ESG WHITE PAPER

The Rise of Intelligent Infrastructure

A Look at a Growing Trend in IT and how DDN and Tintri Are Transforming IT Infrastructure and Adding Value with Key Innovations

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Introduction

Success in business has become increasingly defined by how efficiently and effectively an organization leverages its technology and data. Digital business initiatives unlock previously untapped markets, improve customer engagement, and optimize operations.

Events such as the global COVID-19 pandemic reinforced and accelerated this reality. Sixty percent of IT decision makers told ESG that the pandemic will make their organizations even more dependent upon technology moving forward.[1]

This has tremendous implications for IT. Simply keeping pace with digital business initiatives is no longer good enough. If a business wishes to succeed, IT must accelerate its operations. Reactionary behavior is not a strategy for success. However, as digital initiatives proliferate, the dilemma is that IT complexity also rises—thanks to explosive growth in data and data center resources, increased security concerns, and the need to integrate new technologies. Hiring technical talent to support new and ongoing projects has become more difficult, resulting in problematic skill shortages.

Furthermore, the urgency of new IT projects is driven by the need to innovate faster. Organizations that are unable to efficiently create new value from data will be left behind—whether in existing industries experiencing disruption or in nascent markets undergoing rapid change. Gathering disparate data, managing new data, and speeding up processing adds complexity and strain to existing IT operational challenges.

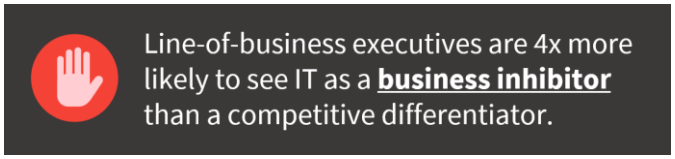
Relying solely on increased budgets and increased hiring is neither cost-effective nor realistic. Therefore, the infrastructure itself must rise to the challenge. It must become "smarter"—more capable of reducing and automating tasks while supplying greater and deeper insight, which will reduce IT burden by several orders of magnitude.

That is the promise of intelligent infrastructure. Using emerging capabilities in artificial intelligence (AI), deep learning, and analytics, it can automatically adapt to the specific needs of an enterprise's application and data environment. It integrates knowledge about the state of the infrastructure, the applications, and the data, and then it self-directs actions to optimize operations and resources.

DDN and Tintri, a DDN company, offer leading intelligent storage infrastructure products and technologies. Together, they deliver an extensive infrastructure portfolio that can help enterprise IT organizations modernize and transform their application environments, harness the power of data everywhere, accelerate time to insight, reduce personnel burdens, decrease OpEx and CapEx, and maximize business benefits now and in the future.

The Digitization of Business Has Disrupted IT Operations

The pressing need to become "more digital" is pervasive. In a recent ESG research study, nearly every IT organization surveyed (98%) said they are in some phase of digital transformation—leveraging technology to improve many facets of the business.[2] They aim to become more operationally efficient (reported by 56% of respondents), provide a better and more differentiated customer experience (40%), and develop innovative new products and services (38%) often by using AI or analytics (28%).



Unfortunately, few IT organizations have been able to fully realize these objectives. Only 6% of line-of-business executives surveyed by ESG regard IT as a competitive differentiator, while 25%—four times as many—view IT as a business inhibitor.[3] If success in

[1] Source: ESG Research Report, *The Impact of the COVID-19 Pandemic on Remote Work, 2020 IT Spending, and Future Tech Strategies*, June 2020.
[2] Source: ESG Master Survey Results, *2021 Technology Spending Intentions Survey*, December 2020. All ESG research references and charts in this white paper have been taken from this master survey results set, unless otherwise noted.
[3] Source: ESG Master Survey Results, *2019 Technology Spending Intentions Survey*, March 2019.

the digital era means that IT must help transform the business, these numbers indicate that 94% of enterprises are failing at it. The two most commonly cited reasons executives perceive IT as a business inhibitor are that (1) processes to deploy IT services take too long (cited by 43%), and (2) it is too difficult to access the data they need for business operations and analysis (43%). For enterprises to succeed, something must change.

IT Skill Shortages and Increased Complexity Necessitate a Technology Shift

In a recent ESG research study, 75% of IT decision makers told ESG they believe IT is more complex than it was just two years ago. Multiple factors are behind the increased complexity. COVID-19's immediate impact tops the current list, but concerns over new data security and privacy regulations and higher data volumes also are major drivers. Complexity also mounts as IT organizations deploy technologies and embark on IT initiatives to accelerate business growth. Almost a third (29%) of respondents report having a major digital transformation activity underway, further enhancing the problem (see Figure 1).

Figure 1. Top Ten Drivers of IT Complexity

Source: Enterprise Strategy Group

The struggle to innovate is pressing and constant. To address market demand, businesses are increasing the scale and diversity of their application environments, accelerating the adoption and integration of new technologies, and expanding remote work options for employees. The result is an almost insurmountable level of IT intricacy and entanglement that stifles innovation and overwhelms personnel. Again, throwing more IT staff at the problem isn't viable. Thirty-four percent of organizations are experiencing problematic skill shortages related to IT architecture and planning, and 17% are seeing storage administrator shortages.

This has led to an industry-wide shift away from domain experts such as storage admins toward generalists. Sixty-two percent of organizations indicated that most of their open IT positions were for generalists.[4] As new hires come into an organization with broader (not deeper) experience, it diminishes the overall level of detailed technology and component knowledge and further deepens the IT skills gap.

The Need for Intelligent Infrastructure

Digital business demands are accelerating. Complexity is rising. Data is exploding. Personnel are scarce and costly. IT infrastructure must therefore become intelligent enough to meet increased demands and automate enough activities to free up personnel. Today, the term "intelligent infrastructure" usually refers to technologies that leverage telemetry data collected from the infrastructure components—including storage, compute, and network resources—and integrated machine learning to reduce burdens on administrators.

Typically, the goal is to move toward an autonomous IT infrastructure. Similar to the range of autonomous operations in vehicles today, intelligent infrastructures come in multiple flavors, defined by a spectrum of capabilities. Like automatic parallel parking or lane-assist features, intelligent infrastructures offer a variety of "self-driving" capabilities that enable an IT organization to simplify and automate certain activities according to specific business needs.

The idea behind intelligent infrastructure is to replace *projects*, which can be large, time-consuming, costly, risky, and reliant on tribal knowledge, with *products*, i.e., intelligent data-driven solutions that are validated, proven, integrated, and repeatable. But different vendors offer different intelligence features with varied levels of maturity.

How a Business Benefits from Intelligent Infrastructure

The following list describes how an intelligent infrastructure, if properly architected and managed, can transform an organization and accelerate business growth and success. It will:

- Increase insight—simplify planned actions: Solutions with integrated intelligence deliver superior insights compared to traditional systems. The insights are often based on detailed telemetry data collected on a specific application and infrastructure environment, including current and past usage. The solution then offers recommendations to improve decision making, proactively reduce risk, and improve the efficiency of the environment. These insights and recommendations deliver value when planning new application or system deployments and provisioning capacity. For example, intelligent infrastructure can help IT forecast future performance or capacity-growth patterns to determine when upgrades will be needed and when infrastructures must be enhanced or scaled up. AI-powered software can also understand and advise how to place data in the right location across the enterprise and deliver optimal results in the most secure and cost-effective way possible.

- Continuously optimize—simplify the day-to-day: Application environments evolve continually. Intelligent infrastructure solutions can monitor a broad range of application environments constantly and in real time, and apply machine learning techniques to optimize workloads on the fly, course correct behaviors, understand current needs, and predict future ones. Combined with detailed understanding of a given technology's capabilities (and in some cases drawing on a wealth of best-practice insights from across that solution's install base), an intelligent infrastructure can offer insights to tune and optimize the environment – or may do so autonomously. The outcome is a superior application experience with consistent quality of service (QoS) to users, more efficient resource utilization, and a lower burden on personnel.

[4] Source: ESG Master Survey Results, *2019 Data Storage Trends*, November 2019.

- Predict and avoid—simplify unplanned actions: "The unexpected" often steals personnel cycles, creates risk, increases costs, and sometimes creates catastrophic failures. Intelligent infrastructure solutions can leverage telemetry data from individual components to optimize workflow performance, proactively identify and resolve immediate bottlenecks and issues, and predict when a failure or potential problem may occur before it arises, alerting IT and suggesting suitable remediation. If a failure does occur, intelligent insights can pinpoint or suggest where the trouble resides, with granular detail and accuracy. The result is a significant reduction in risk to the environment, more efficient and better performing IT, and reclaimed personnel time.

The above benefits will vary depending on the breadth of infrastructure intelligence and the level of automation integrated into the solution. The ability to identify the likeliest cause of a performance slowdown is beneficial. But the ability to highlight potentially impacted workloads and automatically shift resources to ensure consistent performance across them all until an administrator can address the problem—or without requiring an administrator at all—is more beneficial and requires more intelligence.

In addition to the intelligent infrastructure advantages identified above, the following three attributes can help gauge the value of a particular solution:

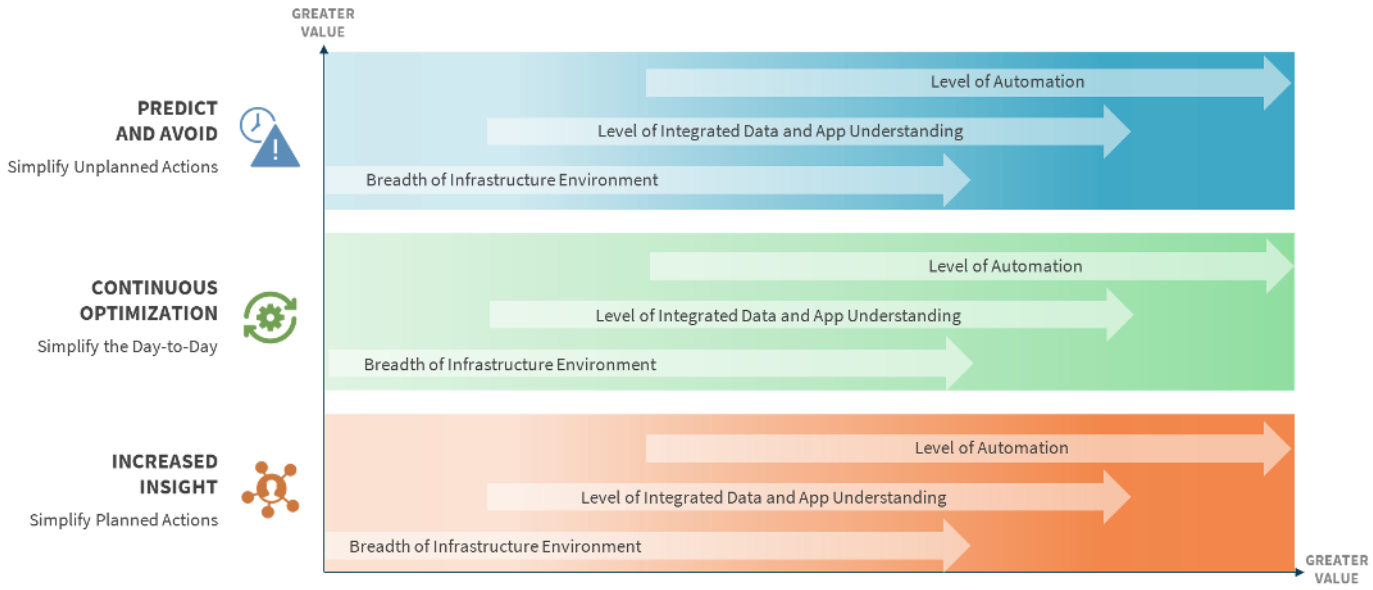
- Breadth—As the *breadth* of integrated intelligence increases across the infrastructure, the *value* of that intelligence increases by many fold. Much complexity within modern IT environments relates to activities or issues that cross multiple infrastructure layers, technology components, or domains of ownership. Solutions that collect data across a broad range of components—storage, compute and network, for example—and provide consolidated, correlated insights offer value that can be truly transformational.

- Data/application understanding and control—Applications and workloads offer very different levels of value to a business. Intelligent infrastructure solutions that understand a specific application environment and provide the right level of insight, guidance, and control to accelerate and prioritize high-value workloads offer tremendous value for accelerating digital initiatives and generating revenue.

- Automation—Intelligent insights simplify operations, but automation helps avoid unnecessary activities altogether. As an infrastructure becomes more autonomous with integrated intelligence, the value it provides increases. Some solutions enable application and development teams to automate infrastructure provisioning decisions using a self-service portal. But more advanced solutions might automatically mitigate or resolve issues by shifting resources to ensure consistent performance when scaling rapidly or in the event of a component failure. The goal is to reduce IT burden, cost, and risk. The closer intelligent infrastructure gets to being an autonomous infrastructure, the closer we are to achieving that goal.

Not every solution will offer automation or even insight across all of these parameters. The graphic in Figure 2 provides a visualization of how to leverage these criteria. As solutions increase their intelligence functionality to apply to a greater variety of actions (represented by the y-axis) the value of the solution increases. In a similar fashion, as solutions increase the breadth and types of infrastructure covered, include insight on data and applications, and integrate more automation (represented by the x-axis),) the value increases as well. The overlapping arrows shown in the graphic for these capabilities attempt to represent the high degree of variation in value they may bring based on your specific needs. When evaluating intelligent infrastructure solutions, ensure that you adapt this guidance to suit the needs of your specific IT environment.

Figure 2. Evaluating Intelligent Infrastructure



Source: Enterprise Strategy Group

The Counter Argument: Why Traditional Means of IT Automation Are Enough

It's arguable that most or all of this intelligence is achievable by using existing APIs and separate infrastructure automation or orchestration tools. While that is possible, current efforts often fall short. Nearly one in three organizations (32%) are experiencing problematic skill shortages in IT automation and orchestration.

In addition, high-level automation activities can increase the "blast radius" or fault domain when errors occur, increasing the cost of being wrong. When IT teams replace old components and apply firmware updates, they need to test and validate the environmental changes to ensure new problems are not introduced. Testing and validation increase cost, complexity, and time. Add one misstep during automated deployment processes and it can break the process. When that process breaks, the impact can span multiple skill domains, further increasing the time and cost of resolution.

Conversely, intelligent infrastructure includes an inherent set of automated and autonomous capabilities, pretested and validated by the vendor. Separate infrastructure automation or orchestration tools still have value, but intelligent infrastructure greatly simplifies the path to achieving the goal of autonomous infrastructure without the complexity and risk associated with traditional approaches.

Tintri and DDN's User-centric but Converging Approaches to Intelligent Infrastructure

Recently, two leaders in the areas of data storage and intelligent infrastructure joined forces when DDN acquired Tintri. DDN offers high-end storage solutions with integrated intelligence that help businesses maximize the value of their data and their high-value applications (e.g., business analytics; machine learning; or digital business applications for media and entertainment, life sciences, or financial services).

Likewise, Tintri has an established history of offering enterprise storage with integrated intelligence to simplify and automate the management of a wide range of application environments, including virtualized applications, virtual desktop environments, databases, and containerized apps. As a combined company, DDN and Tintri are now collaborating to further advance intelligent infrastructure across the spectrum of enterprise and at-scale environments.

DDN, Integrating Intelligence to Maximize Data, Application, and Infrastructure Value

DDN's focus on delivering optimized value at scale to organizations with data-intensive requirements has resulted in its becoming the trusted provider of production systems for enterprise at scale, AI, analytics and high performance computing workloads. DDN's approach to intelligent infrastructure centers on continuously ingesting, storing, processing, protecting, and optimizing complex workloads in distributed on-premises or hybrid cloud environments. The goal is to deliver the most value in the most cost-efficient way, with an ease of deployment and administration unique at this scale. This approach has yielded tremendous value delivering simplicity, efficiency, and flexibility to data-driven organizations.

To accelerate insight, provide more accurate real time analysis and reduce the complexity of AI solution deployments for enterprise customers across a variety of use cases such as recommendation systems, image analysis, and natural language processing, DDN:

- Integrates and automates AI infrastructure, with the goal of reducing implementation time from months to days, while maximizing the utilization of costly computing resources such as GPUs, processors, and networks. The client in the IT workflow is automatically deployed into the right processing environment, in the right place, at the right time, dynamically.
- Optimizes the data path with an intelligent client that makes use of AI-powered software, parallel processing file systems, and technologies like GPU Direct, which boost workload speeds reliably and with minimal IT resources. This simultaneously reduces operating costs and improves ROI, while greatly accelerating innovation and business benefits.
- Supplies end-to-end visibility into the workflow. Powerful application-level analytics and simple, integrated telemetry across compute, networking, and storage assures greater consistency, reliability, and efficiency, and ultimately enables organizations to reap the true rewards of AI-enabled intelligent infrastructures.

To handle the massive scale and breadth of data challenges associated with enterprise AI and analytics, DDN offers:

- Powerful modular infrastructure building blocks, jointly optimized and tested with partners like NVIDIA, to create turnkey AI-enabled environments that scale as needed.
- Always-on, pre-emptive support backed by established expertise in data-intensive workloads, including 24/7 remote analysis to identify current and impending system issues and provide corrective action—often before IT is aware of the event.
- Automated data movement to optimize data locality for performance or bulk capacity as needed, without sacrificing accessibility or requiring any administrative intervention. This minimizes or eliminates the "data movement tax" associated with more traditional data tiering and data migration solutions.

For data security and integrity, DDN delivers:

- Secure multitenancy to maximize resource sharing and utilization, while restricting data access to protect against malicious breaches.
- Automatic end-to-end data integrity to ensure accuracy over the entire data lifecycle.

Tintri, Focused on Automating IT Operations

DDN and Tintri began their intelligence infrastructure approaches by focusing on the needs of their users. Tintri's strategy is based on the goal—which Tintri claims is now widely achieved by its customers—of having artificial intelligence software that eliminates 95% of storage administration tasks. The mission is to perform the whole spectrum of predictable, unpredictable, and continuous-optimization activities autonomously, without human intervention.

For predictable tasks such as new infrastructure planning, deployments, or provisioning, Tintri offers:

- An architecture based on a single AI-managed volume per system, which dramatically simplifies planning, deployment, and provisioning activities that eliminate the complexity and inefficiency of LUNs.
- Actionable visibility, insights, and recommendations across the infrastructure, with telemetry- and management-based granular control at a VM, database, application, or container level to eliminate obstacles and accelerate operations, while reducing risk and cost associated with new application or infrastructure deployments.

For unpredictable activities such as application performance slowdowns or device failures, Tintri offers the ability to:

- Immediately pinpoint the root cause of latency issues for all managed objects, helping to avoid lengthy and costly investigations.
- Automatically identify outliers and anomalies—individual VMs, applications, and databases—across compute, network, and storage.
- Resolve hotspots quickly with deep, real-time performance and capacity metrics for each VM, database, or container.
- Deliver always-on, pre-emptive support, remotely analyzing systems 24/7 for current and impending issues and advising corrective action before IT may even be aware of the event.

For continuous optimization such as ensuring consistent application performance and experience, Tintri offers:

- AI-driven workload-optimization to maintain performance quality-of-service (QoS) for each workload without human intervention. Each managed item (VM, database, etc.) autonomously gets the exact resources it needs based on its behavior.
- Self-healing policies to ensure data is protected regardless of where it resides.
- Autonomous policy propagation for services such as snapshots, replication, and QoS. As workloads are moved to different systems or locations, policies remain tied to them, ensuring consistent protection and performance without breaking anything.

The Business Value Achieved by Leveraging the Intelligent Infrastructure Portfolio of DDN and Tintri, a DDN Company

Using the built-in intelligence capabilities of the DDN/Tintri portfolio, organizations can transform their IT operations and achieve business benefits that include:

- Reducing operational costs through automation and consolidated end-to-end management—Businesses can improve productivity and consolidate responsibilities by avoiding time spent managing traditional storage constructs such as LUNs, RAID groups, aggregates, or volumes. This eliminates helpdesk tickets traditionally required to extend and grow LUNs, datastores, and drives. This also makes more effective use of IT generalists, as any team member can assume responsibility with minimal training and better understand the impact of all production and dev/test behaviors on storage usage.

- De-risking the infrastructure with predictability—IT organizations can improve budgeting and planning via multi-year historical data and machine learning-based models that accurately predict resource needs up to 18 months in advance, reducing the capital cost of overprovisioned infrastructure. Organizations automatically avoid unexpected performance issues—for example, issues from VDI-related activities such as boot storms or virus scans that would otherwise hinder productivity. Better insight enables them to rapidly protect and recover individual objects and avoid disruptive LUN-level snapshots and restores. And IT staff are now free to focus on higher value "big picture" activities, reducing macro-level problems that otherwise arise from a lack of strategic focus.

- Improving and accelerating digital business initiatives—Companies can better serve application users with predictable performance, driven by intelligent workload isolation and auto-QoS. The user experience is further enhanced by reducing latency to < 1ms per object. IT teams can spend less time on support issues and more time on accelerating new initiatives. Infrastructure can be deployed in minutes, not hours or days. DevOps teams can also accelerate development cycles and improve efficiency with instant, zero-stun clones that have no adverse impact on performance or capacity.

- Opening new opportunities for growth—This intelligent infrastructure enables organizations to tame IT complexity by consolidating data onto optimal storage platforms. This reduces change management-related risks in a rapidly scaling dynamic environment. IT can prioritize and accelerate high-value workloads and quickly build innovative new analytics, collaboration, and data-sharing platforms. As a result, they'll deliver more value to stakeholders and strengthen revenue streams.

The Bigger Truth

Modern data centers are increasingly diverse and distributed, resulting in infrastructure complexity—and a growing, unsustainable gap between IT resources and available IT expertise to manage them. When IT leadership attempts to overcome these challenges by adding personnel or new technologies, complexity only increases, and new problems emerge.

IT decision makers need to expect more from storage infrastructure technology vendors. Some vendors are stepping up, knowing that they need to sell intelligent storage infrastructure centered on the idea that technology should make life easier for the business, not more difficult. When evaluating a new infrastructure offering, integrated intelligence should be a top factor influencing the purchase decision.

This paper serves as an overview and a guide to the benefits that storage infrastructure solutions with integrated intelligence can offer, highlighting ways to measure the value they provide. Ultimately, the capabilities you should prioritize depend on your specific IT environment and business requirements.

DDN and Tintri are both pioneers and leaders in intelligent infrastructure. They have joined forces to deliver something even greater. The combined company portfolio provides a wealth of value through intelligent infrastructure that greatly reduces storage management and greatly increases data value, but it's just the beginning; DDN and Tintri are actively

sharing an innovation roadmap designed to serve their customers collectively moving forward. IT and the business both need intelligent infrastructure, and DDN and Tintri are instrumental in leading the charge.

Enterprise Strategy Group is an IT analyst, research, validation, and strategy firm that provides market intelligence and actionable insight to the global IT community.

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