

A Forrester Total Economic Impact™  
Study Commissioned By IBM  
June 2020

# The Total Economic Impact™ Of IBM And Red Hat For Transportation

How Customers Unlocked Business Value With IBM And Red Hat

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# Executive Summary



Technology savings and optimization:  
**\$162 million**



Workforce efficiency:  
**\$105 million**



Enhanced operating margin:  
**\$64 million**



Increased operating income:  
**\$16 million**

Transportation companies including airlines, logistics, supply chain management, and multimodal shipping underpin the world economy. These sectors include heavy competition over commoditized services amongst fragmented providers, especially in shipping. Meanwhile, transportation companies are quite sensitive to external factors like shifting regulatory environments, geopolitical restrictions, natural disasters, climate change, and fuel prices. Uncertainty is especially high in 2020, as the COVID-19 pandemic among other factors causes unprecedented supply and demand shocks in both travel and shipping.

Success in these markets requires transportation companies to compete on price and customer experience (CX). They must scale up and down with elasticity to variably demand, while cutting and controlling costs to ensure profitability while winning customers in a market dominated by carrier bidding and consumer price shopping. Meanwhile, they must ensure industry-leading speed, reliability, and convenience of service while providing digital solutions such as real-time updates, contactless interactions, and digital payments. Reducing operating margin and IT costs is ultimately essential to profitability, but it cannot come at the expense of failing to meet customer expectations nor sacrificing compliance and security.

**Methodology.** IBM commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by using solutions from IBM and Red Hat together in the transportation industry. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of IBM and Red Hat for their own organizations.

## Primary data sources for Forrester's financial analysis



- › **Interviews with 15 organizations** using solutions from IBM and Red Hat together, including four transportation companies.
- › **Eighteen Forrester TEI studies with over 60 interviewed customers** published between 2018 to 2020 examining specific IBM or Red Hat solutions, including several transportation firms.
- › **Annual reports and financial disclosures** for leading publicly traded companies in transportation and two other sectors.
- › **Forrester's comprehensive market research.**

Using the data collected in this primary research, the following Total Economic Impact analysis illustrates the financial benefits, flexibility, costs, and risks that a *sample logistics provider* experiences by investing in a comprehensive set of IBM and Red Hat capabilities. Findings are directly based on and representative of the interviewed customers' experiences.

**Transportation companies must modernize applications and infrastructure while investing in emerging technologies to reduce operating costs, gain elasticity, and enhance CX.**

“Growth is important, so we already had interest in digital transformation with IBM and Red Hat from the C-level. The initial cost is warranted by the long-term business benefits and savings. We will break even within two to three years. Already, we’re doing more efficient analytics, client service reports, and more that have saved us money. We’ve also already used these tools to make payment systems easier and enable quick-pay, which is invaluable. It’s gained us new contracts.”

*Director of IT, logistics and multimodal shipping*



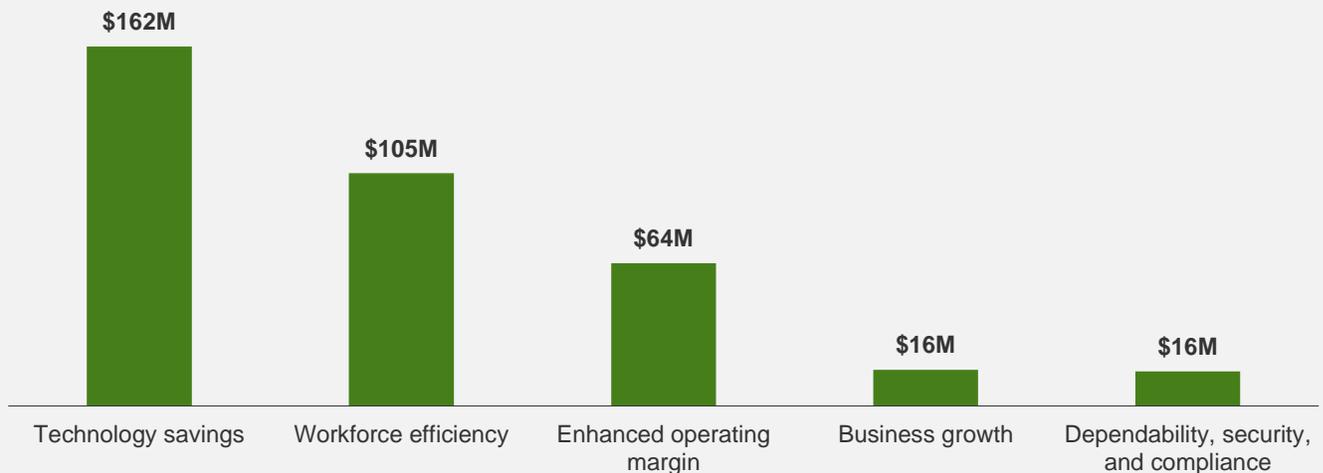
This *sample logistics provider* provides supply chain management, logistics, and multimodal shipping services. It earns \$5 billion in annual revenue at a 6% operating margin, employs 20,000 FTEs, and maintains 360 apps across three data centers with 5,760 virtual machines (VMs). It conducts a three-year technology transformation in which it: 1) migrates two-thirds of its on-premises apps to IBM Cloud; 2) deploys a hybrid multicloud container platform based on Red Hat Enterprise Linux (RHEL), Red Hat OpenShift, and IBM Cloud Paks across its on-premises hardware, IBM Cloud, and a third-party public cloud; 4) modernizes existing applications; and 5) innovates with containerized services including internet of things (IoT), Edge, blockchain, and AI.

## Key Findings

**Quantified benefits.** Forrester modeled total benefits of \$363 million over five years for the *sample logistics provider*, including:

- › Improves CX and launches new customer-facing apps, boosting revenue by \$272 million for \$16 million in additional operating income.
- › Doubles app development speed and reduces app maintenance by 25% to 50%, increasing productivity for 600 developers worth \$70 million.
- › Deploys IoT and AI for data insights that reduce operating costs by \$64 million for fuel, labor, purchased transportation, and insurance claims.
- › Saves \$60 million by migrating on-premises workloads to IBM Cloud, prevents \$24 million in excess spend for over-provisioning, and avoids \$3.4 million in modeled price increases by reducing lock-in risk.
- › Optimizes cloud spend by \$31 million and saves \$6 million by increasing data center resource utilization with the IBM and Red Hat platform.
- › Decreases software license costs by \$20 million and reduces resource consumption by \$17 million by modernizing apps and using container-based deployments and management in the IBM and Red Hat platform.
- › Reallocates 87 IT and operations administrators, saving \$23 million.
- › Avoids \$15 million in costs of downtime, breaches, and compliance.
- › Improves driver, technician, and office worker productivity by \$12 million.

**Five-Year Benefits For The Sample Logistics Provider**  
(Risk-Adjusted Present Values)





**ROI**  
44%



**Benefits PV**  
\$363 million



**NPV**  
\$111 million



**Payback**  
30 months

“We can do faster deployment with Red Hat OpenShift on IBM Cloud than ever before.”

*IT director, logistics and multimodal shipping*



“The goal of [Red Hat OpenShift with IBM Cloud Paks] is to set up a single solution with one company to have an integrated platform for modernization. We will manage all deployments on the cloud. This will decrease costs and labor.”

*Director of IT, logistics and multimodal shipping*



**Unquantified benefits.** Interviewees identified additional benefits that were either unique or did not yet have data for financial quantification. IBM and Red Hat helped customers employ DevOps and Agile processes to release updates more frequently in smaller components, while enhancing employee efficiency for data, security, and support teams. As a result, companies improved employee experience (EX), workplace culture, and could help better attract, hire, and retain employees. They also mitigated risks of unsupported applications or failing to meet new market needs and reduced environmental emissions using AI and IoT insights.

**Flexibility.** Customers gained flexibility and agility to respond to disasters and ensure business continuity, to do more with less, quickly adapt, reallocate resources, and innovate. They gained innovation opportunities with emerging technologies and the broad catalogs of IBM and Red Hat services, while reducing risk of proprietary technology lock-in by using leading open source components like Linux and Kubernetes.

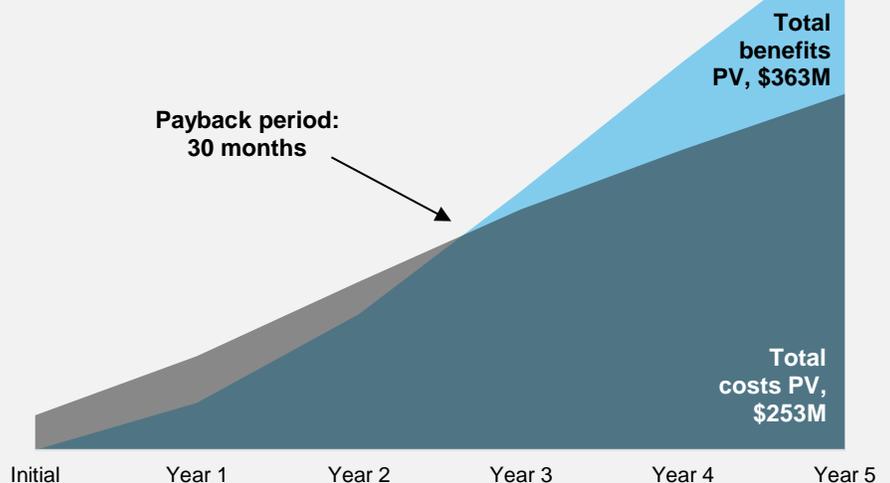
**Costs.** Forrester modeled total incremental costs of \$253 million over five years for the composite organization, including:

- › Technology costs of \$169 million for hardware, cloud, and software.
- › Professional services costs of \$47 million for transformation and \$20 million for ongoing management and support.
- › IT and developer training hours valued at \$17 million.

**Risks.** Forrester has integrated an evaluation of risks and variability into all calculations in this financial analysis. Measuring and proving the impact of an expansive transformation (including hardware, cloud, software, and professional services) is unsurprisingly complex, with many influencing factors such as legacy environments, use cases, selected solutions, industries, regions, sizes, and market trends. Forrester’s financial analysis is a conservative representation of reported impacts from interviewed organizations, but ultimately, results will vary significantly by organization.

**Synopsis.** Forrester’s financial analysis for the *sample logistics provider* illustrates incremental benefits of \$363 million over five years versus incremental costs of \$252 million by modernizing with a hybrid multicloud platform using IBM and Red Hat, adding up to a net present value (NPV) of \$111 million, a payback period of 30 months, and an ROI of 44%.

### Five-Year Financial Summary For The Sample Logistics Provider



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 solutions from IBM and Red Hat 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 solutions 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 IBM and Red Hat.



### **CUSTOMER INTERVIEWS**

Interviewed 15 organizations using IBM and Red Hat to obtain data with respect to costs, benefits, and risks.



### **MULTI-STUDY DATA REVIEW**

Reviewed findings from eighteen recent Forrester Consulting studies of IBM and Red Hat solutions encompassing over sixty interviews and hundreds of survey respondents.



### **COMPOSITE ORGANIZATION**

Designed a composite organization based on characteristics of the interviewed organizations.



### **FINANCIAL MODEL FRAMEWORK**

Constructed a financial model representative of the interviews using the TEI methodology and risk-adjusted the financial model 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 an investment in IBM and Red Hat.

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.

Interviews with eight of the 15 customers were sourced directly by Forrester without the involvement of IBM, with the other seven customer names provided by IBM. Neither IBM nor Red Hat participated in any of the 15 interviews.

# Market Trends For Transportation

## Logistics And Multimodal Shipping

Freight and logistics sectors face significant competition based on mode of transit, on business model (logistics companies, freight brokerages, freight carriers, independent contractors, in-sourced freight, and private freight), and on type of capacity (truckload [TL], less-than truckload [LTL], for-hire truckload [FTL], courier and parcel, and private). They also compete in intertwined ways when bidding for carriers and logistics providers and hiring from a limited pool of drivers.

To win contracts, freight and logistics companies must be able to win competitive bidding price wars, deliver goods with the fastest possible speed, and ensure reliability and accuracy for shipping. These companies must also offer digital apps, real-time updates, and contactless payments among other capabilities to win and retain customers with great CX. Yet, many factors cause challenges:

- › Fuel price fluctuations can cut into operating margins.
- › Driver shortages can drive up labor costs or prevent companies from taking on additional jobs.
- › Regulatory compliance and insurance that is needed for transporting sensitive or expensive goods such as food and medical supplies.
- › Regulatory requirements that impact workforce policy, including restrictions to drive times and the results of unionization.
- › Weather conditions can disrupt or slow normal operations, causing poor CX, delays, refunds, remediation costs, and excess labor. As climate change progresses, natural disasters pose even greater risks to disruption, costs, and safety.
- › External factors can create supply and demand shocks, disrupt normal operations, drive up costs, create safety risks, reduce consumer demand, create credit and cash flow risks, lead to carrier failures, or force the ceasing of operations entirely. Factors include:
  - Contagious diseases such as COVID-19 and SARS.
  - Tariffs, trade agreements, and sanctions that add costs or limit what can be transported between what locations.
  - Geopolitical disruption such as Brexit or war.
  - Economic disruption such as currency manipulation, hyperinflation, or recessions.
  - Societal turmoil such as protests, revolution, or terrorism.
- › Damage to goods, inadequate temperature controls, or failure to deliver on-time can lead to lost customers, refunded revenue, and insurance claims.
- › There are rising customer expectations for speed, cost cutting, enhanced customer service, LTL service, and last-mile delivery.

“Costs of goods and services have gone up. Fuel prices are our No. 1 concern. We’re struggling with driver shortages and retention. We’re dealing with tougher government regulation. We need an effective hybrid cloud strategy.”

*Director of IT, logistics and multimodal shipping*



## Airlines And Consumer Transportation

The airline sector features significant competition between international carriers (sometimes government-owned or subsidized), network carriers, national carriers, regional carriers, point-to-point carriers, and ultra-low-cost carriers. These companies compete on my levels: routes, schedules, fares, CX, and beyond.

Consumers seek the lowest possible fares with the fewest legs and the most convenient times, viewing the flights as a largely commoditized service. Airlines must be able to win the price war while offering the breadth of routes and services customers demand, which requires significant cost-cutting and focus on efficient operations. Airlines must also differentiate themselves and offer industry-leading CX to break out of the price war and to ensure consumer loyalty. To do so, airlines continually enhance their digital applications and processes to make planning and flying more convenient while optimizing operations to ensure on-time flights and good on-plane experiences. And they must do all of this with an eye on reducing their emissions in the face of climate change. Yet, many factors cause challenges:

- › Airline operations and supply chains are incredibly complex across route planning, ground support, security, check-in, ticketing, support, maintenance, and personnel.
- › Significant safety, security, and personally identifiable information (PII) regulations add barriers to innovation and require additional overhead for compliance.
- › Regulatory requirements impact workforce policy, including restrictions to flight times and the results of unionization.
- › Fuel price fluctuations impact operating margins unexpectedly, especially considering that fuel costs consume approximately 20% to 25% of total airline revenue.
- › Weather conditions can disrupt or slow normal operations, causing poor CX, delays, refunds, remediation costs, and excess labor. As climate change progresses, natural disasters pose even greater risks to disruption, costs, and safety.
- › External factors can drive up costs, create safety risks, reduce consumer demand, create credit and cash flow risks, or even force the ceasing of operations. Factors include:
  - Tariffs and sanctions that increase costs, reduce demand, or force cessation of routes such as between the U.S. and Cuba.
  - Contagious diseases such as COVID-19 and SARS.
  - Geopolitical disruption such as Brexit or war.
  - Economic disruption such as currency manipulation, hyperinflation, or recessions.
  - Societal turmoil such as protests, revolution, or terrorism.
- › Technical issues can force the grounding of aircraft (and lost revenues) or cause a crash or accident (impacting public perception of safety).
- › There are rising customer expectations for lower costs, digital apps, new routes, itinerary flexibility, and enhanced customer service.

“The airline industry has complex challenges. Everything is on-premises at each airport for many. Old code and tech from the '90s and early-2000s is rampant. However, airlines also need speed, availability, and data protection. The status quo is not good enough.”

*VP of digital transformation,  
consumer transportation logistics*



## Forrester's Perspective: Disaster Preparedness And Business Continuity During A Global Pandemic

Disasters and recessions can cause massive disruption, and businesses must prepare to protect themselves. As of June 2020, the COVID-19 pandemic is having a profound impact on organizations, employees, and customers in every sector. The world is on the edge of recession, and no one is immune from travel restrictions, health and safety risks, falling revenue to supply and demand shocks, and near-immediate macro behavior changes to new market needs and expectations.

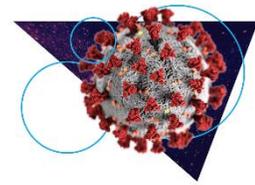
IT teams faced an initial burst of triage activities and then a stoppage of nonessential and on-premises work.<sup>1</sup> They must deal with surging traffic across the digital infrastructure — everything from employee communication to customer usage of digital channels — while these conditions threaten to turn preexisting minor application design flaws or infrastructure capacity constraints into major roadblocks.<sup>2</sup>

In the transportation logistics sector, the supply shock from the manufacturing pause in China and subsequent worldwide pauses has reverberated through global supply chain networks while nonessential industry shutdowns and sudden need for specific household and medical supplies worldwide has caused demand shocks. Companies have had to adapt to falloff in key customer segments, influxes of customers from new segments, and deviations in typical trends. Even demand spikes have challenged transportation companies to meet the logistic challenges of these shocks as they grapple with fleet limitations and bottlenecks. Meanwhile, these companies have had to adapt to new health and safety risks to minimize viral spread and to protect their workers and customers.

For airline transportation, the demand shock is among the most severe ever recorded in an industry. Governments and companies have forbid travel while consumers canceled their own plans. Airlines must now focus on differentiating in order to retain current customers and fill vacuums left by market exits in order to succeed in the post-crisis market landscape.<sup>3</sup> Even as airlines frantically cut costs amid the liquidity crisis, they must be loyal and deliver great experiences to both customers and employees. They will need to meet new customer and employee expectations for health and safety protocols with new seating arrangements, contactless processes, and passenger screenings. Given the strain on customers' wallets and the risk of total business failure, airlines must remember that now is the best time to earn loyalty, and it's the worst time to lose it.<sup>4</sup>

As the pandemic takes a heavy toll on lives and economies, it may seem counterintuitive to launch major innovation campaigns. Yet, there may be no better time to creatively solve customers' problems and stake claim as an innovation leader and driver of change.<sup>5</sup> Today's disruption will permanently change the fabric of the industry, so airlines must adapt in order to be at the forefront of the new market. Organizations should:

- › Increase, not decrease the focus on innovation and speed using cloud technologies, containerization, open source, and Agile and DevOps practices. They must design and deploy new and updated functionality faster and more radically than ever before to meet quickly changing employee and customer demands and to comply with late-breaking government regulatory requirements.
- › Embrace new processes and technologies that allow cross-border, real-time, remote data access and team collaboration with almost no downtime and end-to-end capability to identify and solve problems on the fly.<sup>6</sup>
- › Leverage the cloud and usage-based pricing models to avoid capex cost outlays, control opex cash flow, and scale environments and subscriptions to only pay for what is needed.
- › Cut costs with open source technologies, application portfolio rationalization, and cloud container platforms.<sup>7</sup>
- › Rely on consolidated monitoring, management, and automation to deliver business continuity amidst changing usage patterns and as a stopgap for disruptions in available employee resources.
- › Beware of upticks in security risks from phishing, attempted breaches, and quickly deployed capabilities (potentially without best practices).



Transportation companies face extreme uncertainty during the pandemic. They must invest in solutions to scale up and down with elasticity to meet the supply and demand shocks of today, and they must innovate to succeed in the current and post-pandemic market.

# Customer Journey

## CUSTOMERS' DRIVERS FOR IBM AND RED HAT INVESTMENTS

### Interviewed Organizations

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

- › Interviewed organizations employ between 2,500 and 100,000 FTEs.
- › Two interviewed organizations provide logistics, supply chain management, and multimodal shipping.
- › One interviewed organization is a multinational airline.
- › One interviewed organization provides logistics and technology support for consumer transportation companies.
- › All interviewed companies operate in multiple countries and three operate across continents. Three are based in North America and one is based in Europe.

Forrester also integrated data from the following sources:

- › Eleven interviews with financial services and telecommunications companies using solutions from IBM and Red Hat together.
- › Findings from 18 recent Forrester Consulting studies on specific IBM or Red Hat solutions, which encompass over 60 interviewed companies and hundreds of survey respondents — including several transportation companies.
- › Annual reports and financial disclosures for 15 leading, publicly traded companies in transportation, plus reports from two other sectors.
- › Forrester's comprehensive market research.

### Key Challenges

Interviewed companies faced common pressures:

- › **Legacy performance and availability fell short.** One interviewed airline operated monolithic legacy applications and struggled to move or modify the apps due to complexity and a lack of employee expertise. As a result, it faced major data center outages that were damaging to its reputation and bottom line. A consumer transportation logistics VP of digital transformation explained how common this situation is: "The airline industry has complex challenges. Everything is on-premises at each airport for many. Old code and tech from the '90s and early-2000s is rampant. However, airlines also need speed, availability, and data protection. The status quo is not good enough."
- › **Market pressures necessitated digital innovation.** Commoditized price wars pushed transportation companies to reduce IT costs, offer better digital customer experiences, and use emerging technologies to reduce operational costs (including fuel). One logistics and multimodal shipping company found that its on-premises rack servers were not scalable enough when the company needed agility. As it modernizes, the company needs both IT systems and transportation services to remain high-quality, secure and compliant, stable, and efficient.

Interviewed transportation customers used a range of the following solutions:

#### IBM

Blockchain  
Cloud  
Cloud Pak for Applications  
Cloud Pak for Data  
Cloud Pak for Integration  
Cloud Pak for Multicloud Management  
Cloud Pak for Security  
DB2  
Edge Application Manager  
Garage  
LinuxOne  
MQ  
Power Systems  
Services  
Watson  
Watson IoT  
Watson Studio  
WebSphere Liberty  
Z Systems

#### Red Hat

Ansible  
Container Adoption Program  
Enterprise Linux  
Gluster Storage  
Insights  
JBoss EAP  
JBoss Web Server  
Open Innovation Labs  
OpenShift  
OpenStack Platform  
Virtualization

"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,  
airline*



## Partner Selection

The interviewed organizations searched for partners that could:

- › **Unify different on-premises and cloud environments, regardless of vendor, with strong hybrid multicloud management capabilities and a good user experience (UX).** The consumer transportation logistics company chose RHEL and OpenShift as key solutions to work across any infrastructure and unify its on-premises and third-party public cloud environments with its' partners private and public clouds.
- › **Provide enterprise dependability, security, support, and expertise with IBM Cloud and access to a rich catalog of IBM, Red Hat, and open source services.** Companies wanted to use open source and cloud services with confidence and ease — made possible by RHEL, Red Hat OpenShift, and IBM Cloud Paks. The director of IT for a logistics and multimodal shipping company explained, “Red Hat OpenShift lets us use different services as a la carte ‘Lego’ pieces. IBM Cloud Paks standardize services to simplify the process for developers to with pre-combined components without having to assemble all the individual ‘Lego’ pieces.”
- › **Enable creation of apps with IoT, Edge, AI, and Blockchain.** Both interviewed logistics and multimodal shipping companies turned to IBM and Red Hat to help deploy IoT and Edge devices throughout their transportation fleets and to pull the data into the hybrid cloud platform, merge it with other data streams, and run AI-powered insights and dashboards to boost efficiency and cut operating costs.

## IBM And Red Hat Capabilities

Companies Forrester interviewed have invested in the following offering categories from IBM and Red Hat:

- › **Hardware.** IBM Z and IBM Power Systems boosted security, performance, and value as compared to legacy hardware.
- › **Cloud.** IBM Cloud allowed customers to access the flexibility and value of the cloud while meeting security and compliance needs.
- › **Professional services.** A range of offerings from IBM Services and IBM Garage to Red Hat’s container adoption program helped set strategies and taught companies to leverage modern containerization, microservices, and serverless architectures in the face of technical debt and stringent security and compliance needs.
- › **Platform.** Red Hat OpenShift, RHEL, and IBM Cloud Paks provided the technology to consistently develop, monitor, and manage modern and legacy applications across hybrid and multicloud infrastructures (including hardware and cloud from IBM and third parties).
- › **Middleware and services.** Organizations used prepackaged, containerized software from IBM and Red Hat catalogs including IBM WebSphere Liberty, DB2, MQ, Watson, or Blockchain and Red Hat Virtualization, Ansible, Insights, Gluster Storage, or JBoss.
- › **New technologies.** Organizations leveraged IoT, Edge, AI, and blockchain offerings from IBM, Red Hat, and the open source community via the IBM and Red Hat platform.

“The goal of [Red Hat OpenShift with IBM Cloud Paks] is to set up a single solution with one company to have an integrated platform for modernization. We will manage all deployments on the cloud. This will decrease costs and labor.”

*Director of IT, logistics and multimodal shipping*



“IBM’s biggest strength is the catalog of apps and the ease to run them, while Red Hat’s biggest strengths are strong virtualization, containerization, and operating systems based on open source.”

*IT director, logistics and multimodal shipping*



“We are setting up our on-premises environment with Red Hat Enterprise Linux and using OpenShift to connect it with IBM Cloud and [other cloud providers]. We can let apps run anywhere and everywhere. We can use open source. We can virtualize environments and automate tasks. It will let us use JBoss for Java developers and web applications, which is best in class and brings us modern standards, easy configuration, and quick deployment.”

*Director of IT, logistics and multimodal shipping*



# Transportation Model

## Composite Organization

To model the Total Economic Impact of investing in solutions from IBM and Red Hat for a transportation company, Forrester aggregated findings to design a composite organization referred to as the *sample logistics provider* and an associated ROI analysis that is representative of the four interviewed transportation customers. The *sample logistics provider*:

- › Provides supply chain management, logistics, and multimodal shipping services including FTL and LTL freight shipping.
- › Uses a blended model of owned, contracted, and brokered capacity for truck transportation with 13,000 owned trucks and 12,000 average carrier trucks on the road.
- › Earns \$5 billion in revenue per year with a 6% operating margin. Freight shipping drives \$3.6 billion in revenue (72% of total revenue) as each truck generates approximately \$3,000 in revenue per week with 48 operational weeks per truck, per year. The remaining 28% of revenue comes from the company's logistics services.
- › Incurs operating costs as a percentage of revenue including 50% for purchased transportation and rent, 24% for labor, 6% for depreciation and amortization, 6% for fuel, 3% for operating supplies and expenses, 2% for insurance and claims, and 3% for general and administrative expenses among other miscellaneous costs.

### Operating Costs As A Percent Of Revenue For The Sample Logistics Provider

COST CATEGORY	OPERATING MARGIN	COST CATEGORY	OPERATING MARGIN
Purchased transportation and rent	50%	Insurance and claims	3%
Labor	24%	General and administrative expense	2%
Depreciation and amortization	6%	Miscellaneous operating cost categories	3%
Fuel	6%	<b>Remaining operating income</b>	<b>6%</b>

- › Runs 360 apps in three data centers with a total of 180 server racks and 5,760 VMs, along with 40 apps in a third-party public cloud.
- › Employs 20,000 FTEs, including:

### Fully Burdened Employee Salaries For The Sample Logistics Provider

ROLE	FTEs	HOURLY SALARY	ANNUAL SALARY
Drivers	14,000	\$27 per hour	\$56,000
Technicians	1,000	\$23 per hour	\$48,000
IT/ops admins	200	\$58 per hour	\$120,000
Developers	800	\$65 per hour	\$135,000
Other office workers (sales, marketing, finance, etc.)	4,000	\$35 per hour	\$73,000

## Modeled Deployment

The *sample logistics provider* conducts a three-year technology transformation including data center redesign, cloud migration, and application modernization. The *sample logistics provider*:

- › Utilizes the **Red Hat Container Adoption Program** to teach its DevOps teams to use containers and microservices to their potential, helping modernize existing applications and develop new ones.
- › Partners with **IBM Services** to: 1) strategize and plan its modernization; 2) support adoption of IBM Cloud; 3) implement RHEL, Red Hat OpenShift, IBM Cloud Paks, and containerized IBM middleware; 4) design best practices for modernization to ensure security, compliance, performance, and agility; and 5) advise on innovation with IoT, Edge, blockchain, and AI.
- › Decommissions 120 server racks (66% of its total data center) over a three-year period, moving 240 apps to **IBM Cloud**.
- › Deploys **RHEL** with **Red Hat OpenShift** and **IBM Cloud Paks for Applications, Data, Integration, Multicloud Management, and Security** to form a private cloud including its data center, IBM Cloud, and a third-party public cloud environment.
- › Invests in **IoT, Edge computing, and AI** to monitor, analyze, and optimize its supply chain and freight shipping efficiency and outcomes.

Financial modeling is based on customer data. Modeled impacts are shown for the most common, consistent solution combinations shared by interviewed customers.

Benefit and summary sections summarize all important elements for the calculation, but they omit the full tables to avoid excessive length. Calculation tables will be available upon request.

# Analysis Of Benefits

## QUANTIFIED BENEFIT DATA FOR THE SAMPLE LOGISTICS PROVIDER

Total Benefits						
BENEFIT	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	PRESENT VALUE
Technology savings: optimize data center resources with platform management	\$691,200	\$1,382,400	\$2,073,600	\$2,073,600	\$2,073,600	\$6,032,609
Technology savings: decommission data centers with cloud migration	\$6,912,000	\$13,824,000	\$20,736,000	\$20,736,000	\$20,736,000	\$60,326,085
Technology savings: optimize cloud resources with platform management	\$4,212,000	\$7,181,460	\$10,285,279	\$10,521,857	\$10,763,878	\$31,361,755
Technology savings: optimize resources with app modernization	\$631,800	\$2,693,048	\$5,399,771	\$7,891,393	\$8,072,908	\$17,259,519
Technology savings: avoid overprovisioning with cloud scalability	\$3,159,000	\$5,386,095	\$7,713,959	\$7,891,393	\$8,072,908	\$23,521,316
Technology savings: reduce software licensing	\$1,862,093	\$4,041,441	\$6,560,440	\$7,799,769	\$7,978,864	\$20,243,395
Technology savings: avoid infrastructure lock-in	\$0	\$0	\$349,352	\$1,326,040	\$3,576,210	\$3,388,722
Operational efficiency	\$1,836,000	\$5,202,000	\$7,548,000	\$8,874,000	\$8,874,000	\$23,210,306
Developer efficiency	\$8,189,376	\$18,047,744	\$23,974,080	\$25,459,200	\$19,094,400	\$69,617,556
General workforce efficiency	\$1,017,450	\$2,034,900	\$3,362,600	\$4,690,300	\$6,018,000	\$12,073,304
Dependability	\$1,930,481	\$3,366,881	\$4,788,000	\$4,788,000	\$4,788,000	\$14,378,064
Security and compliance	\$274,886	\$305,414	\$335,617	\$335,617	\$335,617	\$1,192,080
Business growth	\$483,830	\$1,687,660	\$4,800,000	\$7,200,000	\$9,600,000	\$16,319,458
Enhanced operating margin	\$5,600,000	\$11,200,000	\$18,000,000	\$24,800,000	\$31,600,000	\$64,430,621
<b>Total benefits (risk-adjusted)</b>	<b>\$36,800,115</b>	<b>\$76,353,041</b>	<b>\$115,926,699</b>	<b>\$134,387,168</b>	<b>\$141,584,385</b>	<b>\$363,354,790</b>

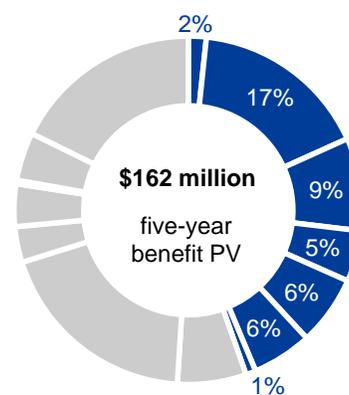
## Technology Savings

**Benefit summary.** Investments in cloud migration plus platform and app modernization allowed interviewed companies to eliminate data center operational costs, control cloud spend and licensing, and scale to meet peak demands. Organizations benefited from improved cash flow as they replaced upfront hardware and license purchases with usage-based subscription costs, while also reducing risk of vendor or infrastructure lock-in. Cost savings were linked with equivalent or better security, compliance, performance, and dependability across environments.

**Impact to transportation.** Transportation companies must run apps and access data across infrastructure in multiple regions with speed, security, and dependability. They need to quickly develop and deploy solutions using emerging technologies, including Edge, IoT, and blockchain for fleet monitoring and tracking and AI to drive operational efficiencies and to improve speed and quality of service for customers.

Interviewed transportation companies migrated on-premises workloads and developed new applications in IBM Cloud, providing scale and agility. Companies deployed hybrid multicloud container platforms using RHEL, Red Hat OpenShift, and IBM Cloud Paks in existing data centers, IBM Cloud, and third-party clouds — consolidating development, management, and monitoring. These platforms ultimately provided foundation for IoT and AI, as data flowed into the platform for analysis and usage in all apps. Interviewed transportation companies shared:

- › **A multinational airline reduced licensing costs by 38% using Red Hat OpenShift.** Red Hat’s containerized middleware was more lightweight and cost-effective than traditional middleware licensing, and because it was available in containers covered under the supply chain agreement, it could be tested and deployed much faster. The company also reduced per-OS licensing cost by running apps in containers.
- › **A logistics and multimodal shipping company used Red Hat OpenShift, IBM Cloud, and IBM Watson to reduce IT costs and deploy an IoT and AI solution.** The company used OpenShift to unify third-party cloud and on-premises environments, and it deployed apps in IBM Cloud for more cost-effective scaling. It deployed IoT devices in its truck fleet and fed data into OpenShift for consumption by IBM DB2 and Watson. The director of IT shared: “Red Hat connects with other companies, including [third-party cloud providers]. The independence of Red Hat strengthens the environment. We can use OpenShift on-premises and in IBM Cloud, but we can also use it on other clouds.”
- › **A logistics and multimodal shipping company gained access to emerging technologies and can handle 10% growth without increased IT spend.** The IT director said: “IBM’s data, analytics, user experience, and AI are on the cutting edge with competitive costs. . . . IBM and Red Hat provide the environment for people to use and manage open source, infrastructure, containers, and middleware in a functional, effective way with multiple public and private clouds. This is the system that lets everyone work together as effectively as possible no matter where they are or what they are working on.”
- › **A consumer transportation logistics company used RHEL and OpenShift to provide control, streamline processes, and improve developer experience.** It is successfully using the platform across its on-premises infrastructure and a third-party public cloud, helping manage it all with one cohesive experience and reducing wasted labor.



**Technology savings: 45% of total benefits**



A multinational airline reduced its billion-dollar IT budget by 4% with IBM and Red Hat, saving \$40 million per year.

“IBM and Red Hat had the best cost-to-quality ratio for the public cloud and container platform.”

*Director of IT, logistics and multimodal shipping*



“We’re expecting to grow 10% this year, and having the IBM Cloud with Red Hat OpenShift makes it possible to scale for the growth.”

*IT director, logistics and multimodal shipping*



**Financial model.** The *sample logistics provider's* investment in IBM and Red Hat yields a five-year risk-adjusted present value of \$162 million:

- › **Boosts data center resource utilization by 20% with RHEL, OpenShift, and IBM Cloud Paks, saving \$6 million.** The *sample logistics provider* reduces 60 server racks to 48 racks for core apps and data with improved utilization, saving \$128,000 in annual operational costs and avoiding \$320,000 five-year refreshes per rack.
- › **Avoids \$60 million in hardware refresh and operational costs by migrating workloads to IBM Cloud.** The *sample logistics provider* migrates 120 server racks over three years, saving \$128,000 in annual operational costs each and \$320,000 per refresh at a five-year cycle.
- › **Optimizes cloud costs with platform management, improving density by 20% to save \$31 million.** Containerization and management using Red Hat OpenShift and IBM Cloud Paks reduces workload resource requirements by 20% in both IBM Cloud and a third-party cloud, saving approximately \$40,000 per app, per year.
- › **Reduces resource requirements by 30% for modernized apps, saving \$17 million.** The *sample logistics provider* refactors and modernizes 140 apps over four years using microservices and serverless architectures plus prepackaged services. Modernization saves \$61,000 per app by rationalizing needs, allocating resources per microservice, shutting down idle workloads, and boosting density.
- › **Prevents 15% in over-provisioned infrastructure for peak loads, avoiding \$24 million in potential costs.** The *sample logistics provider* scales cloud resources as needed with usage-based pricing.
- › **Trims software license costs by 15% for containerized apps and by 35% for apps refactored with modern architectures, saving \$20 million.** The *sample logistics provider* containerizes 400 apps and modernizes 140 apps with IBM and Red Hat. As a result, it decreases the number of licenses by decreasing servers, VMs, and workload requirements, and by finding and ending idle workloads.
- › **Diminishes risk of lock-in to rising costs, avoiding \$3 million in modeled cost increases.** The *sample logistics provider* gains workload portability to any on-premises and cloud environment that supports z/OS, RHEL, Red Hat OpenShift, or IBM Cloud Paks. With modeled annual price increases for infrastructure and licenses tied to 2.3% inflation, the composite evaluates alternate solutions due to pricing pressure and changing marketplace dynamics beginning in Year 3 with a 10% chance of leveraging portability to change solutions or vendors, rising to a 50% chance in Year 5.
- › **Faces impact risks of 10% that may cause realized savings to be less than modeled.** Factors include: 1) variability in a company's legacy environment, selected IBM and Red Hat products, and desired use cases; 2) unpredictability in pricing including selected solutions, discounting, and regional variation; 3) risk of delayed or limited implementation success preventing recognition of benefits; and 4) broader market forces impacting business needs and costs.



## The sample logistics provider:

- Boosts resource utilization for the data center by 20%, saving \$6M.
- Migrates workloads from legacy hardware to IBM Cloud, saving \$60M.
- Optimizes cloud costs with platform management by 20%, saving \$31M.
- Reduces resource demands for modern apps by 30%, saving \$17M.
- Prevents excess overhead of 15%, saving \$24M.
- Trims software licensing by 15% for containerized apps and by 35% for modernized apps, saving \$20M.
- Diminishes risk of lock-in, avoiding \$3M in modeled price increases.

"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,  
airline*



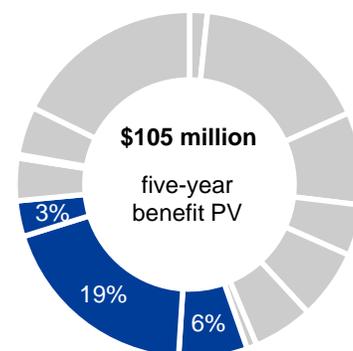
## Workforce Efficiency

Interviewed transportation companies needed to improve workforce efficiency while innovating to meet rising customer expectations. Linux and platform consolidation enabled IT and development teams to work faster and more efficiently, streamlining management and monitoring while releasing updated capabilities more frequently. Developers used emerging technologies to build tools and generate data insights for office staff (e.g., finance and sales) to streamline manual processes and better predict costs for new proposals. The new systems also helped optimize transportation routes, reducing excess truck rolls and flights to optimize capacity while better predicting and allocating maintenance technicians. Improved planning and monitoring reduced delays, accelerated deliveries, and helped ensure the right goods ended up at the right place. New customer-facing apps such as route-progress notifications and digital payments combined with this improved quality and speed of service to reduce customer call and email volume, saving more time for contact centers, sales, and other office employees. Interviewees shared:

- › **A multinational airline streamlined platform and middleware administration, reducing staffing costs by 35%.** Separate teams no longer needed to procure, deploy, and manage each technology. The airline could now handle it all via developer self-service with oversight from OpenShift platform managers.
- › **A multinational airline accelerated release cycles by 66%.** Previously, developers struggled with frustrating tools, wasteful processes, and difficult app architectures. Developers using OpenShift worked much faster, saving significant labor costs, improving employee morale, and ultimately benefiting customers with faster app updates.
- › **A logistics and multimodal shipping company raised developer and IT productivity with OpenShift and IBM Cloud.** Teams gained efficiency, could work on the same apps concurrently, and saved time for data analysis, monitoring, management, and reporting.
- › **A logistics and multimodal shipping company boosted developer productivity by switching to RHEL.** Developers enjoyed a better UX with easier tools, simpler maintenance, fewer errors, better accuracy, and improved reliability and speed. The IT director shared, “We can now work faster, grow more quickly, and have fewer errors.”
- › **Another logistics and multimodal shipping company lifted productivity for development, IT, compliance, finance, and drivers.** Developers and IT teams valued having a single cloud experience instead of dealing with multiple platforms, different infrastructure environments, and legacy middleware. Teams worked faster, releasing more apps and capabilities for internal users and customers than they could before. They created new apps and dashboards that aggregated data and automated processes: saving time and improving employee experience for finance and compliance teams, while improving route planning to maximize truckloads and minimize wasted miles and labor.

**Financial model.** The *sample logistics provider's* investment in IBM and Red Hat yields a five-year risk-adjusted present value of \$104.9 million:

- › **Reallocates 30% of infrastructure admins for its data centers by deploying the IBM and Red Hat platform.** The *sample logistics provider* begins with 30 admins (10 per data center), nine of which are shifted to other value-add tasks by Year 2 (three per data center).



### Workforce efficiency: 29% of total benefits

“Microservices and containers provide higher-quality apps that are easier to troubleshoot, making reaction times faster. We expect operations savings between 50% to 70% as many classical operations tasks are automated over time.”

*IT manager, airline*



“Our workloads on IBM Cloud with Red Hat tools let us do rapid application updates over multi-region deployments.”

*Director of IT, logistics and multimodal shipping*



“We save so much labor with one management plane to release images. 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, airline*



- › **Reallocates all infrastructure admins for environments migrated to the cloud.** The *sample logistics provider* begins with 30 admins for this segment (10 per data center), 33% of which are shifted each year to other value-add tasks with all FTEs reallocated by Year 3.
- › **Reallocates 70% of middleware admins by using prepackaged services from IBM and Red Hat catalogs.** Five percent of the *sample logistics provider's* 40 middleware admins (each specializing in a different technology) are reallocated in Year 1, with 30% in Year 2, 50% in Year 3, and reaching 70% in Year 4.
- › **Boosts productivity for platform and operations administrators by up to 40%.** The *sample logistics provider* improves efficiency for its 100 admins with streamlined monitoring, management, and automation in a single hybrid multicloud solution with improved UX. It recaptures 50% of time saved for added business value.
- › **Doubles app development speed, reducing timelines from 24 weeks to 12 weeks.** The *sample logistics provider's* eight-person teams eliminate environment wait time, streamline service integration with prepackaged containers, and code faster with improved, consolidated UX. Teams deliver apps with 90% fewer errors which, combined with automation, slashes time needed for testing and deployment.
- › **Decreases annual maintenance labor by 25% for containerized legacy apps.** The *sample logistics provider's* product teams previously dedicated eight weeks per year to update and maintain apps. The IBM and Red Hat platform saves two weeks with automation, consolidated tools, prepackaged services, and improved UX.
- › **Halves annual maintenance for modernized apps.** Microservices architecture shaves another two weeks per year from app updates and maintenance (from eight to four weeks), as the company can complete work much more easily with fewer dependencies and lower complexity.
- › **Reduces excess trips for drivers by 0.5% with data- and AI-optimized packing and route planning.** The *sample logistics provider* saves 70 FTEs of hours across its 14,000 drivers.
- › **Increases technician efficiency by 1% with data- and AI-optimized maintenance planning.** The *sample logistics provider* saves over 10,000 hours across its 1,000 technicians (equal to 5 FTEs), assuming only 50% of time saved is recaptured for additional productivity.
- › **Improves productivity for general office personnel by 2%.** Faster app updates, improved performance and availability, automated communications, digital account portals, and new data- and AI-powered dashboards help finance, sales, and other general employees work more quickly and accurately. The company delivers better speed, quality, and customer service for shipping, reducing complaints and communication. The *sample logistics provider* saves 40 FTEs of hours across its 4,000 general employees, assuming only 50% of time saved is recaptured for added business value.
- › **Faces impact risks of 15% that may cause realized savings to be less than modeled.** Factors include: 1) variability in a company's legacy environment, selected IBM and Red Hat products, and desired use cases; 2) size of IT and development teams; 3) typical employee salaries, 4) risk of delayed or limited implementation success preventing recognition of benefits; and 5) broader market and regulatory forces impacting business needs and internal processes.



## The sample logistics provider:

- Reallocates 87 IT and operations administrators, saving \$23M.
- Boosts productivity for 600 developers, saving \$70M.
- Reduces excess truck trips by up to 0.5%, increases maintenance efficiency by up to 1%, and boosts general office productivity by 2%, saving \$12M.

“Our containerized platform allows developers to build apps and work more efficiently with good tracking, maintenance, collaboration, and communication.”

*IT director, logistics and multimodal shipping*



“We have IoT devices set up through the engine management system of our trucks that we combine with other sensor data like cold storage temperature variations and driver-input data. It collects engine utilization, engine breaking, oil usage and duration, fuel economy — everything. We can use this to identify issues and get a mechanic where they are needed quickly.”

*IT director, logistics and multimodal shipping*



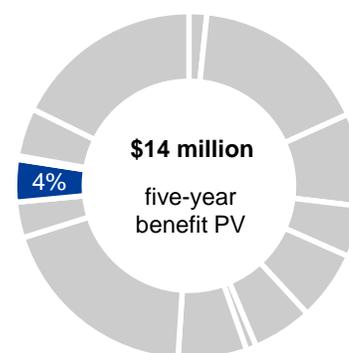
## Dependability

**Benefit summary.** Eighty-five percent of companies face unplanned downtime at least every other month, with an average of 830 minutes per year at a cost of \$5.6 million per year.<sup>8</sup> Organizations significantly improved dependability by modernizing with IBM and Red Hat, accessing enterprise-grade versions of open source technologies and leveraging robust hardware, cloud, and platform offerings. IBM Cloud provided high-performance, secure, dependable infrastructure to run applications and store data. Meanwhile RHEL, Red Hat OpenShift, and IBM Cloud Paks provided platform services to connect infrastructures, data, and apps with consistent monitoring and management to catch, fix, and prevent issues to ensure availability, performance, and resiliency. As a result, companies significantly reduced user-impacting downtime.

**Impact to transportation.** Airlines and airfare services companies must ensure immediate access to extensive data from passenger identification and ticketing to route scheduling and security risk profiling to technical performance tracking. Logistics and shipping companies must ensure the right goods end up at the right places quickly and effectively with no lapses or delays that could cause revenue losses or insurance claims. Interviewed customers trusted IBM and Red Hat platforms, cloud, and services to deliver the availability and performance they needed, and they relied on professional services from IBM and Red Hat to design applications and infrastructure for dependability. Interviewees shared:

- › **A multinational airline was plagued with major data center outages that damaged its reputation and revenue.** With IBM and Red Hat, the company prevented further outages, which avoided remediation costs, lost revenue, and damaged brand reputation.
- › **A logistics and multimodal shipping company used IBM Cloud Paks to monitor and manage its hybrid multicloud environment to ensure dependability.** The director of IT said: “With IBM Cloud Pak for Multicloud Management, we can discover and fix problems. It improves CX and retention while reducing business risks.”

**Financial model.** The *sample logistics provider* slashes unplanned downtime by 95% in the IBM and Red Hat environment, yielding a five-year risk-adjusted present value of \$15 million.



**Dependability:  
4% of total benefits**

“The risks of deploying an update decrease significantly [using microservices] since a small portion of the product is affected.”

*IT manager,  
airline loyalty program*



### Dependability: Calculation Table

ANNUAL COST OF UNPLANNED DOWNTIME	REDUCED DOWNTIME WITH IBM AND RED HAT PLATFORM	PERCENT OF ENVIRONMENT IN IBM AND RED HAT PLATFORM	RISK ADJUSTMENT
\$5.6 million	95%	40% in Year 1, 70% in Year 2, and 100% in Year 3 and beyond.	Moderate (10%)

## Security And Compliance

The future of computing will be multicloud and hybrid, and if security leaders thought their footprints of digital assets were already difficult to protect, it's only going to get worse.<sup>9</sup> Breaches pose immense risk in remediation costs, lost sales, and regulatory fees. Ensuring and proving compliance is also a major challenge for transportation companies, which manage significant PII that must be protected in accordance with stringent rules from the California Consumer Privacy Act (CCPA), the General Data Protection Regulation (GDPR), and the Health Insurance Portability and Accountability Act (HIPAA). These companies must also adhere to regulations from the Federal Motor Carrier Safety

“With IBM Cloud Pak for Multicloud Management, we can discover and fix problems — improving CX and retention while reducing business risks.”

*Director of IT, logistics and multimodal shipping*



Administration (FMCSA), the US Department of Transportation (DOT), the US Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), the California Air Resources Board, the US Department of Homeland Security (DHS), and more.

IBM Services helped companies wade through security and compliance challenges, while IBM and Red Hat monitoring, management, and remediation tools reported on and ensured security and compliance. Companies streamlined processes, saved labor for monitoring and reporting, and avoided remediation costs and lost sales:

- › **A logistics and multimodal shipping company improved hybrid multicloud security and compliance.** Using Red Hat OpenShift with IBM Cloud Pak for Multicloud Management, the company gained greater control of security configurations across its infrastructure.
- › **A logistics and multimodal shipping company also relied on IBM and Red Hat as one of its key partners in deploying and defending its IoT devices and the data stream from them.** IoT is essential for business growth and cost savings, but security was a major concern. The director of IT said, “We need to ensure a high level of security with any IoT devices.”
- › **A logistics and multimodal shipping company relied on platform tools from IBM and Red Hat to ensure HIPAA compliance.** The company used IBM and Red Hat capabilities to report on and ensure that its transport of medical items adhered to regulations.
- › **A multinational airline improved compliance and security even as it reduced its total cost of ownership.** One year prior, the airline discovered a long-standing data breach via a third-party middleware service that led to remedial, legal, and other incident resolution costs. It now meets compliance needs more easily by enforcing everything as code, but it remains cautious to carefully vet each app and manage containerized assets to ensure there are no lapses.
- › **IBM and Red Hat helped protect sensitive data for the consumer transportation logistics company.** The VP of digital transformation said: “We handle tons of PII such as passport numbers, traveler names, destinations, facial recognition, and more. We also need to protect information about high-value items or important people’s movements to ensure their safety.”

**Financial model.** The *sample logistics provider’s* investment in IBM and Red Hat yields a five-year risk-adjusted present value of \$1 million, slashing the likelihood of a breach by 80% and avoiding \$292,000 in fines per year. Forrester found that 53% of firms have had a breach in the past year, with 10% leading to lost customers.<sup>10</sup> The *sample logistics provider* earns \$5 billion in revenue per year at a 6% operating profit margin, and breaches are assumed to affect only 1% of customers, resulting in \$300,000 in projected losses per breach.

Forrester recognizes that the likelihood and size of compliance fees or breaches will vary substantially. This calculation reflects a conservative approach to estimating risk reduction based on current averages.



The sample logistics provider **saved over \$1 million** by mitigating security and compliance risks with IBM and Red Hat.

“We handle tons of PII such as passport numbers, traveler names, destinations, facial recognition, and more. . . . We also need to protect information about high-value items or important people’s movements to ensure their safety.”

*VP of digital transformation, consumer transportation logistics*



“We can now quickly deal with compliance using IBM Cloud Pak for Multicloud Management. We can crunch data in real time and remediate violations automatically. It gives us an easy-to-use and customizable dashboard for monitoring with an intuitive user interface.”

*Director of IT, logistics and multimodal shipping*



### Security And Compliance: Calculation Table

AVOIDED COMPLIANCE FINES	LOST SALES PER BREACH	LIKELIHOOD OF A BREACH	REDUCED LIKELIHOOD WITH IBM AND RED HAT	ENVIRONMENT IN IBM AND RED HAT	RISK ADJUSTMENT
\$292,321 per year	\$300,000 in operating income	53%	80%	40% increasing to 100% by Year 3	Very high (20%)

## Business Growth

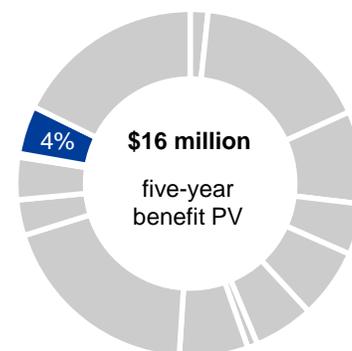
**Benefit summary.** Interviewed customers shored up environments using hardware, platforms, and services from IBM and Red Hat to guarantee performance, availability, and dependability that boosts CX and drives revenue via retention and enrichment. Transformation with IBM and Red Hat enabled developers to release equivalent capabilities at least twice as fast, with much more frequent incremental updates delivering value to customers as fast as possible. The investments also enabled developers to connect all their existing data to mine and capitalize with new data models and new applications. Combined with new capabilities driven by packaged services from IBM and Red Hat catalogs (including AI, blockchain, and IoT), it ultimately generated additional business growth.

**Impact to transportation.** Infrastructure and application modernization with IBM and Red Hat helped transportation companies offer better digital experiences for customers, reduce customer-impacting service issues, make processes more seamless, better predict and communicate status and arrival or delivery times, and deliver goods more quickly and seamlessly with fewer mistakes. As a result, companies shielded themselves from lost revenue due to refunds or customer churn. They improved retention, boosted loyalty (driving enrichment), and strengthened their brand perceptions. Ultimately, by releasing new offerings and improving processes, companies improved customer service and therefore increased revenue. Interviewees shared:

- › **A logistics and multimodal shipping company improved customer service and retention, ultimately increasing sales.** The director of IT said, “We have seen a growth in contracts due to quicker throughput and data stream efficiency.” The company is also bringing new offerings to market using Edge computing to grow its business.
- › **Another logistics and multimodal shipping company improved CX, driving revenue growth.** The company shortened transportation times, streamlined communications for adjustments or special payload needs, and improved the information available to drivers for onsite communication.

**Financial model.** The *sample logistics provider’s* investment in IBM and Red Hat yields a five-year risk-adjusted present value of \$16 million. Topline revenue increases by 0.5% in Year 1, rising to a 4% lift in Year 5 due to improved shipping speed, new offerings, improved customer service and quality, new digital apps, and streamlined processes.

Modeled business growth is representative of interviewed customers. However, Forrester levied a very high risk adjustment of 20% as impact to revenue will vary widely for every transportation company due to: 1) broad market trends; 2) specific use cases and solutions deployed; 3) typical revenue driven by baseline customer behavior; 4) the particular ways that IoT, data, and AI are leveraged to improve customer outcomes; and 5) the number and purpose of new modern apps deployed using IBM and Red Hat.



**Business growth:  
4% of total benefits**

“We have seen a growth in contracts due to quicker throughput and data stream efficiency. . . . Our investment in Red Hat OpenShift and IBM Cloud Paks has made sense for Edge computing. It opens up a new opportunity for our business.”

*Director of IT, logistics and multimodal shipping*



“We can now focus on increasing our customer base, growing customer relationships, building our brand, and enhancing important systems.”

*IT director, logistics and multimodal shipping*



### Business Growth: Calculation Table

ANNUAL REVENUE	ENVIRONMENT IN IBM AND RED HAT	INCREASE IN TOPLINE REVENUE	OPERATING MARGIN	RISK ADJUSTMENT
\$5 billion	57% increasing to 100% by Year 4	0.5% in Year 1, 1.0% in Year 2, 2.0% in Year 3, 3.0% in Year 4, and 4.0% in Year 5	6%	Very high (20%)

## Enhanced Operating Margin

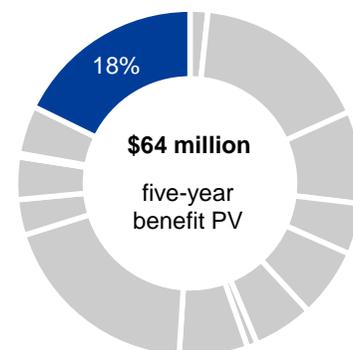
Transportation companies including logistics, multimodal shipping, and airlines face intense competition. To win, they must simultaneously cut operating costs to meet price competition while also delivering sector-leading CX through differentiated capabilities, reliability, and speed to drive loyalty and grow sales. Interviewed transportation companies successfully leveraged IBM and Red Hat offerings to drive down the operating costs of their businesses. Use cases included:

- › Pricing algorithms leveraging AI, a consolidated platform, and IoT data to accurately quote deals as low as possible while ensuring profitability.
- › AI-powered load balancing and dynamic routing optimization using historical data, IoT and Edge devices, and other data streams such as weather to decrease empty miles, saving fuel and labor costs while reducing environmental emissions.

Interviewed transportation customers shared:

- › **A logistics and multimodal shipping company is reducing operating costs with IoT and AI.** The IT director shared, “IBM Cloud Paks connect our private and public environments. We are using it to build metadata platforms, analytics platforms, and cloud apps to discover and report on actual data from the field. How many trucks are on the road? Are there any breakdowns? Are storage temperatures within tolerances? Is weather causing any interruptions? Will a challenging route be weather permissible?” This lets the company monitor and address any operational issues, saving costs, and also helps predict future costs. Further, the IT director shared that “We have reduced fuel costs by identifying where to purchase it, when to buy it, identifying vehicles that are consuming too much of it, mapping travel routes and grades to reduce use of it, and avoiding conditions that cause to more waste of it. This lets us better predict costs, reduce costs, and mitigate our environmental impact.”
- › **A logistics and multimodal shipping company is combatting rising costs with IoT and AI to create a value chain to optimize shipments.** The director of IT said: “Costs of goods and services have gone up. Fuel prices are our No. 1 concern. We’re struggling with driver shortages and retention. We’re dealing with tougher government regulation. We need an effective hybrid cloud strategy.” IBM Watson offers a path forward to margin enhancement. The director of IT explained: “IBM Watson is very powerful and intuitive. Plus, it’s low code for building machine learning models and setting up APIs. This helps us get quick data about problems with workloads and project management issues, identify delays or mechanical concerns, and beyond.”

**Financial model.** The *sample logistics provider’s* investment in IBM and Red Hat yields a five-year risk-adjusted present value of \$64 million. The company reduces excess trips with carrier providers by 0.5%, reduces fuel costs by 5%, and reduces claims by 8%, improving its overall operating profit margin from 6% to 6.79%.



Enhanced operating margin:  
18% of total benefits

“IoT data comes into our system through custom applications developed in [Red Hat OpenShift], which collects and integrates the information into our system and then goes into IBM DB2 for analytics. It’s allowed us to cut costs by streamlining operations.”

*IT director, logistics and multimodal shipping*



“We’ve reduced fuel costs by identifying where to purchase it and when to buy it, identifying vehicles that consume too much of it, mapping travel routes and grades to use less of it, and avoiding conditions that waste too much of it. This lets us better predict and reduce costs and mitigates our environmental impact.”

*IT director, logistics and multimodal shipping*



### Enhanced Operating Margin: Calculation Table

MARGIN FOR PURCHASED TRANSPORTATION AND RENT	MARGIN FOR FUEL	MARGIN FOR INSURANCE AND CLAIMS	ANNUAL REVENUE	RISK ADJUSTMENT
50% reduced to 49.75%	6% reduced to 5.7%	3% reduced to 2.76%	\$5 billion	Very high (20%)

## Unquantified Benefits

The interviewed organizations identified a range of other benefits they experienced that were either unique to their business or that they could not yet quantify. Unquantified benefits include:

- › **Increased release frequency.** Companies were more successful at deploying DevOps and Agile processes in the new environment, which helped them adopt microservices and ultimately release more frequently in smaller components and get value to end users faster.
- › **Enhanced efficiency for data teams.** IBM Cloud Pak for Data on RHEL and OpenShift helped businesses capture, integrate, analyze, and report on disparate data sources much faster than ever before. A recent Total Economic Impact study of IBM Cloud Pak for Data found savings equivalent to several data engineers and scientists per organization.<sup>11</sup>
- › **Enhanced efficiency for security professionals.** IBM Cloud Pak for Security on RHEL and OpenShift helped security professionals automate processes, conduct tasks more easily with better UX, and streamline monitoring across the hybrid multicloud environment. Teams saved time monitoring, detecting, remediating, and reporting while detecting risks faster and accelerating remediation.
- › **Reduced support labor.** Developers and IT professionals had less need to reach out to support teams with task automation, governance, issue monitoring, and a better UX. Higher performance and availability with accelerated release cycles boosted experience for employee and customer end users and reduced their need to contact support.
- › **Improved hiring and retention.** Replacing legacy infrastructure and tools improved EX and 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, Kubernetes, and Java or specific IBM and Red Hat knowledge. Not only was the talent pool larger, but it was easier to attract, hire, and retain employees as with a better experience using modern, consolidated solutions.
- › **Diminished business risk.** By not modernizing, organizations risk having legacy applications that are no longer supported or would be challenging to use. These legacy apps also have significant risk of downtime and performance issues. If companies cannot quickly improve offerings, and if apps don't meet current market expectations, they will quickly fall behind.
- › **Reduced emissions.** Optimizing loads, routes, and fuel consumption has the added benefit of helping companies reduce their emissions.
- › **Improved culture.** Better systems and user experiences can help employees spend less time on frustrating manual tasks and more time on innovation and collaboration, improving EX and fostering a stronger connectedness and sense of purpose in work.

“The IBM and Red Hat platform lets us modernize and manage containerized applications with an integrated platform to develop applications.”

*Director of IT, logistics and multimodal shipping*



“Reducing fuel consumption isn't just about saving costs, it's also good for the environment.”

*IT director, logistics and multimodal shipping*



“Data is the new oil. Datacenter virtualization and hybrid multicloud environments is where the energy and innovation is going.”

*Director of IT, logistics and multimodal shipping*



“IBM Watson is collecting a bunch of our IoT and other data points, which just look like arrays of strings and numbers. But Watson can find what it means: help optimize things, increase value, and avoid unplanned upsets. We use it extensively because it is user-friendly with high-end graphics and visualizations, and it meets our security and compliance needs.”

*IT director, logistics and multimodal shipping*



## Flexibility

There are many scenarios in which customers might implement solutions from IBM and Red Hat and later realize additional uses and business opportunities, including:

- › **Disaster preparedness.** Running a hybrid multicloud platform on OpenShift provides agility and flexibility to respond to disasters (like the COVID-19 pandemic) as needed, quickly reallocating resources to address issues or unexpected loads. The shift to the cloud from data centers combined with automated monitoring and remediation can help companies do more with less and better manage when normal workflows, procedures, and operations are disrupted.
- › **Adopt a broader catalog of middleware and services from IBM, Red Hat, third-party providers, and open source communities.** IBM and Red Hat offered catalogs of regularly updated, containerized versions of middleware and solutions based on open source. The platform also enabled simpler integrations with third-party cloud services and software-as-a-service (SaaS) products via API connectors.
- › **Test and deploy new AI, ML, blockchain, and IoT capabilities.** Operating a containerized hybrid multicloud environment opened the door for several interviewed companies to consider building new capabilities using AI services such as IBM Watson and Red Hat Insights, plus other services like IBM Blockchain.
- › **Shift infrastructure and back-office technology without disrupting application development.** OpenShift and Cloud Paks provided a consistent management plane and framework for all developers to work within, abstracted from the resources they consume — even when new technologies, infrastructure, or patterns were introduced. This ultimately drove faster transformation and adoption of new technologies.
- › **Reduce risk of proprietary technology lock-in.** Basing new development on leading open source components such as Linux, Kubernetes, Knative, and Istio helped organizations develop applications that were not locked into a specific cloud provider, hardware stack, middleware vendor, or professional services provider. Companies significantly lowered the barriers to make major shifts if needed, and they could now more easily update or swap one component without massive redevelopment of a monolithic application.

“Switching to Kubernetes was a great concept. It allows for open source application layer set up. It’s a big step forward.”

*Director of IT, logistics and multimodal shipping*



“IBM Watson is very popular in the transportation industry. We are considering it to access IoT data in real time and form a value chain to drive optimization for shipments.”

*Director of IT, logistics and multimodal shipping*



“We consider IBM Blockchain best in class. It integrates with our OpenShift and Cloud Paks platform. We are considering a private permission blockchain networking service for data throughput. That would help us aggregate and harmonize policy, while keeping data accessible for regulatory reporting. We have a lot of regulation with the [Organic Crop Improvement Association] (OCIA) and HIPAA. We need to do a lot of tracking and validation of hours for our carriers. Blockchain would help.”

*Director of IT, logistics and multimodal shipping*



# Analysis Of Costs

## QUANTIFIED COST DATA AS APPLIED TO THE COMPOSITE

Total Costs							
COST	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	PRESENT VALUE
Technology	\$0	\$23,092,650	\$40,860,776	\$55,497,919	\$55,055,641	\$56,225,408	\$168,974,261
Professional services for transformation	\$15,750,000	\$15,750,000	\$15,750,000	\$5,250,000	\$0	\$0	\$47,029,113
Professional services for management and support	\$0	\$5,250,000	\$5,250,000	\$5,250,000	\$5,250,000	\$5,250,000	\$19,901,631
Training	\$8,905,600	\$2,180,464	\$2,096,248	\$2,037,552	\$2,004,376	\$2,004,376	\$16,764,695
<b>Total costs</b>	<b>\$24,655,600</b>	<b>\$46,273,114</b>	<b>\$63,957,024</b>	<b>\$68,035,471</b>	<b>\$62,310,017</b>	<b>\$63,479,784</b>	<b>\$252,669,700</b>

## Technology

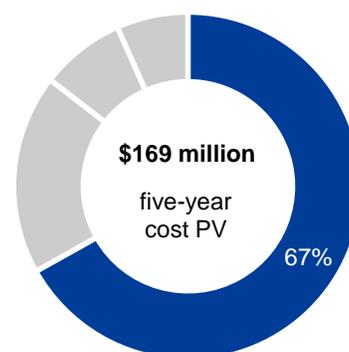
Cloud migration, container platform, and IoT/Edge/AI implementation requires significant investments in cloud usage fees and subscriptions for the platform and software services.

- › Data center apps are migrated to IBM Cloud alongside new development, incurring usage-based cloud costs.
- › The *sample logistics provider* incurs subscription costs for RHEL, Red Hat OpenShift, and IBM Cloud Paks for Applications, Data, and Multicloud Management. It may incur additional costs for services including Red Hat Virtualization, Gluster Storage, and Ansible or IBM WebSphere Liberty, DB2, or MQ.
- › Cloud models improved cash flow by moving to monthly subscriptions and usage fees, rather than upfront license purchases.

The IBM and Red Hat platform is also rolled out to the on-premises environment, replacing alternative third-party operating systems, virtualization, platforms, and management tools. Interviewees cited an approximate breakeven or slight decrease in cost as a result. Therefore, Forrester excluded server platform costs from both Benefits and Costs sections for simplicity as they would not impact the ROI.

Cloud and platform costs grow over time as apps are moved to the cloud over three years, but costs are offset by savings modeled above. Hardware, cloud, subscription, and licensing costs will vary significantly based on actual usage, bulk discounts, and specific technologies used.

Forrester's model for the *sample logistics provider* shows up to \$50 million per year in cloud and platform costs plus up to \$6 million per year for Edge, IoT, and AI technology. Annual reports indicate logistics companies spend approximately \$40 million in technology costs per \$1 billion in revenue, suggesting that this investment will account for roughly 25% of the sample logistics providers' technology budget.



**Technology:**  
**67% of total costs**

## Technology: Calculation Table

NUMBER OF CLOUD APPS	CLOUD/PLATFORM COST PER APP	IOT, EDGE, AND AI TECHNOLOGY	RISK ADJUSTMENT
97 increasing to 232 (adjusted to reflect resource savings from benefit section)	\$195,000 to \$214,000	\$3M in Year 1 and \$6M in Year 2 and 3 for deployment \$4M per subsequent year for maintenance and expansion	Low (5%)

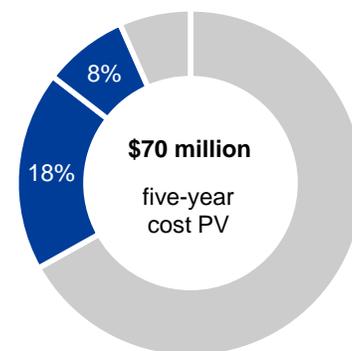
## Professional Services

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 they often carried significant costs in the millions. However, organizations felt these services were essential. They helped companies figure out where to start, avoid major missteps, implement quickly, and ensure the environments run appropriately. Forrester interviewed organizations with experience partnering with:

- › Red Hat Container Adoption Program, Red Hat Open Innovation Labs, and IBM Garage to learn to use modern architectures, to improve existing applications with new technologies, and to come up with new and innovative products meeting internal or customer opportunities.
- › IBM Services for large-scale strategy, design, implementation, and deployment of the new environment’s hardware, cloud migration, and container platform.
- › IBM and Red Hat services for ongoing support and expertise.

Forrester’s model for the *sample logistics provider* assumes usage of the Red Hat Container Adoption Program and IBM Services without differentiation for specific line items. Total budget is estimated at \$50 million for the deployment over a three-year period, plus \$5 million per year in ongoing support and management. These estimates are based on the high end of reported customer experiences from this and other related studies to ensure conservatism in the model. Actual professional services costs for customers will vary substantially based on the legacy environment, transformation goals, and selected solutions.

Readers should note that internal labor was also crucial throughout the process from IT administrators, developers, and cross-functional leadership. The *sample logistics provider* is assumed to have transformation work completed using a portion of approximately 200 employees’ time. However, this work resulted in a net reduction rather than an increase in internal FTEs for the IT and operations teams, even with the significant time dedicated to this effort. This model shows a reduction in FTEs with their employment costs already incurred by default, so Forrester did not add the value of their internal labor as a line item to this ROI analysis to avoid double-counting.



Professional services:  
**26% of total costs**

“Red Hat’s Container Adoption Program and Open Innovation Labs help us develop, scale up, and grow effectively with new technologies. They can help you run real-time analytics to test where you are in the process and how successful you are being.”

*Director of IT, logistics and multimodal shipping*



### Professional Services: Calculation Table

PLANNING, DEPLOYMENT, IMPLEMENTATION	ANNUAL MANAGEMENT AND SUPPORT	RISK ADJUSTMENT
\$50 million over three years	\$5 million per year	Low (5%)

“We’ve run every part of our adoption of OpenShift through Red Hat’s Container Adoption Program team. Red Hat’s Container Adoption Program is helping us stand up our platform and develop the application templates for it. We’ve also completed a six-week Red Hat Open Innovation Lab to help legacy teams understand what it means to develop on this new platform.”

*Principal application architect, multinational airline*



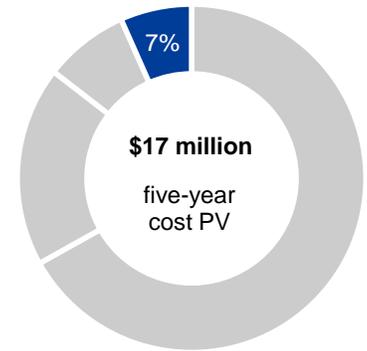
## Training

Employees must be trained to use and take advantage of the new platform, architecture, and DevOps practices. Various roles including developers and infrastructure, platform, and middleware administrators will need to learn to use IBM Cloud, RHEL, Red Hat OpenShift, and IBM Cloud Paks — along with other selected services such as Red Hat Virtualization, Ansible, and JBoss EAP or IBM Watson, WebSphere Liberty, DB2, and MQ.

These employees must learn to leverage these solutions as a consistent platform across the company’s hybrid multicloud environment to ensure optimal resource utilization, performance, and dependability. They will need to understand best practices with microservices and modern architectures, including underpinning open source technologies such as containerization (Kubernetes), serverless (Knative), and service mesh (Istio). They will also need to learn the various prepackaged containers available to them in the catalogs from IBM and Red Hat, to decide which technologies to use where and to find opportunities for innovation.

Forrester’s analysis for the *sample logistics provider* includes four weeks of initial training for 200 IT operations administrators and 600 developers, followed by one week of continuing learning per year thereafter.

Forrester levied a moderate 10% risk adjustment as costs will depend upon on the number of employees, prior architectures and existing knowledge, the specific technologies and scale of implementation, and average regional salaries.



**Training:**  
**7% of total costs**

“We have developed and produced more cloud-native apps quicker, easier, with less learning curve.”

*Director of IT, logistics and multimodal shipping*



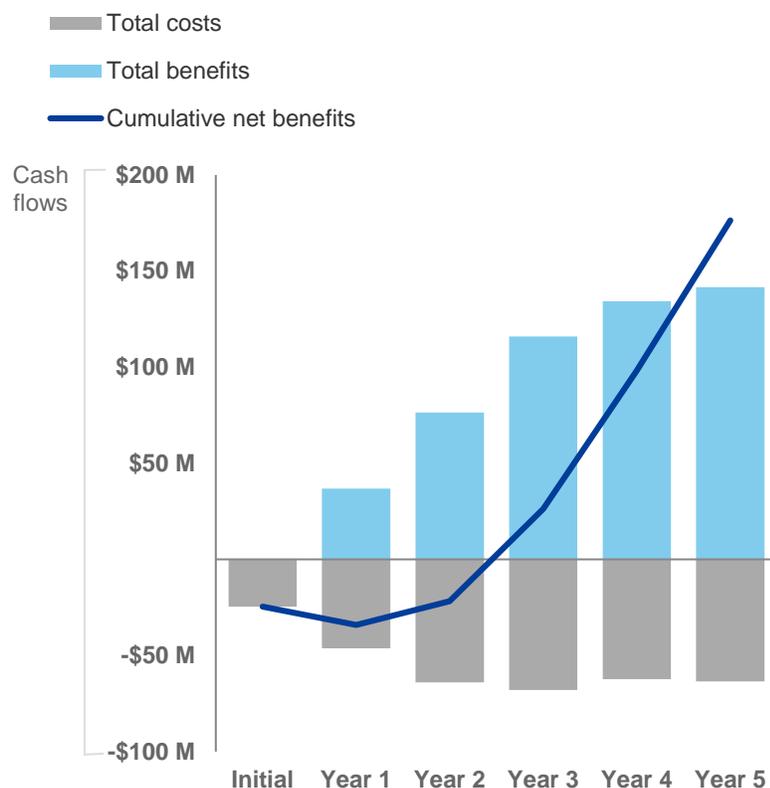
### Training: Calculation Table

IT/OPS FTEs	IT/OPS SALARY	DEVELOPER FTEs	DEVELOPER SALARY	INITIAL TRAINING	CONTINUING TRAINING	RISK ADJUSTMENT
200	\$58 per hour	600	\$65 per hour	160 hours	40 hours per year	Moderate (10%)

# Financial Summary

## CONSOLIDATED FIVE-YEAR RISK-ADJUSTED METRICS

### Cash Flow Chart (Risk-Adjusted)



The financial results and risk-adjustment factors calculated in the Benefits and Costs sections are used to determine the ROI, NPV, and payback period for the composite organization's investment. Forrester assumes a yearly discount rate of 10% for this analysis.

### Cash Flow Table (Risk-Adjusted)

	INITIAL	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	PRESENT VALUE
Total costs	(\$24,655,600)	(\$46,273,114)	(\$63,957,024)	(\$68,035,471)	(\$62,310,017)	(\$63,479,784)	(\$252,669,700)
Total benefits	\$0	\$36,800,115	\$76,353,041	\$115,926,699	\$134,387,168	\$141,584,385	\$363,354,790
Net benefits	(\$24,655,600)	(\$9,472,999)	\$12,396,017	\$47,891,228	\$72,077,150	\$78,104,601	\$110,685,090
ROI							44%
Payback period							30 months

# 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: Supplemental Material

Forrester referenced data from the following research and studies in formulating this analysis:

- › “Emerging Technology Assessment: The Total Economic Impact™ Of Using Both IBM And Red Hat Solutions Together,” a commissioned study conducted by Forrester Consulting on behalf of IBM, June 2019.
- › “Emerging Technology Projection: The Total Economic Impact™ Of IBM Blockchain,” a commissioned study conducted by Forrester Consulting on behalf of IBM, July 2018.
- › “The Real Costs Of Unplanned Downtime,” Forrester Consulting, Inc., August 2019.
- › “The Total Economic Impact™ Of IBM Cloud For VMWare Solutions,” a commissioned study conducted by Forrester Consulting on behalf of IBM, September 2019.
- › “The Total Economic Impact™ Of IBM Cloud Pak For Data,” a commissioned study conducted by Forrester Consulting on behalf of IBM, February 2020.
- › “The Total Economic Impact™ Of IBM Cloud Private,” a commissioned study conducted by Forrester Consulting on behalf of IBM, March 2019.
- › “The Total Economic Impact™ Of IBM Cloud Global Technology Services,” a commissioned study conducted by Forrester Consulting on behalf of IBM.
- › “The Total Economic Impact™ Of IBM Design Thinking,” a commissioned study conducted by Forrester Consulting on behalf of IBM, February 2018.
- › “The Total Economic Impact™ Of IBM Multivendor Support Services,” a commissioned study conducted by Forrester Consulting on behalf of IBM, January 2019.
- › “The Total Economic Impact™ Of IBM Power Systems For S4HANA,” a commissioned study conducted by Forrester Consulting on behalf of IBM, July 2019.
- › “The Total Economic Impact™ Of IBM Services For Application Migration And Modernization To A Hybrid Multicloud Environment,” a commissioned study conducted by Forrester Consulting on behalf of IBM, September 2019.
- › “The Total Economic Impact™ Of IBM Watson Studio And Watson Knowledge Catalog,” a commissioned study conducted by Forrester Consulting on behalf of IBM, July 2018.
- › “The Total Economic Impact™ Of IBM WebSphere Liberty,” a commissioned study conducted by Forrester Consulting on behalf of IBM, September 2018.
- › “The Total Economic Impact™ Of Red Hat Ansible Tower,” a commissioned study conducted by Forrester Consulting on behalf of Red Hat, June 2018.
- › “The Total Economic Impact™ Of Red Hat Consulting’s Container Adoption Program And Red Hat Open Innovation Labs,” a commissioned study conducted by Forrester Consulting on behalf of Red Hat, June 2018.
- › “The Total Economic Impact™ Of Red Hat OpenShift Dedicated,” a commissioned study conducted by Forrester Consulting on behalf of Red Hat, June 2019.
- › “The Total Economic Impact™ Of Red Hat Virtualization,” a commissioned study conducted by Forrester Consulting on behalf of Red Hat, July 2019.
- › “Unlock Open Source Technology’s Full Value,” Forrester Consulting, Inc., October 2019.

## Appendix C: Endnotes

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<sup>1</sup> Source: “Quantifying Coronavirus (COVID-19) For The Technology Channel,” Forrester Research, Inc., March 24, 2020.

<sup>2</sup> Source: “COVID-19 — Vendors Step Up To Help IT Manage Increased Digital Loads,” Forrester Research, Inc., April 1, 2020.

<sup>3</sup> “COVID-19: For Airlines, It Is Time To Give Nothing Less Than Their Best,” Forrester Research, Inc., March 30, 2020.

<sup>4</sup> “COVID-19 Has Ground Airlines And Hit Their Pockets, But They Can Soar Again If They Learn The Right Lessons,” Forrester Research, Inc., March 26th, 2020.

<sup>5</sup> Source: “Now Is A Counterintuitive But Ideal Time To Drive A Companywide Innovation Campaign,” Forrester Research, Inc., March 25, 2020.

<sup>6</sup> “COVID-19: For Airlines, It Is Time To Give Nothing Less Than Their Best,” Forrester Research, Inc., March 30, 2020.

<sup>7</sup> Source: “Agile, DevOps, And COVID-19,” Forrester Research, Inc., March 23, 2020.

<sup>8</sup> Source: “The Real Costs Of Unplanned Downtime,” Forrester Consulting, Inc., August 2019.

<sup>9</sup> “Enterprise Security Vendors Need An Infusion Of Open Source Culture,” Forrester Research, Inc., November 21, 2019.

<sup>10</sup> Business Technographics Global Security Survey, 2019

<sup>11</sup> Source: “The Total Economic Impact™ Of IBM Cloud Pak For Data,” a commissioned study conducted by Forrester Consulting on behalf of IBM, February 2020.