

A Forrester Total Economic Impact™
Study Commissioned By IBM
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Emerging Technology Assessment: The Total Economic Impact™ Of Using Both IBM And Red Hat Solutions Together

Potential Cost Savings And Business
Benefits Enabled By IBM And Red Hat

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Executive Summary

IBM and Red Hat provide a range of technology and services that can support their customers' IT and development needs. IBM commissioned Forrester Consulting to conduct an emerging Total Economic Impact™ (TEI) technology assessment study to examine the ways in which customers utilize solutions by both companies in tandem and the impacts achieved as a result. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of solutions using both IBM and Red Hat offerings on their organizations.

Forrester interviewed five organizations that use IBM and Red Hat offerings together. These interviewees are focused on modernizing infrastructure and applications to resolve legacy architecture challenges and meet quickly changing market needs. These companies adopted a wide range of solutions from IBM (including IBM Power, IBM Z, IBM Cloud Paks, middleware, and professional services) and Red Hat (including Red Hat Enterprise Linux, OpenShift, JBoss, and professional services).

Balancing Speed, Flexibility, And Dependability

According to Forrester, “delivering software with speed and quality is now essential . . . and customers won't wait.”¹ Considering that the pace of changing technology capabilities and customer expectations is only increasing, the answer today may not be the answer tomorrow — so building solutions with flexibility is essential.

Yet, at the same time, dependability is mandatory for enterprises in today's ruthless environment. Achieving this dependability requires technology services to excel in seven categories: availability, capacity, performance, simplicity, consolidation of operations, cost control, and trust.²

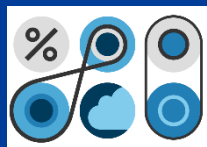
For organizations seeking modernization for long-term success, finding the balance between speed, flexibility, and dependability is incredibly challenging. Interviewees looked to cloud technologies and open source solutions to enable their transformation but were faced with major challenges: How could they ensure enterprise dependability while also avoiding lock-in? How could they bring life to their legacy applications and infrastructure without starting from scratch? How could they get moving?

Forrester recommends leveraging containerization, microservices, and the cloud: “Packaged and run within a container platform, monolithic apps can achieve a smaller infrastructure footprint, lower maintenance and support costs, and easier portability across a wider range of cloud infrastructure and platform services.”³ Next, “by converting a monolithic app to microservices a piece at a time rather than all at once, an enterprise can better match investment with business value delivered — reducing risk in the process.”⁴ Organizations can then use hybrid cloud management tools to abstract infrastructure and “use enterprise container platforms (ECPs) to speed, simplify, and automate container development and deployment.”⁵ Finally, with the infrastructure groundwork in place, development teams can design continuous integration and continuous delivery pipelines to reduce labor costs and ensure velocity, consistency, and quality.⁶

Modernization With IBM And Red Hat

Grappling with messy existing hybrid infrastructures and unknown future environments, interviewed organizations saw Linux and Kubernetes emerge as essential components of their modern infrastructure and

Key Benefits



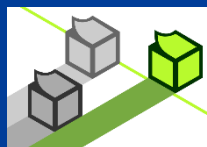
Up to 50%

Reduced infrastructure hardware and licensing costs



33% to 90%

Reallocated infrastructure administration labor



Up to 66%

Accelerated development cycles



Up to 10x

Increased release frequency

“We were changing into a more customer-centric business model. In order to do that, we had to have better service, availability, resiliency, and security along with data and analytics to more deeply understand our customers.”

Chief technology and operations officer, APAC financial services



applications. And to ensure successful implementation and long-term dependability, they turned to IBM and Red Hat as trusted vendors that package, manage, and improve these open source components.

All five interviewed organizations deployed Red Hat’s Enterprise Linux across their infrastructure, and to boost aging on-premises infrastructure, four of the five deployed IBM’s Linux-based servers and mainframes. Four of the organizations deployed IBM’s or Red Hat’s enterprise-supported Kubernetes-based container platforms (on both bare metal and virtualized private clouds), and then tapped into a variety of containerized middleware and services from both IBM and Red Hat. Along the way, all interviewees turned to IBM’s and Red Hat’s professional services to navigate these challenging waters.

While each organization’s specific use case and investments varied, they all were focused on both infrastructure *and* application modernization as simultaneous key priorities. They reported a consistent set of key steps along the path to modernization:

Key Steps Towards Infrastructure And Application Modernization For Interviewed Organizations

- ✓ Replace aging on-premises infrastructure with high-performance hardware and public cloud environments.
- ✓ Implement Linux across on-premises and public cloud infrastructure.
- ✓ Deploy solutions to monitor, manage, and automate hybrid and multicloud infrastructure as a centralized hybrid cloud.
- ✓ Launch self-service automation and service catalogs to deploy containerized environments and services quickly.
- ✓ Create automated CI/CD software delivery pipelines to eliminate manual processes and increase release frequency.
- ✓ Containerize legacy, monolithic applications and shift them into the Linux-based private and public cloud environments.
- ✓ Develop new applications exclusively with a Linux-based containerized microservices approach.
- ✓ Break down existing monolithic applications incrementally into containerized microservices.

“We don’t have to build the house for Easter Sunday. In our virtualized environment, we were always having to build for worst-case scenarios. With containers, we can scale based on demand. We’ve improved performance, reliability, and elasticity.”

Principal application architect, NA transportation



IBM And Red Hat Enabled Significant Returns

Interviewees identified a wide range of impacts resulting from their modernization efforts with IBM and Red Hat, which Forrester evaluated in four principal categories: infrastructure savings, workforce acceleration, enhanced business outcomes, and flexibility. All interviewed organizations discussed positive impacts within each of these four categories; however, the specific ways they achieved those benefits, the degree they could be quantified, and the amount of financial impact varied widely. In this study, therefore, Forrester has illustrated the range of impacts rather than aggregate disparate use cases into a single financial model. Interviewees identified the following specific impacts:

- › **Infrastructure savings.** IBM and Red Hat enabled interviewees to consistently reduce the total cost of ownership (TCO) of IT by reducing hardware, cloud, and/or licensing costs. Quantified examples included:
 - Reduced top-line TCO by as much as 4%.
 - Decreased hardware costs by up to 44%.
 - Optimized resource utilization by up to 30%.
 - Reduced licensing costs by up to 50%.

IBM and Red Hat enabled organizations to build secure, dependable applications while leveraging the flexibility of open source and hybrid infrastructure.

“We needed to support our high-growth environment to absorb a minimum of 30% year-over-year growth in our customer base.”

Chief technology and operations officer, APAC financial services



“We save so much on labor and management because there’s one management plane for how images are released. Skill sets are no longer needed [to manage each specific technology] . . . because at the end of the day, they are all just images and containers.”

Principal application architect, NA transportation



“We were looking for a platform that would be highly scalable, resilient, and future-proof. We didn’t want to buy something and have to go back to the board five years later.”

Chief technology and operations officer, APAC financial services



- › **Workforce productivity and acceleration.** Modernization enabled administrators and developers alike to eliminate wasteful manual tasks, spend less time waiting for manual steps to be completed, and complete work faster — saving labor costs, accelerating work, and enhancing employee experience. Companies could access a larger talent pool and better attract, hire, and retain employees. Quantified examples included:
 - Reallocated 33% to 90% of infrastructure administration labor.
 - Accelerated development cycles by up to 66%.
- › **Enhanced business outcomes.** Modernization helped companies accelerate product development, create better offerings, increase performance, ensure dependability, and strengthen security — ultimately mitigating risk, delighting customers, and driving business growth. Quantified examples included:
 - Increased release frequency by up to 10x (signifying more features and patches reaching customers more quickly).
 - Accelerated workload processing speed by between 2x and 10x.
 - Virtually eliminated user-impacting downtime.
- › **Agility and flexibility.** Organizations working with IBM’s and Red Hat’s Linux- and Kubernetes-based offerings reduced their risk of lock-in to vendor-specific hardware, public clouds, technology, or services. They gained agility to try new things from almost any source, with the ability to later swap or replace them with alternative IBM, Red Hat, or open source components. Open source software-based cloud and containerization platforms provided flexibility to adopt middleware and services from other vendors or open source communities.

Modernization Required Substantial Investments

The benefits and flexibility gained through infrastructure and application modernization with IBM and Red Hat required significant investments. Regardless of the approach or partner, modernization is difficult — there’s no getting around it. Costs for planning, scoping, piloting, implementing, and managing each solution were significant when considering internal labor, professional services, and technology (typically in the millions). Yet, interviewees emphasized equally many costs would be required to simply maintain the status quo. Modernizing was not a choice: If they didn’t act soon enough, they would be left behind and facing major business issues.

IBM And Red Hat Balanced Competing Priorities

When evaluating hybrid cloud solutions, organizations should consider the pain-gain tradeoff. According to Forrester, “at times, vendor variety is worth it . . . but on the other hand, strategic partnership creates great value.”⁷ For interviewees, deploying hybrid cloud and containerization solutions using IBM and Red Hat represented a compelling balance between the benefits, flexibility, costs, and risks represented by variety and partnership. IBM and Red Hat provided enterprise-grade technology and expertise to help plan, design, and build solutions without sacrificing the underlying flexibility of open source and hybrid infrastructure.

So while modernization was typically difficult and expensive, and while the nature of these complex and years-long efforts prevented clear ROI analysis, the interviewed organizations nonetheless reported that using IBM and Red Hat offerings in tandem helped them reduce risks, control costs, and accelerate their businesses for long-term success.

The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

TEI Framework And Methodology

From the information provided in the interviews, Forrester has constructed a Total Economic Impact™ (TEI) framework for those organizations considering implementing IBM and Red Hat solutions together.

The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision. Forrester took a multistep approach to evaluate the impact that using offerings from IBM and Red Hat together can have on an organization:



DUE DILIGENCE

Interviewed IBM and Red Hat stakeholders and Forrester analysts to gather data relative to use cases with IBM and Red Hat offerings.



CUSTOMER INTERVIEWS

Interviewed five organizations using IBM and Red Hat offerings together to obtain data with respect to costs, benefits, and risks.



FINANCIAL MODEL FRAMEWORK

Constructed a financial model framework representative of the interviews using the TEI methodology and including risks based on issues and concerns of the interviewed organizations.



CASE STUDY

Employed four fundamental elements of TEI in modeling IBM and Red Hat's impact: benefits, costs, flexibility, and risks. Given the increasing sophistication that enterprises have regarding ROI analyses related to IT investments, Forrester's TEI methodology serves to provide a complete picture of the total economic impact of purchase decisions. Please see Appendix A for additional information on the TEI methodology.

DISCLOSURES

Readers should be aware of the following:

This study is commissioned by IBM and delivered by Forrester Consulting. It is not meant to be used as a competitive analysis.

Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of investments in IBM and Red Hat offerings.

IBM reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.

IBM provided the customer names for the interviews but did not participate in the interviews.

Customer Journey

BEFORE AND AFTER THE IBM AND RED HAT INVESTMENTS

Solutions Using Both IBM And Red Hat Offerings

IBM has engaged Forrester Consulting in the use of Forrester's Total Economic Impact value-based business case framework to examine the value proposition of current hybrid cloud solutions powered by a combination of IBM's and Red Hat's offerings. These offerings include hardware, operating systems, middleware, management and orchestration technologies, and professional services.

Organizations could build many potential solutions using both IBM and Red Hat offerings. Some examples include:

- › Running Red Hat Enterprise Linux on IBM hardware.
- › Running the IBM container platform and IBM Cloud Paks on Red Hat Enterprise Linux.
- › Using IBM Cloud Paks with OpenShift to build applications that use both IBM and Red Hat middleware in tandem.
- › Managing IBM infrastructure using OpenShift.
- › Engaging IBM's professional services to design and support applications or environments built on Red Hat.
- › Working with IBM's or Red Hat's professional services to learn to containerize and modernize legacy applications and environments.

This study does not focus on direct or implied market or competitive comparisons nor on the future direction or offerings of either company; rather, the objective is to illustrate the potential financial impact areas and calculations customers are achieving today.

Forrester evaluated the business impact of possible use cases that use both IBM and Red Hat offerings together.



Interviewed Organizations

Forrester interviewed five organizations that are customers of both IBM and Red Hat to learn about their experiences utilizing solutions from both companies in tandem.

COMPANY PROFILE	INTERVIEWEES	IBM SOLUTIONS	RED HAT SOLUTIONS
European telecommunications company with over 100,000 FTEs	Product manager, cloud platforms	<ul style="list-style-type: none"> • IBM Cloud Paks* • IBM Power9 processors • Professional services 	<ul style="list-style-type: none"> • Red Hat Enterprise Linux
North American telecommunications company with over 100,000 FTEs	<ul style="list-style-type: none"> • Senior manager, systems engineering • Systems architect • Systems engineer 	<ul style="list-style-type: none"> • IBM Z mainframes • Middleware including MQ, HTTP, WebSphere • IBM Watson • Professional services 	<ul style="list-style-type: none"> • Red Hat Enterprise Linux • Middleware including JBoss JWS, EAP, and VPN • Red Hat OpenShift • Professional services
North American transportation company with between 50,000 and 100,000 FTEs	Principal application architect	<ul style="list-style-type: none"> • IBM Power servers • Middleware including WebSphere, MQ • Professional services 	<ul style="list-style-type: none"> • Red Hat Enterprise Linux • Red Hat OpenShift • Middleware • Container Adoption Program
Asian financial services company with approximately 10,000 FTEs	Chief technology and operations officer	<ul style="list-style-type: none"> • IBM Z mainframes 	<ul style="list-style-type: none"> • Red Hat Enterprise Linux
European financial services company with under 1,000 FTEs	Chief technical architect	<ul style="list-style-type: none"> • IBM Cloud Paks* • DataPower Gateway • WebSphere Liberty 	<ul style="list-style-type: none"> • Red Hat Enterprise Linux • JBoss EAP

**Note: When interviewed, these companies were using IBM Cloud Private. IBM has now rebranded this offering as IBM Cloud Paks, which customers were running on IBM's Kubernetes-based container platform. The new branding is used in this study to prevent confusion.*

Drivers For Modernization

Interviewed companies faced common challenges, as legacy monolithic applications and complex infrastructure led to excess costs, wasted IT labor, and poor developer experiences.

- › **Infrastructure issues.** Availability and performance issues negatively impacted users and required excessive labor to resolve. Visibility and management were very limited, as environments often needed to be overprovisioned to handle peak loads. Ultimately, lacking resources and inflexible architectures held organizations back.
- › **Skill gaps.** Legacy applications and infrastructure often required niche skill sets, making it difficult to find the needed specialists. Even when preexisting specialized skills weren't required, organizations struggled to attract and retain employees who were interested and willing to work on these legacy environments. As years went by, this became increasingly risky as the organizations could not adequately keep applications running, let alone update or enhance them.
- › **Impaired agility.** Manual processes, monolithic applications, legacy architecture, and limited management capabilities slowed development to a crawl. Organizations wasted significant labor just to keep the lights on, let alone meet quickly evolving market pressures and customer needs. Desires for new and enhanced offerings were quickly squashed by the reality of decades of technical debt and outdated approaches.

"Kubernetes was the easiest way to create a new platform with the capabilities our end customers need to put their cloud-native services into production. Avoiding vendor lock-in is very important because our customers need to know they can move to another platform based on Linux and Kubernetes to put them at ease. . . . We chose [IBM Cloud Paks] because we wanted to use a solution based on open source Kubernetes."

Product manager of cloud platforms, EMEA telecom



Use Cases For Interviewed Customers

All interviewees identified that application and infrastructure modernization is a top priority of their organizations as they seek to fix performance and security issues, control IT costs, reduce risk, attract and retain talent, accelerate innovation, and ultimately improve customer outcomes.

In practice, these priorities have led to a range of unique use cases at each company as it partners with IBM and Red Hat to leverage the companies' hardware, middleware, management, and professional services offerings to meet their business goals.

The following is an examination of each company's use case including its challenges, actions taken, and outcomes experienced:

- › **The European telecommunications company launched a new B2B offering of a cloud computing platform based on IBM's container platform running on RHEL.** The company hopes to build a robust new revenue stream from this offering and is planning to augment the service by adding a marketplace of IBM middleware and technologies.

CHALLENGES	ACTIONS	OUTCOMES
<ul style="list-style-type: none"> • Sought to fill a new market opportunity for a regionally based cloud platform in Europe and Latin America. • Aimed to leverage native Kubernetes for maximum portability. • Needed to maximize profit margins on infrastructure, while ensuring performance, scalability, and the opportunity to expand capabilities. 	<ul style="list-style-type: none"> • Launched a B2B cloud platform using IBM's container platform on bare metal and virtual machines running RHEL. • Created a self-service portal to automate deployment for customers. • Scoping additional cloud offerings managed by IBM Multicloud Manager. • Scoping additional IBM middleware and technologies such as Watson to offer. 	<ul style="list-style-type: none"> • Achieved infrastructure flexibility and competitive TCO with minimal risks. • Early adoption includes five customers containerizing legacy applications or creating new ones with microservices. • Customers avoid lock-in with native Kubernetes.

- › **The North American telecommunications company is beginning to modernize its aging environment.** The company is early in its journey but aims to leverage containerization, cloud environments, IBM professional services, and Red Hat middleware to control its IT costs, gain infrastructure flexibility, and attract and retain top talent.

CHALLENGES	ACTIONS	OUTCOMES
<ul style="list-style-type: none"> • Lost product knowledge and technical expertise from employee departures. • Highly stringent availability requirements limit ability to innovate and use open source technologies. • Excessive licensing costs • Need to deliver perfect availability; cannot tolerate any downtime. • Highly varied development teams and application architecture. 	<ul style="list-style-type: none"> • Adopting open source and lighter-weight middleware with enterprise support. • Engaging IBM to rearchitect applications with lighter-weight middleware and support cloud migration. • Containerizing the first 20 applications for a lift-and-shift cloud migration. • Replacing data centers with multiple public clouds running RHEL. • Evaluating broad containerization of applications with Kubernetes. 	<p>Modernization is beginning to inch forward, but impacts are yet to be determined. The company hopes to:</p> <ul style="list-style-type: none"> • Gain flexibility to shift infrastructure as needed. • Reduce infrastructure and licensing TCO. • Better attract, hire, and retain talent with modern technology. • Enhance applications with AI via Watson.

- › **The North American transportation company is modernizing its IT processes and infrastructure with IBM and Red Hat.** The company aims to reduce IT costs, accelerate innovation, improve employee experience, and deliver better customer experience.

CHALLENGES	ACTIONS	OUTCOMES
<ul style="list-style-type: none"> • Monolithic legacy applications are difficult to update, move, or find new employees with expertise. • Major data center outages have damaged reputation and revenue. • Overprovisioning resources to handle peak capacity has caused excess infrastructure costs. • Developers are complaining about frustrating tools and wasted time. 	<ul style="list-style-type: none"> • Shifting to DevOps, CI/CD, and cloud-native development. • Modernizing mainframes with IBM. • Containerizing applications with the goal of managing 100% in OpenShift. • Simplified procurement, deployment, and management of OpenShift technologies to one team with developer self-service. • Adopting Red Hat middleware bundled with OpenShift service-level agreement. • Partnering with both IBM and Red Hat services to enable transformation. 	<ul style="list-style-type: none"> • Reduced TCO by 35% with licensing and labor savings from OpenShift. • Tightened compliance and security. • Prevented further data center outages — avoiding remediation costs, lost revenue, and damaged brand reputation. • Accelerated release cycles by over 66% — saving costs and delighting customers. • Improved employee productivity and morale. • Projecting \$200 million in net benefit over five years — a 4% total IT savings.

› **The Asian financial services company replaced legacy data warehouse hardware with IBM Z running Red Hat Enterprise Linux.** By consolidating infrastructure and increasing performance, the company aimed to reduce TCO and drive business growth.

CHALLENGES	ACTIONS	OUTCOMES
<ul style="list-style-type: none"> • Data warehouse was filled with legacy and commodity hardware and had no physical space to expand. • Storage and performance could not meet growth, with frequent downtime. • Security attacks were on the rise. • Struggled to find, hire, and retain talent with the needed skill sets to work on the legacy infrastructure. 	<ul style="list-style-type: none"> • Replaced legacy hardware with IBM Z mainframes running Red Hat Enterprise Linux. • Immediately moved Linux-based workloads to IBM Z. • Containerizing and rearchitecting legacy applications using Linux to be moved to the new environment. • Developing new apps in Linux. 	<ul style="list-style-type: none"> • Reduced TCO of on-premises infrastructure by 44%. • Reallocated four admins (33%). • Reduced labor costs for support. • Shortened batch processes by 40%. • Slashed disaster recovery failover from 4 hours to 10 seconds. • Eliminated downtime — protecting brand reputation and revenue.

› **The European financial services company containerized its applications using IBM's container platform, Red Hat Enterprise Linux, and JBoss.** The company drove drastic productivity improvements for developers, accelerated production, and slashed administration labor and infrastructure resource costs.

CHALLENGES	ACTIONS	OUTCOMES
<ul style="list-style-type: none"> • Manual, complex testing and deployment processes held back product development. • Underutilized infrastructure resources caused excess costs. • Major incidents stopped production and impacted customers — often lasting weeks. • Struggled to employ a team of specialists to manage and deploy each middleware offering. 	<ul style="list-style-type: none"> • Containerized 25% of nonmainframe applications using JBoss in IBM's container platform running on Red Hat Enterprise Linux. • Launched self-service, automated deployment of containerized environments and applications. • Consolidated middleware deployment and management to one IT FTE. • Containerizing the remaining 75% of applications within three years. 	<ul style="list-style-type: none"> • Optimized \$200K of infrastructure resource costs and reallocated 14 excess administrators. • Slashed major incident resolution from weeks to a couple of hours. • Gained significant agility and speed without increasing TCO. • Increased developer efficiency by 10x. • Slashed deployment errors by 10x. • Eliminated 75 hours of labor every time they roll to production.

Benefits Analysis

QUANTIFIABLE BENEFITS EXPERIENCED BY INTERVIEWED CUSTOMERS

As the range of possible ways to utilize both IBM and Red Hat solutions is vast, the specific benefits and key performance indicators (KPIs) will vary widely. Forrester has identified three key categories of benefits that encompass the myriad of specific impacts seen by each organization: infrastructure savings, workforce productivity and acceleration, and enhanced business outcomes.

Infrastructure Savings

IT departments are under constant pressure to reduce costs while absorbing business growth and accelerating outcomes. By modernizing the infrastructure with new hardware, Linux, containerization, and automation, all interviewed organizations ultimately reduced or maintained infrastructure costs while simultaneously driving better business outcomes with these new technologies.

- › **High-performance hardware from IBM replaced higher numbers of commodity hardware, saving hardware costs and reducing data center footprint and utilities.** Despite the higher per-machine cost of the IBM hardware, the total hardware cost could be reduced by replacing multiple (as many as 10) commodity machines per IBM machine. More servers could be fit into the same amount of space, preventing the need for data center expansion and reducing costs for electricity and environmental controls.

For example, the Asian financial services company had experienced significant growth of over 200%, with new burst traffic patterns. The company had to shift to be able to handle not just average capacity but peaks that consumed two to four times the resources as average. And meanwhile, limited cloud availability and security concerns in the region forced the company to remain on-premises — which meant the data warehouses had to be massively scaled up. As the company ran out of physical space, it replaced commodity hardware with IBM's Z Linux platform, which ultimately enabled the company to handle the growth it needed while avoiding the need for additional physical space and reducing its temperature controls and electricity costs.

- › **Fewer physical servers decreased licensing costs.** With significantly fewer cores, organizations could save costs for software priced on a per-core basis — even if the per-core cost was sometimes higher for the higher-performance cores.

The Asian financial services company was able to reduce licensing costs significantly, as its new hardware cores could support the same capacity that previously required seven to 10 cores to complete — reducing the number of needed licenses.

- › **Containerization and hybrid cloud management both optimized resource usage, saving cloud costs and preventing the need for further hardware purchases.** Containers can be more accurately sized based on the needs of the environment and application, helping fit more into the infrastructure. Separating common services out of monolithic applications or virtual machines into their own container can help avoid the need to have the service in multiple separate locations. Containers can be quickly created and destroyed through automation,



Infrastructure savings

- Reduced overall TCO for IT by up to 4%.
- Decreased hardware costs by up to 44%.
- Optimized resource utilization by up to 30%.
- Reduced licensing costs by up to 50%.
- Enhanced performance, security, and productivity even with cost savings.

“We don’t have to build the house for Easter Sunday. In our virtualized environment, we were always having to build for worst-case scenarios. With containers, we can scale based on demand. We’ve improved performance, reliability, and elasticity.”

*Principal application architect,
NA transportation*



monitoring, and management, reducing the amount of allocated resources sitting unused for long periods of time. Containers can also be dynamically shifted from one part of the infrastructure to another to optimize resource usage during periods of heightened demand, and they can be moved to a lower-cost cloud if one becomes available.

For example, the European financial services company saved \$200,000 in hardware costs by optimizing resource utilization with IBM Cloud Paks running on Red Hat Enterprise Linux. Containers helped optimize capacity, and the company could now easily identify and destroy environments that were no longer needed to free up resources. It ultimately increased utilization by 20% to 30%.

- › **Containerization also decreased licensing costs.** Some organizations found that middleware licenses were more cost-effective under the new containerized pricing models. Shifting to containerized middleware also helped to adopt cloud-like, pay-as-you go pricing models rather than upfront costs — improving cash flow. Finally, it became more feasible to implement lower-cost or open source middleware within the environment.

For example, the North American transportation company has found Red Hat’s containerized middleware more lightweight and cost-effective in its OpenShift environment — reducing licensing costs. As the middleware is prepackaged in containers and covered under the supply chain agreement, the company can test and deploy those containers much more quickly. Further, the company reduced licenses based on a per-OS cost by running them in containers. Ultimately, the organization has reduced platform licensing costs by 38%.

Additionally, the European financial services company optimized middleware licensing costs by as much as 50% with its containerized environment. It further benefited from improved cash flow as it shifted to pay-as-you-go pricing models.

- › **Enhanced performance, security, and productivity despite cost savings.** Interviewees emphasized that their modernization efforts did not sacrifice business outcomes for cost savings; rather, cost savings were secondary to improving business results. So while they were under pressure to reduce costs, they could not compromise the performance and security of their environments, and they needed to implement solutions that could reduce administration labor, save time for development teams, and ultimately accelerate business growth.

“When we were upgrading our hardware, we needed performance and stability. We weren’t looking for business savings — but we got them. Our total cost of ownership went down by 44% over a five-year period. Looking back, it’s a no-brainer.”

Chief technology and operations officer, APAC financial services



“We use a lot less resources now that we are in a private cloud. We found that we were 20% to 30% under our potential utilization, and containers squeezed out that extra hardware capacity.”

Chief technical architect, EMEA financial services



Infrastructure Savings: Sub-Benefits And Recommended Metrics

SUB-BENEFIT	RECOMMENDED METRICS
Streamline data center with high-performance hardware	<ul style="list-style-type: none"> • Cost differential of high-performance hardware versus the needed commodity hardware to perform the same work • Cost differential for space, cooling, and electric
Optimize resource utilization	<ul style="list-style-type: none"> • Percent of infrastructure with dormant environments • Budget spent on hardware and cloud services • Cost efficiency of storage and processing
Consolidate licensing or adopt lower-cost middleware	<ul style="list-style-type: none"> • Number of active licenses • Cost differential for licensing • Present value of cash from pay-as-you-go licensing • Cost reduction in excess, unused licenses

Workforce Productivity And Acceleration

Modernization drove significant benefits to both IT administration and development teams for the interviewed organizations. The shifts toward Linux, containerization, microservices, consistent management tools, and deployment of self-service and automation all incrementally enabled administrators and developers alike to eliminate wasteful manual tasks, spend less time waiting for manual processes to be completed, and complete work in fewer hours — ultimately saving labor costs, accelerating work across teams, and enhancing employee experience.

Time saved freed administrators and developers to focus on new technologies and product development rather than keeping the ship running. This drove further cost savings and business growth in the long run and empowered talent with more interesting work.

Replacing legacy infrastructure and tools also addressed pressing talent search needs. Where organizations previously struggled to find specialists to work on niche, outdated technologies, they could now access a much larger workforce with skill in Linux and Kubernetes along with those with specific IBM and Red Hat knowledge. Not only was the talent pool larger, but it became easier to actually attract, hire, and retain these employees with modernized infrastructure as employees were more interested in and satisfied with working with these tools.

Administration labor savings from infrastructure and application modernization with IBM and Red Hat included:

- › **Simplified hardware administration.** With higher-performance hardware, fewer machines, and Linux-based architectures, organizations were able to significantly reduce the administration labor needed to set up, maintain, and upgrade hardware.

For example, the Asian financial services company replaced commodity hardware with IBM Z servers running Red Hat Enterprise Linux, reducing the total number of machines and reallocating four of its 12 infrastructure administrators — even as the company experienced massive business growth.

- › **Consolidated middleware administration.** In the past, organizations employed dedicated, specialized resources for each specific middleware technology who implemented, deployed, upgraded, and maintained each technology for the applications using them. With IBM's container platform, IBM Cloud Paks, and Red Hat OpenShift, these technologies were now containerized as part of the service catalog. Organizations found that the high level of technology-specific specialization was no longer needed, and the amount of labor needed to actually manage them was drastically reduced as many of the steps were now automated and standardized (labor reductions were at least 33%, if not larger). Organizations were now able to employ a single team dedicated to the container platform that managed the entire breadth of middleware offered within it.

For example, the European financial services company and the North American transportation company no longer require separate teams to procure, deploy, and manage each individual technology; it can now be handled via developer self-service with simplified oversight from the team managing their container platform (IBM's container platform for one and OpenShift for the other).

- › **Decreased labor for deploying environments.** Linux-based hardware, hybrid cloud management, and container platform tools



Workforce productivity and acceleration

- Reallocated 33% to 90% of administration labor.
- Accelerated development cycles by up to 66%.
- Enhanced ability to attract, hire, and retain employees.

“With IBM Z Linux, we set it up, and it just runs — we’re not always fussing with it. And since we have fewer machines because of their increased performance, we spend less time physically working on the machines, doing software patches, diagnosing issues, and making updates.”

Chief technology and operations officer, APAC financial services



enabled organizations to create self-service capabilities for deploying the resources and standardized technology for new environments. Where many cross-functional specialists were previously required to complete manual, sequential steps, the entire process could be automated without manual intervention needed for most use cases.

For example, the Asian financial services company was able to set up test environments much more easily using IBM Z mainframes running Red Hat Enterprise Linux, saving significant labor hours for IT and accelerating the development process.

- › **Reduced testing and maintenance.** Self-service, containerized middleware catalogs, and automation helped to ensure environments were consistent and stable. Combined with smaller application footprints (and less risk of issues), organizations could significantly reduce the labor needed for testing and maintenance of applications as they were developed and deployed.

For example, the European financial services company found that deploying containerized applications with IBM Cloud Paks on IBM's container platform typically produces one-tenth of the deployment errors as production launches for legacy applications.

- › **Decreased labor for rolling to production.** By breaking down monolithic applications into smaller pieces and microservices, companies reduced complexity with fewer potential ramifications needing to be tested before rolling an update to production. Containerized applications could more easily be monitored or even rolled back if necessary, and automation heavily reduced the manual steps required. Ultimately, companies strove to reach the goal of an automated CI/CD pipeline, which promised to slash rollout labor.

For the European financial services company, launching to production previously required approximately 75 hours of labor across 15 FTEs. With containerized, self-service infrastructure built on IBM's container platform, one employee could oversee launch to production in 10 minutes. Further, this employee no longer needed to be highly specialized (previously an expert for each item of middleware was needed), ensuring continuity and avoiding delays.

- › **Automated disaster recovery.** Modern hardware and enterprise management tools helped customers automate the disaster recovery process, protecting critical services and information while also reducing the labor needed to manually fix an issue.

For example, the Asian financial services company slashed disaster recovery failover from 4 hours to 10 seconds by switching to IBM Z hardware running Red Hat Enterprise Linux. Similarly, the European financial services company used its newly containerized environment to launch automated disaster recovery, preventing future labor costs and potential delays.

- › **Shortened training.** New employees can be trained to use modern tools and hardware more quickly than with legacy architectures — helping new administrators ramp up more quickly.

Modernizing applications and infrastructure, especially with Linux and containerization, drove significant labor savings for development teams. Not only did this provide significant labor savings and better business outcomes, but it also heightened employee experience as the transportation company's principal application architect described: "Our developer experience has done a 180. It makes developers feel good

"We used to need many different specialists to manage each different middleware technology. Now that we've containerized applications with [IBM Cloud Paks], one person checks and launches to pipeline for all our containerized middleware."

*Chief technical architect,
EMEA financial services*



"We save so much on labor and management because there's one management plane for how images are released. Skill sets are no longer needed [to manage each specific technology]. We are moving to one small administration group for all of OpenShift, because at the end of the day, they are all just images and containers."

*Principal application architect,
NA transportation*



about the work that they do.” Interviewees identified workforce acceleration benefits impacting developers in several ways:

- › **Reduced downtime spent waiting for environments.** Organizations deployed catalogs of containerized middleware and services using IBM’s container platform, IBM Cloud Paks, and/or Red Hat OpenShift and built self-service automation to deploy consistent, containerized environments immediately upon request. Developers spent less time grappling with cumbersome, legacy processes to submit and manage requests. And ultimately, rather than wait days or weeks, developers could begin work almost immediately using the new environment.
- › **Accelerated development.** Organizations found that developing, testing, and updating applications in a containerized environment is significantly more efficient for developers. Developers enjoyed working with Linux and using the tools and interface of OpenShift or IBM Cloud Paks. Further, as organizations began to break down monolithic applications into smaller parts and microservices, developers could work much more quickly as the number of dependencies and risk of issues was significantly reduced versus potentially impacting the entire application. The exact level of labor savings for developers ranged significantly; for example, the European financial services company’s 200 developers saw extreme savings as those working on containerized applications increased their productivity tenfold.
- › **Simplified issue resolution.** When an application issue arose, engineers found it significantly more efficient to work on Linux-based and containerized applications than their legacy predecessors. Fewer employees needed to be involved, and they could get it done in less time. Further, issues were typically easier to resolve when they occurred for applications that had already been broken down into smaller pieces or microservices as they could more quickly identify and fix the problem with less risk of externalities. Applications could be built to degrade rather than break down entirely, and the infrastructure could load balance when a particular application or part of an application needed more resources during a peak rather than maxing out the capacity and causing user-impacting issues.
- › **Shortened training.** New employees can be trained to use modern tools and work with a containerized code base more quickly than with legacy architectures — helping new developers ramp up more quickly.

Labor savings can additionally be quantified when the end user of applications is an internal employee, rather than a customer. Improving availability and performance or enhancing application features at a quicker pace could result in productivity improvements and heightened employee experience for these business worker end users wherever they sit within an organization.

“We were getting dinged for old crappy tools. Now, our developer experience has done a 180. It makes developers feel good about the work that they do.”

*Principal application architect,
NA transportation*



“We usually have around four to eight major incidents per year that stop production and impact customers. Before, it could take weeks to resolve. With [IBM Cloud Paks], they only take hours.”

*Chief technical architect,
EMEA financial services*



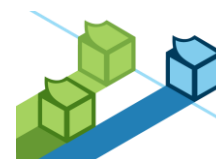
Workforce Productivity And Acceleration: Sub-Benefits And Recommended Metrics

BENEFIT	RECOMMENDED METRICS
Request, deployment, and rollout automation	<ul style="list-style-type: none"> • MTTC (mean-time-to-complete) • MTTR (mean-time-to-resolution) • Reallocated headcount for administration • Reduced hours lost to downtime • Length of release cycles
Administrator productivity	<ul style="list-style-type: none"> • Reallocated headcount/reduced hours for administration • Reduced professional services
Developer productivity	<ul style="list-style-type: none"> • Output per developer • Hours per release • Reduced developer team size
Simplify training	<ul style="list-style-type: none"> • Reduced trainer cost • Reduced trainee hours • Fewer days spent onboarding
Better attract, hire, and retain talent	<ul style="list-style-type: none"> • Reduced attrition/improved retention • Reduced employee replacement cost
Improve productivity for employee end users	<ul style="list-style-type: none"> • Labor hours saved per employee end user

Enhanced Business Outcomes

Modernization is an essential goal for organizations with legacy infrastructure and applications. Without modernization, they risk falling behind and losing customers. Through modernization, companies can accelerate product development, create better offerings, increase performance, ensure dependability, and strengthen security — ultimately mitigating risk and driving business growth. Interviewed organizations cited several key ways modernizing with IBM and Red Hat improved business outcomes:

- › **Reduced business risk.** By not modernizing, organizations risk having legacy applications that can no longer be supported or worked on. These legacy applications also have significant risk of downtime and performance issues. More importantly, however, the market moves fast, and customer expectations are quickly changing. If organizations cannot quickly improve offerings, and if those applications do not meet current expectations around experience, features, and performance, then they will quickly fall behind.
- › **Accelerated releases.** The labor savings described in the previous section (Workforce Productivity And Acceleration) drove increased business velocity. More productive teams combined with automated processes and pipelines meant that companies could do more product development, release more quickly, and release more frequently — benefiting customers and driving long-term business growth.
- › **Dependability.** Organizations were able to significantly improve the dependability of their infrastructure and applications by modernizing with IBM and Red Hat. Ensuring dependability was an essential reason that interviewees turned to IBM and Red Hat for their modernization initiatives as they could not get the enterprise-grade support they



Enhanced business outcomes

- Accelerated release frequency by up to 10x.
- Increased workload processing by 2x to 10x.
- Virtually eliminated user-impacting downtime.

“We can’t let our systems go down. As a financial services company, people might think they’ve been hacked: It’s a huge brand reputation risk.”

Chief technology and operations officer, APAC financial services



needed for pure open source solutions. As a result, companies were able to significantly reduce or eliminate user-impacting downtime.

For example, the Asian financial services company eliminated frequent downtime that previously plagued its environment — which was resulting in lost revenue, excess resolution costs, and major brand reputation risks.

- › **Improved performance.** Organizations that deployed IBM Z and IBM Power saw significant increases in hardware performance, helping to process data faster and ensure applications perform at their best. By containerizing applications, breaking them into microservices, and managing them across the hybrid cloud environment with an enterprise container platform, organizations were able to dynamically allocate resources and shift workloads to ensure consistent performance even during peak times.

For example, the Asian financial services company moved legacy applications to new IBM Z mainframes running Red Hat Enterprise Linux, reducing daily batch cycles from 10 hours to fewer than 6 hours.

- › **Strengthened security.** Little is more important to businesses than security — especially companies in sensitive industries such as financial services. Therefore, ensuring security across applications and hybrid infrastructure was paramount for interviewees. They identified that they saw IBM and Red Hat as perfect partners to help them protect their environments, without holding back business velocity.

For example, the North American transportation company improved compliance and security even as it reduced its total cost of ownership. However, the company must remain highly cautious as each application must be carefully vetted, and it currently struggles to track and manage containerized assets.

- › **Automated disaster recovery.** In the event of a major issue, the newer hardware and container platforms enabled organizations to automate disaster recovery failover — protecting user experience and ensuring no loss of important data.

For example, with IBM Z running Red Hat Enterprise Linux, the Asian financial services company was able to slash disaster recovery times from 4 hours to 10 seconds by automating failover.

“Offering our platform built on Red Hat Enterprise Linux is an important part of the value proposition because it makes the environment more secure.”

Product manager of cloud platforms, EMEA telecom



“We need to be stable and resilient. We’re a major target [in an emerging market], and we need to stay in front of the security space. You get enterprise-class security and stability with IBM Z. It’s encrypted at the machine level, which is very important. The number of people knocking on doors goes up every year, but even if an attacker gets into an endpoint or on our network, they can’t traverse our environment. Our data is behind a hardened central area. We feel really good about it.”

Chief technology and operations officer, APAC financial services



Enhanced Business Outcomes: Sub-Benefits And Recommended Metrics

BENEFIT	RECOMMENDED METRICS
Improve dependability and performance	<ul style="list-style-type: none"> • Reduced incident volume • Reduced hours of downtime • Reduced support and remediation costs • Reduced customer churn • Reduced revenue losses
Reduce security and compliance risks	<ul style="list-style-type: none"> • Reduced compliance fees • Avoided/reduced security breach costs
Accelerate releases and enable innovation	<ul style="list-style-type: none"> • Shortened release cycles • Increased frequency of releases • Increased revenue • Reduced churn • Improved profit margins

Agility And Flexibility Analysis

REAL FLEXIBILITY OPTIONS IDENTIFIED BY INTERVIEWED CUSTOMERS

Flexibility, as defined by TEI, represents an investment in additional capacity or capability that could be turned into business benefit for a future additional investment. This provides an organization with the “right” or the ability to engage in future initiatives but not the obligation to do so. The value of flexibility is clearly unique to each customer, and the measure of its value varies from organization to organization.

Flexibility was consistently one of the most important drivers for interviewees in their decisions to undergo modernization efforts using IBM and Red Hat offerings. They identified a range of real flexibility options in which they may later realize additional uses and business opportunities. Interviewed companies gained flexibility options to:

- › **Lay the groundwork for containerization, microservices, and cloud adoption.** The Asian financial services company needed high-performance mainframes but wanted to future-proof for cloud efforts. IBM Z running Red Hat Enterprise Linux kept the doors open, rather than needing to hire employees with niche mainframe OS experience. In the long run, the company hopes this is the first step on an upgrade path involving cloud applications, Kubernetes, and agile development.
- › **Adopt a broader range of middleware and services from IBM, Red Hat, third-party providers, and open source communities.** IBM Cloud Paks and Red Hat OpenShift provided access to regularly updated, containerized versions of IBM’s and Red Hat’s large middleware catalogs along with third-party cloud services via API connectors and Linux- and Kubernetes-based open source solutions.
- › **Test and deploy AI technologies.** A containerized cloud environment opened the door for several interviewed companies to consider building new application services using IBM Watson.
- › **Shift infrastructure and back-office technology without disrupting application development.** By running OpenShift on its virtualized environment, the North American transportation company provided a consistent management plane and framework for all developers to work within, even when new technologies or patterns were introduced. This ultimately drove faster adoption of new technologies.
- › **Be able to later change hardware, public cloud, middleware, or services vendors without lock-in to IBM and Red Hat.** By basing new development on widely accepted, open source standards of Linux and Kubernetes, and by shifting from monolithic applications to containerized microservices, organizations could develop applications that were not locked into a specific cloud provider, hardware stack, or middleware vendor. They significantly lowered the barriers to make major shifts if needed and can now more easily update or swap one component without massive redevelopment of a monolithic application.
- › **Accelerate development efforts to respond more quickly to customer needs and opportunities.** The European financial services company described how it has been able to expand from five to 15 development teams simultaneously working in the environment. This was not possible with the prior static environments, but the company can now automatically fire new IBM Cloud Pak containers and have the development team up and running within 15 minutes.

“We needed a system to absorb the regular demand and have enough room and horsepower to get through peaks. That’s what led us to IBM Z with Red Hat Enterprise Linux: We were looking for a platform that would be highly scalable, highly resilient, and future-proof. I didn’t want to have to go back to the board five years from now and ask for more. IBM Z Linux offered extreme flexibility in that future state.”

Chief technology and operations officer, APAC financial services



“With [IBM Cloud Paks], we’re better able to do parallel, agile development. Before, something like a government compliance request would become top priority and halt all other work.”

Chief technical architect, EMEA financial services



Costs Analysis

QUANTIFIABLE COSTS EXPERIENCED BY INTERVIEWED CUSTOMERS

The benefits and flexibility gained through infrastructure and application modernization with IBM and Red Hat require significant investments. No matter your approach or partner, modernization is difficult — there's no getting around it. Costs were typically in the millions of dollars when considering planning, scoping, piloting, implementing, and managing each solution across technology, professional services, and internal labor. Interviewees identified costs in three major categories:

- › **Infrastructure and technology.** Replacing legacy hardware requires investment in new servers and components, along with the electricity, floor space, heating/cooling, and networking interfaces required. Licensing costs can add up on top, including costs for Red Hat Enterprise Linux, for third-party virtualization and orchestration, for container platforms (IBM Cloud Paks and OpenShift), for middleware, and for other management, monitoring, and orchestration tools. Some licenses were upfront, while others were incurred as a pay-as-you-go subscription. Interviewees noted that containerized versions of middleware were generally the same cost or less than on-premises licenses; however, the costs for the operating system and container management platform could add up significantly. Ensuring resource optimization, hardware savings, license savings, and labor savings was essential to balance out the costs of these platforms.
- › **Professional services.** Organizations turned to professional services from IBM and Red Hat to determine strategy, test, deploy, and support their modernization efforts. These services could be one-time or recurring and often carried significant costs. However, organizations felt these services were essential: They helped them figure out where to start, avoid major missteps, implement quickly, and ensure the environment ran appropriately.
- › **Internal labor.** Internal labor was required throughout the process from IT administrators, developers, and cross-functional leadership. Quantifying the number of hours through each step is an essential part of the business case: planning, scoping, piloting, implementing, and managing. Organizations typically devoted multiple resources full-time to these efforts, and a large number (anywhere from 20 to 50) of cross-functional employees would pitch in anywhere from a few hours to half their workload. With most of these employees earning well over \$100,000 a year in fully burdened salary, these costs are significant.

While these costs add up, interviewees emphasized that there were similarly many costs required to simply maintain the status quo. Modernizing was not a choice: If they didn't act soon enough, they would be left behind and facing major business issues.

"The way Red Hat is doing things is a perfect world because they are preparing for both sides of the coin. They contribute to the open source community and [provide enterprise support] with very stable products."

Senior manager of systems engineering, NA telecom



"The cost of updates to [IBM Cloud Paks] are reducing with each version. This is fantastic because it makes the cost of development less expensive."

Product manager of cloud platforms, EMEA telecom



Risks Analysis

RISKS EVALUATED BY THE INTERVIEWED CUSTOMERS

The benefits and flexibility experienced by interviewed customers from their modernization efforts with IBM and Red Hat are significant. Nonetheless, modernization is extremely complicated. For any organization, it will take substantial labor, expertise, and funds to enable true transformation — and initial predictions may be incorrect. Successful transformations will require internal expertise, professional services, and technology, likely from a range of vendors. Evaluating risk is therefore especially important when building the business case for major initiatives such as those described in this study.

Across the market, application and infrastructure technologies are rapidly evolving, and no consistent or clear path has emerged that meets every company's needs. What appears to be the best approach today may very well be upended in coming years by new technologies, approaches, and market pressures. Further, simply understanding the complete current costs of an infrastructure environment is difficult, let alone controlling them. There may be blind spots, utilization may change, and the pricing of any third-party solutions themselves may change as well.

Risks evaluated by the interviewed organizations include:

- › **Highly complex infrastructure or poorly designed and understood legacy applications may be excessive barriers to modernization.** Modernization was a multiyear process as organizations started with pilots, moved to small selections of key priorities, and continually expanded their efforts.
- › **Companies' unique needs and labor skill sets may not align to specific IBM or Red Hat solutions.** Organizations typically hired individuals with Linux or Kubernetes experience and brought in professional services from IBM and Red Hat to bridge the gap, but in some cases, the availability of local talent and common specialization actually dictated the specific technologies that were implemented.
- › **Deployments may be more complex than expected — and may require additional technologies.** After deploying IBM's container platform and IBM Cloud Paks on Red Hat Enterprise Linux, the European financial services company struggled to upgrade its environment and instead provisioned a new environment with significant manual effort. It is now looking to incorporate an orchestration solution for automation-enabled upgrades in its next build. Further, in most cases, IBM and Red Hat were not the only vendors involved in interviewees' modernization efforts.
- › **Capabilities, compatibility, and pricing could change.** Interviewees cited uncertainty about IBM and Red Hat offerings they didn't currently use, how they can be used together today, and how the solutions may change down the road. While this would be a consideration for any investment with any vendor, evaluating how the market and offerings may change is still essential when making major DevOps investments.

Interviewees described modernization as a balancing act of competing trade-offs, but ultimately, the interviewed organizations identified that their investments with IBM and Red Hat were successful in simultaneously tackling existing risks and challenges, reducing IT costs and administration, and enhancing business outcomes.

Impact risk for benefits

Impact risk is the risk that the business or technology needs of the organization may not be met by the investment, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for benefit estimates.

Implementation risk for costs

Implementation risk is the risk that a proposed investment may deviate from the original or expected requirements, resulting in higher costs than anticipated. The greater the uncertainty, the wider the potential range of outcomes for cost estimates.

Business Case Summary

HOW THE BENEFITS, COSTS, RISKS, AND FLEXIBILITY STACK UP

Potential impacts of centralized infrastructure with IBM and Red Hat offerings are in four categories: benefits, flexibility, costs, and risks. Every business case will be unique, depending upon factors such as:

- › Specific products and services being considered.
- › Capabilities, dependencies, and pricing of existing infrastructure.
- › Structure and dependencies of legacy applications.
- › Organization location, size, use cases, and regulatory needs.
- › DevOps team structure and processes.

For interviewees, deploying hybrid cloud and containerization solutions using IBM and Red Hat represented a compelling balance between the benefits, flexibility, costs, and risks represented by variety and partnership. IBM and Red Hat provided enterprise-grade technology and expertise to help plan, design, and build solutions without sacrificing the underlying flexibility of open source and hybrid infrastructure.

Major undertakings like those described in this study will always be a balancing act of competing trade-offs to reduce costs, simplify environments, enhance performance, ensure compliance and security, improve employee experience, and avoid lock-in. Yet while modernization was typically difficult and expensive, and while the nature of these complex and years-long efforts prevented clear ROI analysis, the interviewed organizations nonetheless reported that using IBM and Red Hat offerings in tandem helped them successfully tackle existing risks and challenges, reduce IT costs and administration, and enhance business outcomes.

IBM and Red Hat provided enterprise-grade technology and expertise to help plan, design, and build solutions without sacrificing the underlying flexibility of open source and hybrid infrastructure.

Appendix A: Total Economic Impact

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders.

Total Economic Impact Approach



Benefits represent the value delivered to the business by the product. The TEI methodology places equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization.



Costs consider all expenses necessary to deliver the proposed value, or benefits, of the product. The cost category within TEI captures incremental costs over the existing environment for ongoing costs associated with the solution.



Flexibility represents the strategic value that can be obtained for some future additional investment building on top of the initial investment already made. Having the ability to capture that benefit has a PV that can be estimated.



Risks measure the uncertainty of benefit and cost estimates given: 1) the likelihood that estimates will meet original projections and 2) the likelihood that estimates will be tracked over time. TEI risk factors are based on "triangular distribution."

The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1 that are not discounted. All other cash flows are discounted using the discount rate at the end of the year. PV calculations are calculated for each total cost and benefit estimate. NPV calculations in the summary tables are the sum of the initial investment and the discounted cash flows in each year. Sums and present value calculations of the Total Benefits, Total Costs, and Cash Flow tables may not exactly add up, as some rounding may occur.



Present value (PV)

The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total NPV of cash flows.



Net present value (NPV)

The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.



Return on investment (ROI)

A project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits less costs) by costs.



Discount rate

The interest rate used in cash flow analysis to take into account the time value of money. Organizations typically use discount rates between 8% and 16%.



Payback period

The breakeven point for an investment. This is the point in time at which net benefits (benefits minus costs) equal initial investment or cost.

Appendix B: Endnotes

¹ Source: “Faster Software Delivery Will Accelerate Digital Transformation,” Forrester Research, Inc., April 12, 2018.

² Source: “Design For Dependability By Embracing A Future Of Trusted Technology: Reliable Services Are Critical For A Secure, Always-On Economy,” Forrester Research, Inc., February 25, 2019.

³ Source: “Monoliths Benefit From Both Containers And Microservices,” Forrester Research, Inc., June 26, 2017.

⁴ Source: Ibid.

⁵ Source: “Now Tech: Enterprise Container Platforms, Q2 2018,” Forrester Research, Inc., June 25, 2018.

⁶ Source: “Evolve Or Retire: Administrators Are Now Developers,” Forrester Research, Inc., July 13, 2018.

⁷ Source: “Assess The Pain-Gain Tradeoff Of Multicloud Strategies,” Forrester Research, Inc., March 19, 2019.