customized its performance validation solution for all-flash-arrays (AFAs) in collaboration with the industry's flash leaders and published methodologies from SNIA and industry analysts IDC and Evaluator Group. To optimize its performance validation solution for AFAs, WorkloadWisdom paid specific attention to the following three areas:

1. Specific pre-conditioning of the array to create a realistic AFA state prior for applying load

2. Stressing of specific AFA behaviors that affect performance such as deduplication and compression.

3. Stressing with realistic emulations of typical AFA supported workloads

For more detail, please go to: http://virtualinstruments.com/solutions

Q: How is WorkloadWisdom different than freeware / shareware alternatives?

A: Generally, the alternative to WorkloadWisdom is a lab full of servers, with dozens of Virtual Machines, running freeware tools like Iometer, with a heavy dose of custom scripting and reporting. These may be viable for "ballpark" estimates on performance, but they don't represent how storage systems will perform on your installed production applications. We're different in 5 ways:

- Superior realism. We support things like meta-data and file system calls to better mimic real-world applications. And our high-performance load generation appliance scales to emulate the largest production loads on the largest storage arrays. And if you're thinking about or using flash storage with dedupe and compression, we have an extremely configurable patent pending method of testing data streams that contain compressible and dedupable content, which is critical for Flash testing. Higher realism results in better and more accurate decision-making.

- Consistency of results. Because we're based on an appliance, you can do apples to apples comparisons over time and in any geographic location. A test run this week in London will give you the same exact results if you run the test run in 6 months in Atlanta for any amount of load generated. When using freeware tools on commodity hardware, it is nearly impossible to recreate tests over different geographies and time periods as so many of the underlying components and software revisions are changing.

- It's a lab in a box. Instead of racking and stacking tens of servers and hundreds of VMs, you simply add a single, purpose built device. No more spending 80% of your time setting up your lab and doing custom scripting. With WorkloadWisdom, you spend 80% of your time on testing, not setup and admin.

We've had customers tell us that their efficiency increases so much that it's like cloning their Storage Architects and Storage Engineers.

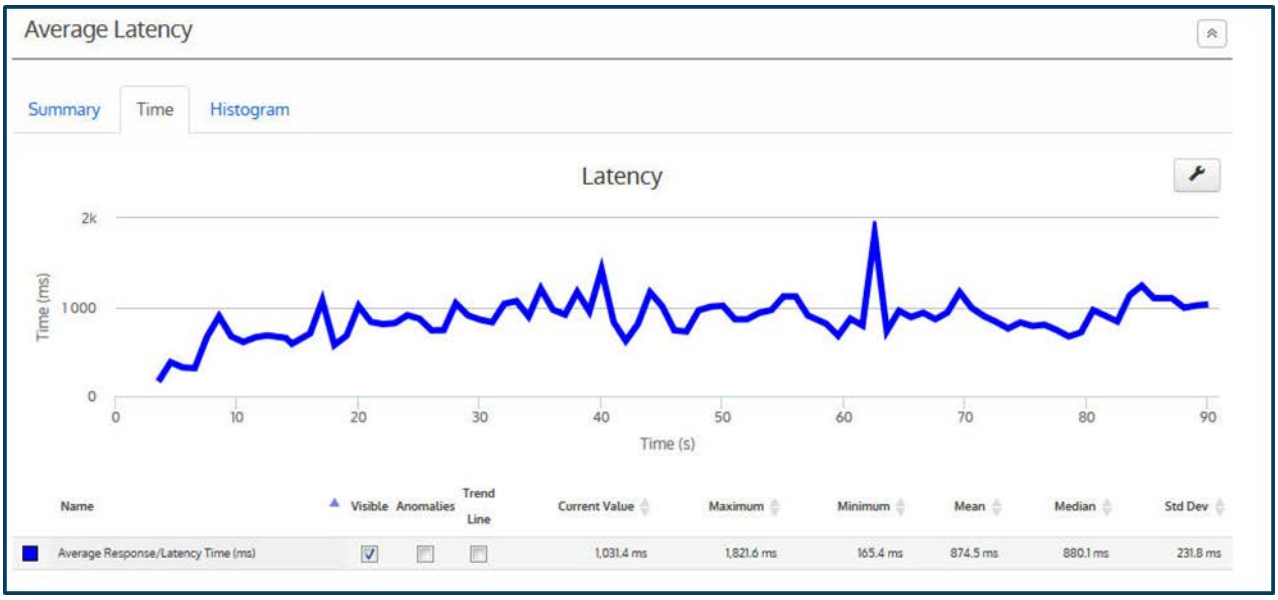
- Ease of use & deployment. The WorkloadWisdom appliance is a single solution for File, Block and Object storage. With a single validation solution, you develop, run, automate tests and analyze results. Simple reporting removes the need to compile and analyze results from dozens of clients and tools. External analyst firms, such as Demartek, have done side by side comparisons and found that using WorkloadWisdom is nearly 10X more efficient than freeware tools such as Vdbench and Iometer. This means for tests can be run and better decisions can be made.

- Make Decisions on Data, Not Guesswork. Finally, and most importantly, because we're more accurate, consistent, easier and cheaper to run, you'll run tests you could never do before and reap the financial benefits of making decisions based on data, not guesswork.

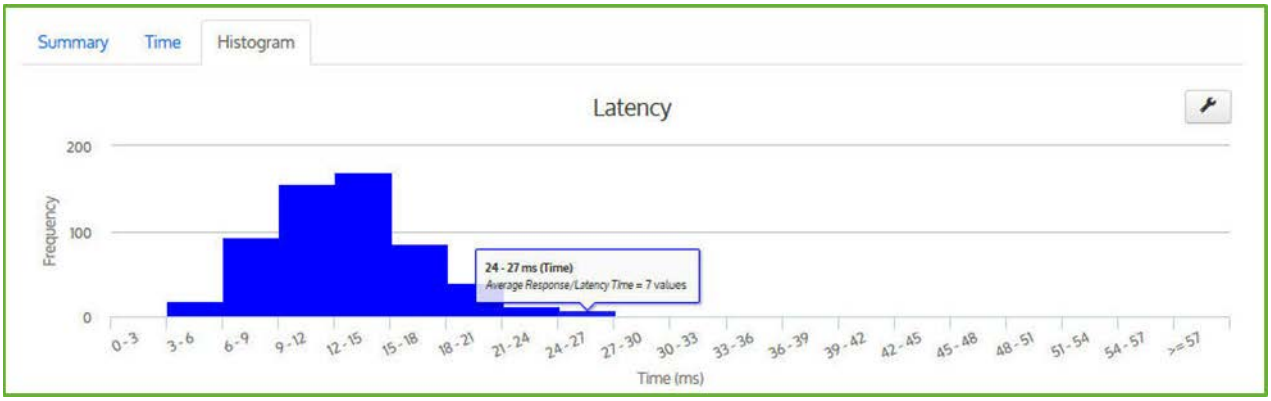
For an industry analyst report on this subject, please refer to:
http://www.loaddynamix.com/resources/analyst-reports/storage-switzerland-report-iometer-and-vdbench-alternatives/

Q: Can you show me some sample output of a test?

A: The best way to answer this question is to speak directly with a WorkloadWisdom representative who can show you examples of reports that represent the kinds of tests you might run. Analysis output is extremely configurable and can be presented or customized in many ways, though a full suite of "canned" report formats are included. In WorkloadWisdom, you may choose to view test results as a summary table, a time-based line graph, or as a histogram. Two simple examples are shown below:



Example above of time-based graph, response time delivered by the storage array / infrastructure to I/O requests



Example above of a response time histogram delivered by the storage array / infrastructure to I/O requests

Q: Does WorkloadWisdom offer a standard set of benchmarks?

A: WorkloadWisdom is not a benchmarking platform in the traditional sense of the term, though you can easily create the commonly used benchmarks in WorkloadWisdom. Benchmarks provide a method of comparing performance of various systems. Today, their value has become somewhat narrow for a multitude of reasons, but they offer some broad guidance of relative system performance for a particular configuration. What if your read/write or random/sequential ratios, or multi-pathing, or compression ratios are different than the ones used in the benchmark? A big value of WorkloadWisdom is that rather than providing a single benchmark, WorkloadWisdom is designed to do multi-dimensional benchmarking to fully understand an array's capabilities and limitations across a nearly limitless set of variables. With a single command. Another big value of WorkloadWisdom solutions is that our customers can design tests that accurately test and validate storage performance in their environment with their application workloads. Industry benchmarks offer some guidance, but they certainly cannot tell you, for instance, at what point your storage array performance will fall over. When making multi-million dollar decisions, our customers look for better guidance. As we have repeatedly seen when working with our customers, small changes in workload behavior can have a very large impact on response time and throughput.

Q: How does synthetic model load generation differ from using actual production clients?

A: There are two parts to this answer. First, both methodologies are meant to help predict how workloads will behave in production environments, by testing. In a perfect world with limitless resources, we would do this testing using the same equipment and applications as we expect to use in production. But in the real world, it's simply not feasible, primarily due to the scale found in production. We know that many organizations do some level of testing on a small scale, but results at full scale are merely extrapolations. Although that's better than pure guesswork, real world results don't change linearly. To use an analogy, it's like saying that my minivan runs fine for many hours at 20, 40, 60, and 80 miles per hour, so, by extrapolation if I run it at 160 mph for many hours, it will work just as fine. We know that's unlikely to be the case with a minivan. So in practice, we use synthetic workloads, and load generators that together can accurately simulate the I/O profile and scale as you would find in the production datacenter. Using the best practices in the industry, our customers routinely achieve test results that exceed 90% accuracy and, in many cases, show 98% accuracy. The second part of the answer is, because with most synthetic model load generators, your model probably does not represent a realistic workload. With all the burstiness, hotspot drift, compression, and dedupe characteristics found in the real world, you may be forced to try to create a pre-production lab environment using production facilities. But because we can handle scale, burstiness, hotspot drift, compression and dedupe, you can depend on WorkloadWisdom for a realistic, synthetic workload model.

VIRTUAL INSTRUMENTS

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