

Introducing Technology Economics

A Guide for Enterprise IT Leaders

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What is technology economics?

It's hard to overstate the importance of information technology in the modern economy. In fact, worldwide IT spending today, including the labor needed to develop and maintain it, is close to \$8 trillion. That's more than a thousand dollars for every person on Earth. If global IT spending were a standalone country, it would be the world's 3rd largest economy after the U.S. and China.

The technology economy is huge, and it grows every year in size and importance. Given this, focusing on *technology economics* makes obvious sense. Technology economics studies the interaction and impact of IT on businesses, governments, and other organizations. Beyond this, it also considers societal, quality of life, political, environmental, and other complex issues of vital concern to the world.

For IT leaders, technology economics can provide a better way to understand and manage your own IT spending. It helps you answer questions such as:

- How can we optimize the costs of running the business so we can channel more money toward investments in growing the business?
- How should we measure value?
- How does our technology spending compare to the best-in-class organizations in our industry? Are we spending too much, not enough, or the right amount?

To see how technology economics can help your organization, you first need to understand its fundamental principles.

Principles of technology economics

Technology economics encompasses a broad range of concepts, but three ideas matter most for IT leaders:

- Manage IT spending as an investment
- Use modern measures to assess and manage your IT spending
- Connect IT spending to business outcomes

Manage IT spending as an investment

Many business leaders have long viewed IT spending as a cost. Because of this, their goal has often been to minimize this cost. This perspective was reasonable in the early days of information technology, when IT was primarily a back-office concern. Today, when IT underlies so much of modern business, it's become clear that viewing IT spending solely as a cost is an antiquated—and ultimately self-destructive—approach.

The truth is that IT spending is an investment in the success of your organization. The goal isn't to minimize IT spending; it's to optimize that spending to provide the most business value. For many organizations, this is a mindset shift. Think of your investment in IT as buying the enabling technologies that set your business in motion.

An important part of doing this is viewing your organization's IT spending as a portfolio of investments. Just as financial investors maintain a portfolio of different asset classes, such as stocks, bonds, and real estate, organizations can think about their portfolio of IT investments. In both financial investing and IT investing, different asset classes have different levels of risk and potential reward. For example, stocks traditionally offer higher risk with the possibility of higher reward, while bonds are typically lower in both risk and reward. An efficient portfolio combines different asset classes to best meet your goals.

The same reasoning applies to IT investments. Your organization invests in different technology asset classes with varying levels of risk and reward. Examples of technology asset classes include these:

- **Custom applications:** A successful custom application can provide uniquely valuable business differentiation, while an unsuccessful attempt can burn a lot of money with little to show for it. This higher-risk/higher-reward structure makes custom applications analogous to stocks in a financial investment portfolio.
- **Infrastructure in the public cloud, such as virtual machines and storage:** Investments here are an essential foundation, but they're typically not as risky as custom application projects. They're also unlikely to provide as much differentiating business value as a successful custom app. This technology asset class can be seen as broadly analogous to corporate bonds.
- **Infrastructure in your own on-premises data centers, such as servers and networking equipment:** Most organizations today are limiting new on-premises IT spending, choosing instead to invest in modern public cloud infrastructure. Yet on-premises technologies can still be crucially important. This spending category is quite conservative. In fact, in many organizations, mainframes play a role analogous to municipal bonds in a financial portfolio.

Viewing IT spending as an investment portfolio makes clear that the job of an IT leader isn't to squeeze out every possible cost. Just as the goal in financial investing is to maximize return rather than minimize investment costs, the goal of IT spending is to maximize the business value you get from that spending. Doing this means optimizing the mix of technology asset classes for your organization.

To do this, IT leaders should focus on *technology asset class optimization (TACO)*, an essential aspect of technology economics. For example, spending more on custom applications is associated with higher profits. (This isn't surprising, since custom applications are the main way IT provides unique business value.) Decreasing your spending on lower-return technology asset classes, such as on-premises infrastructure, frees up money to invest in higher-return custom applications. This is a simple TACO scenario, but the idea applies broadly across organizations.

Adopting technology economics implies moving away from the old approach of minimizing IT costs to instead managing IT spending as a portfolio of investments in different technology asset classes. Doing this can help your organization maximize the business value it gets from its technology investments.

Sidebar: [Keep your risk profile in mind](#)

As with any investment, you should always make IT investment decisions that match your risk profile. Commercial banks, for example, invest a substantial amount in security, disaster recovery, and other kinds of risk mitigation. But the US Federal Reserve devotes an even higher percentage of its IT spending

to these areas, simply because of its central role in the world economy. Similarly, IT problems in healthcare organizations can kill people, so firms in this sector will typically spend more on risk mitigation. Different organizations have inherently different risk profiles, a reality that should always underlie your IT investment decisions.

Sidebar: Master IT spending through transparency

Optimizing your IT investment requires business leaders and IT leaders to work well together. An essential part of doing this is making sure that both groups have a shared understanding of what your IT spending is and the value it provides.

For example, if you ask three senior IT leaders what your organization's total IT expense is this year, will you get the same answer from all of them? If you ask three senior business leaders the same question, will their answers match those given by the IT leaders? Do these groups even define total IT expense in the same way?

Similarly, if you ask a business leader how the needs of their business drive IT costs, do they have an answer? Can they tell you what their IT cost of goods looks like? And does your CEO know the key drivers of the organization's IT costs?

These questions are hard to answer consistently because shared definitions of core IT measures often aren't widely known across business and IT; they might not even exist. Even if these definitions do exist, current data about IT spending often isn't easy to come by. Changing this—making it easier for IT and business leaders to work together—can help you optimize your IT investment portfolio.

The foundation for managing any investment, including IT, is clearly defined measures of costs, returns, and more. Make it a priority to define and disseminate these within your organization. Without this kind of transparency, your organization will struggle to set targets and track progress.

Use modern metrics to assess and manage your IT spending

Many organizations are still using industrial age metrics to assess and manage their IT spending. But using metrics designed for a different world makes no sense. We should be using new metrics that accurately measure our technology-centric world.

For example, how should we measure the business value of each IT investment? Without targeted metrics, we have no way to optimize our spending across different IT asset classes. At a larger scale, how can we compare our own organization's IT spending with similar organizations? Are we spending too much, too little, or the right amount?

Addressing these last questions requires thinking about benchmarking. There is no single metric that on its own can tell you whether you're spending the right amount on IT. There is a measure, however, that can provide valuable guidance in this area: *technology intensity*.

To understand technology intensity, start by thinking about two popular measures for overall IT performance:

- IT spending as a percentage of an organization's revenue, and
- IT spending as a percentage of an organization's operating expenses.

By themselves, each of these metrics has limitations. Combining them, however, can yield a value that's more useful. Imagine a right triangle, where the base is IT spending as a percentage of an organization's revenue and the vertical side is IT spending as a percentage of its operating expenses. The hypotenuse of this triangle is technology intensity. This number is easy to calculate using the Pythagorean theorem.

Why is this important? Because data gathered by Rubin Worldwide across many different industries shows a strong correlation between a firm's technology intensity and its operating margins: higher technology intensity is correlated with higher operating margins. Technology intensity isn't the only metric you need, but it can be a useful tool for thinking about your IT spending compared to other organizations.

Connect IT spending to business outcomes

IT spending has the same goal in every organization: to improve business outcomes. Yet while connecting IT spending with those outcomes can be difficult, doing this well is an essential part of optimizing spending across your technology asset classes. How else can you know whether your organization is spending too much or too little and whether you're investing in the right things?

IT investment creates business value in various ways. It can improve operations by automating business processes to make them faster, less expensive, and more accurate. It can improve how you interact with customers and partners by providing custom applications that support interactive self-service. Spend too little on IT, and you'll quickly find yourself behind your competition. Spend too much, and you'll see your profits needlessly decrease.

A useful way to think about your IT spending compared to peer organizations is to plot your technology intensity against your operating margins. Rubin Worldwide has examined this ratio across 3,000 companies spanning 21 sectors. The result is a simple curve called the *technology economics frontier*. Figure 1 shows this curve for a group of firms in the banking industry.

Addressing these last questions requires thinking about benchmarking. There's no single metric that on its own can tell you whether you're spending the right amount on IT. But technology economics is built upon measurement at the IT portfolio-level that, ideally, is benchmarked. Taking a metric-driven approach tied to relative operating performance allows company leaders to cut across investment in individual initiatives to look at the overall effectiveness and efficiency of their total IT investment. Key among these "tech econ" metrics is technology *intensity*. See the sidebar for a brief description of this concept.

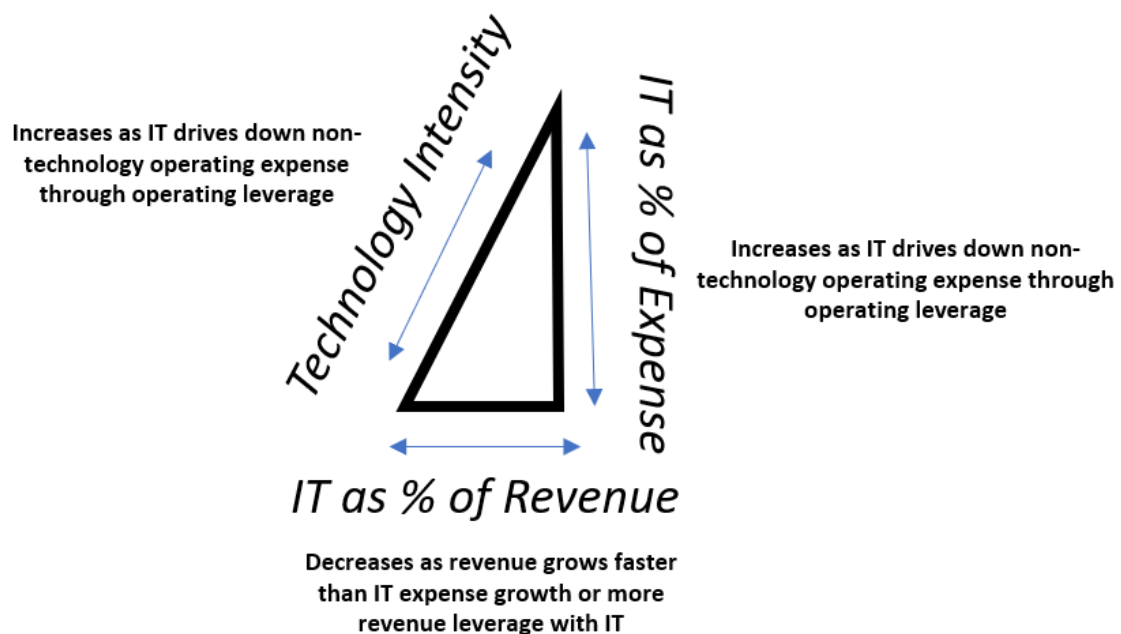
"We should be using new metrics that accurately measure our technology-centric world."

Sidebar: A closer look at technology intensity

To understand technology intensity, start by thinking about two popular measures for overall IT performance:

- IT spending as a percentage of an organization's revenue, where companies tend to want this number to be as low as possible because it is money that cannot be used elsewhere.
- IT spending as a percentage of an organization's operating expenses, where companies want this number to be as high as possible, as it shows the degree of automation of their business.

Technology Intensity is a Function of Two Commonly Used Metrics



Next, imagine a right triangle, where the base is IT spending as a percentage of an organization's revenue and the vertical side is IT spending as a percentage of its operating expenses. The hypotenuse of this triangle is technology intensity. This number is easy to calculate using the Pythagorean theorem.

A longer hypotenuse shows that the firm is optimizing technology spend towards outcomes. A short hypotenuse shows that financial inputs and operating outcomes are out of balance. When benchmarked against margins within an industry, technology leaders can see how well they are deploying scarce

resources versus their peers, and with additional analysis can determine how to increase the returns on their technology investments. Ultimately optimized technology investment, as shown by data collected by Rubin Worldwide across many different industries over the last 20 years, shows a strong relationship between optimized technology investment and operating margins. Technology intensity isn't the only metric you need, but it can be a useful tool for measuring the impact of your IT spending.

Connect IT spending to business outcomes

IT spending has the same goal in every organization: improving business outcomes. Yet even though connecting IT spending with those outcomes can be challenging, doing this well is an essential part of optimizing spending across your technology asset classes. How else can you know whether your organization is spending too much or too little and whether you're investing in the right things?

A useful way to think about this is to first understand the *efficient IT investment frontier* for your industry. Doing this starts with using data about the operating margins and technology intensity for you and your industry competitors. As Figure 1 shows, you can plot this data on a simple two-dimensional graph. The best-fit line drawn through these data points represents the efficient IT investment frontier for your industry. Some firms spend a lot with poor outcomes, others invest wisely for outsized outcomes. Overall, there is an efficient frontier that balances investment with outcomes, dependent on the firm's level of technology intensity.

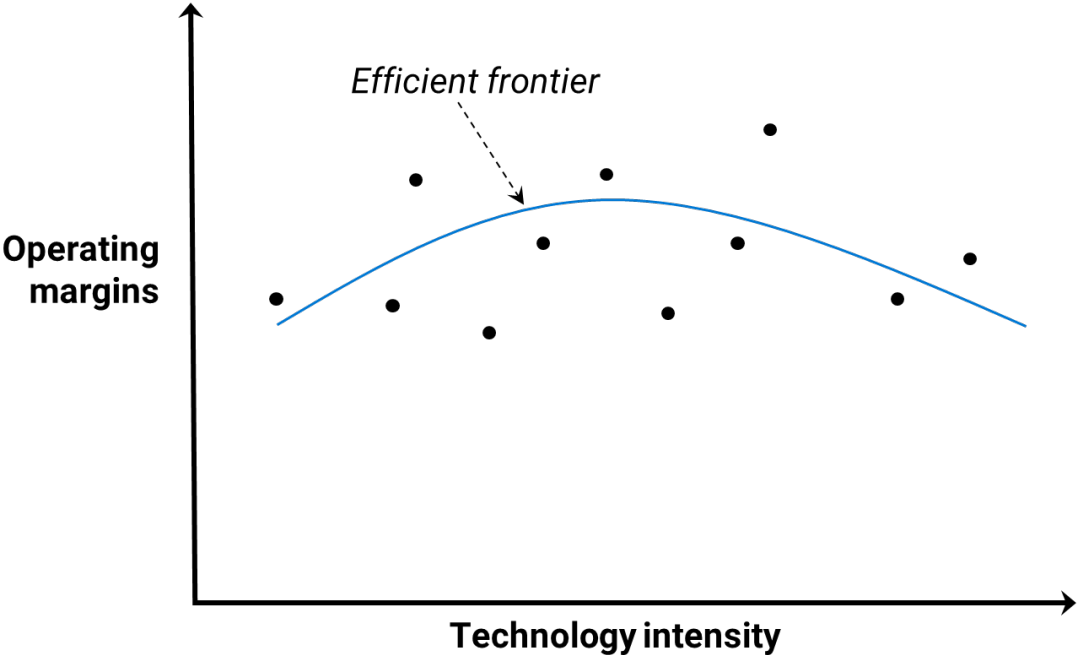


Figure 1: Plotting many firms' operating margins against technology intensity produces an efficient IT investment frontier for an industry.

Seeing where you fit in this diagram—comparing your organization's IT investment to others in your industry—can help you think more clearly about your own IT spending. Once you know where your

organization sits with respect to your industry's IT investment frontier, you can use this information to guide your future IT spending. One way to do this is to divide the space into four quadrants, as Figure 2 shows.

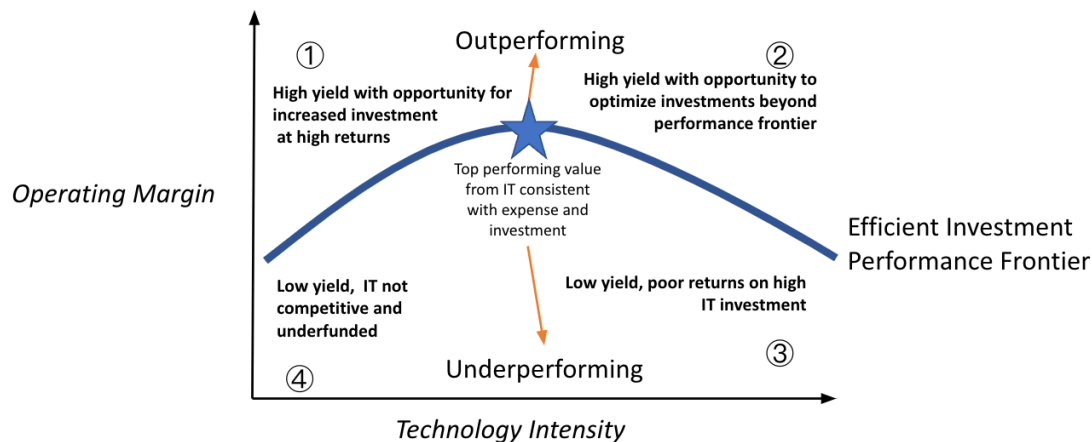


Figure 2: The technology economics frontier can help you compare your organization's IT spending to your peers.

The apex of this curve is the level of technology spending that maximizes profits. It's where operating margins and technology intensity are optimized for the industry.

For interpretation, the four quadrants are:

- **1. Potential for more high-ROI investment:** If your firm is here, you're investing less than your peers but still generating outsized operating margins. This isn't common, but if you find yourself in this quadrant, keep doing what you're doing. You are able to increase your IT investment and continue to generate high returns to the point of optimality.
- **2. Potential to optimize investment:** Firms in this quadrant are getting great returns, but they're spending more than their peers—maybe too much. If you're here, consider optimizing your spending. Maybe you're investing too much in bleeding edge technologies, for example, with too many expensive failures. Or perhaps you can reduce spending with no loss in performance by moving more workloads to the public cloud.
- **3. Insufficient returns on investment:** If your firm is in the lower right quadrant, you're spending a lot but not getting the returns you should from this investment. For example, you might have lots of separate data silos, all running on expensive on-premises infrastructure. Targeting your IT investments more intelligently has real potential to improve your business results.
- **4. Investing too little:** Firms in the lower left quadrant probably aren't spending enough on IT, which leaves them with lots of opportunities to create more technology-driven business value.

Doing this well can significantly improve your operating margins compared to other firms in your industry. Consider undertaking a broad review of how embracing technology can help your firm make or save more money.

By comparing your organization to others in your industry, you can use the technology economics frontier to think more clearly about your own IT spending.

Every bit of IT investment you put into your business will have an impact, but at some point, the value of further investment shrinks. Understanding your firm's technology intensity and where you fit in Figure 2 can help you reach the frontier of what's possible with your IT budget.

While this approach illuminates potential areas for you to explore, it's not necessarily a detailed diagnostic of what to fix. Instead, it's a broad measure that gives you a place to start. Even once you know which zone you're in, you'll need to do more analysis to work out what to do next. Still, this useful tool can help you move toward getting the most business value from your IT investment.

Technology economics in a cloud-centric world: Cloud economics

The move to cloud computing brings substantial technology change. Just as important, it brings enormous financial change. Along with technology economics, you'll need to embrace another mindset shift: cloud economics.

How cloud economics changes IT spending

Cloud economics has many aspects. The most important include these:

- ***The bulk of your IT spending can be shifted from fixed, up-front capital investments to variable, ongoing operating expenses.*** Cloud computing gives you financial agility: you can shrink and grow your IT spending as needed to match business conditions. This is very unlike traditional models of long-term investment in fixed IT costs. Rather than buying everything up front that you might need to handle peak loads, cloud computing can use a pay-as-you-go model. If you invest in more cloud resources only as you need them, your IT spending can be more closely related to the business value that spending provides.
- ***Over time, your spending on the basics of IT can go down.*** The hyperscale public cloud providers—IBM, Google, Amazon, and Microsoft—buy and manage servers and storage in such large quantities that their costs can be substantially lower than yours, while competition among them lets you benefit from their cost savings.
- ***By lowering the amount you spend on basic IT infrastructure, the shift to cloud computing lets your organization move more money to IT investments that provide unique business value, such as new custom applications.*** Why pay people to rack and stack servers when you could instead pay them to create differentiating business value? Embracing cloud computing lets you spend less on running your business and more on growing your business.
- ***Adopting cloud computing lets your organization move significantly faster.*** Rather than waiting months for the new servers you ordered to arrive, your development team can start working on a new cloud application immediately, because cloud computing resources are available on demand.

- **The financial risk of IT investment goes down.** The traditional IT model requires big up-front investments, such as buying racks of servers, with the hope of returns down the road. Cloud computing can allow you to start small, then grow (or shrink) your spending in line with what a given product or service needs. Venture capitalists recognized this some time ago, which is why we've seen an explosion of startups in the cloud era. The same dynamic lets your organization try more new ideas with less financial risk.

Exploiting cloud economics

Because cloud computing lets you shift money from running the business to growing the business, getting the most business value from this change commonly means shifting your IT investment portfolio toward new applications. These applications are built on their own cloud services; the old model of IT providing generalized support to the business from your own big data centers matters much less. And because it makes no sense to build powerful new business applications on top of old-fashioned infrastructure, the place to start is by thinking hard about how to create a high-quality cloud foundation for your new initiatives.

For example, suppose you'd like to create a new online service for your customers. There are three major components to think about for this kind of value creation:

- **The platform:** what technologies do you need to support this business initiative? These are the cloud capabilities you'll use to build digital solutions that provide unique business value. You can select from many different options to choose the cloud services that best meet your specific business goal.
- **The data:** what information do you need for this initiative? Your data is unique for your business, and it's part of what lets you provide unique value. It's a key differentiator.
- **The people:** how do you get your people using these cloud technologies and this data to build and support the experience you're trying to enable? As always in IT, success requires thinking about more than just technology. You also need to enable the right people and processes.

Even though traditional IT projects also involve a technology platform, data, and people, it's important to realize how different things are in the cloud era. With traditional IT projects, you probably bought lots of general-purpose computing resources, such as racks of servers, that supported a range of diverse business initiatives in your organization. With a cloud-based initiative, however, you're investing in pay-as-you-go cloud services for a specific business solution. This lets you target and track your investment much more effectively. It also makes it easier for you to measure the project's ROI, because all the IT investment is supporting this single business initiative.

With cloud computing, IT investments no longer require broadly leveraging a fixed asset with a long-term cost to your organization. Using the cloud lets you be much nimbler, adapting your IT spending to match what a given business initiative requires. Making this change lets your organization build more high-return capabilities for the business more quickly. It helps you digitize faster. Combined with the lower costs that cloud computing brings, the result can be outsized economic returns.

Cloud computing isn't a panacea, no matter who you choose to partner with. It is important to consider hybrid models and applications containerization strategies that avoid vendor lock-in. Additionally, it is

important to carefully evaluate vendor “savings plans” that may leave you with more capacity than needed, essentially converting variable costs into fixed costs.

Digitization, Transformation, and Artificial Intelligence (AI)

And Digitization/Digital Transformation is not just migrating systems to public cloud. It is a process with a multitude of initiative areas organized around 3 “stages” from Initiation to Operationalization each with a differing level of emphasis on the five critical Transformation components (Rubin et al, 2006)

- **Foundations**/Migration to Cloud & Hybrid Technology Models with a Focus on Infrastructure + APIS's and Development Tooling
- Digital **Channels** Implementation and Operation + Requisite Software and Development
- **Data Analytics** and AI/ML
- **Operations** - Application of Digitization to Business Functions + Robotics, Automation etc.
- **Core Support Functions** - Application of Digitization to HR, Finance, Risk, HR, etc.

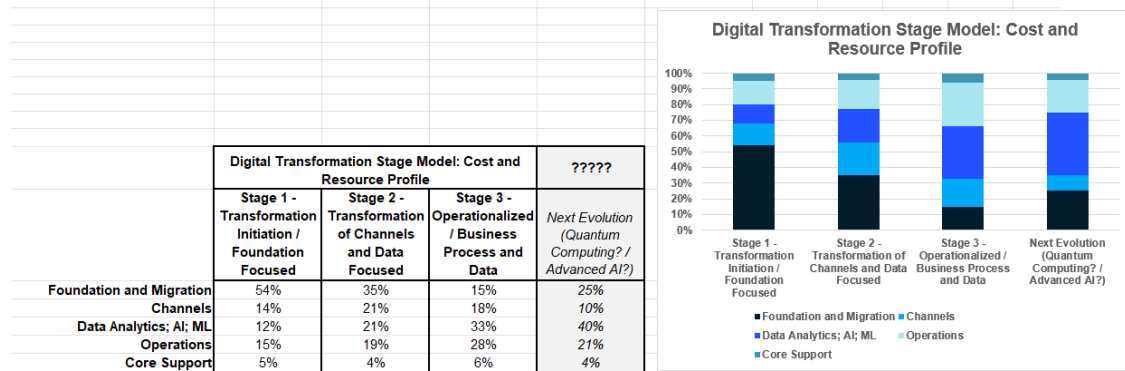


Figure 2. Transformation Model and Where AI “Fits”

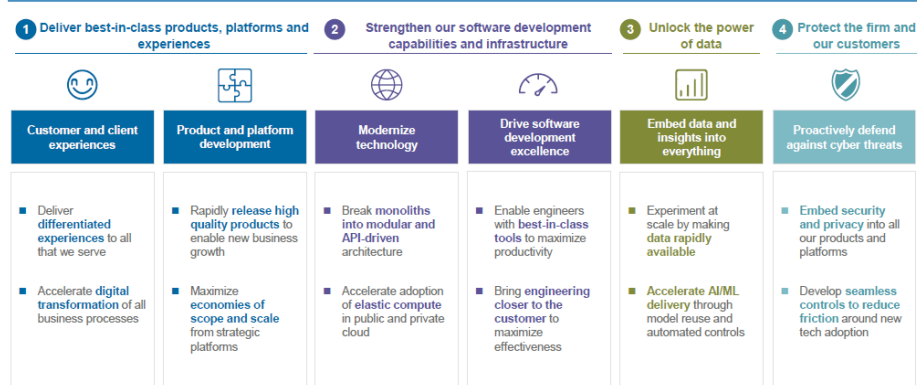
It should be noted that staffing resources and the required mix of those resources (and capability) varies by Stage and that creates a challenge for workforce optimization and workforce needs as workforce size and capability balance vary by stage – especially in consideration of specializations like Data Analytics, Machine Learning, and AI.

	Digital Transformation Stage Model: Resource Mix by Stage (National IT Model)		
	Stage 1 -Transformation Initiation / Foundation Focused	Stage 2 - Transformation of Channels and Data Focused	Stage 3 -Operationalized / Business Process and Data
Strategic planning (including Portfolio management)	2.0%	2.0%	3.0%
Engineering	45.0%	48.0%	50.0%
Architecture, Research and Development	5.0%	5.0%	5.5%
Release management	4.0%	5.0%	4.0%
Analyst/Ops and support	18.0%	15.0%	12.0%
Product Mgr	3.0%	3.0%	2.5%
Admin / Other management	1.0%	1.0%	1.0%
Chapter Lead	1.0%	1.0%	1.0%
Manager	2.0%	2.0%	1.5%
Product Owner	4.0%	5.0%	7.0%
Developer	13.0%	11.0%	10.0%
TSM	1.0%	1.0%	1.0%
Other	1.0%	1.0%	1.0%

Figure 3. The changing balance of resource needs

And of course, there is always the issue of “value” – the best most recent illustration is the 2022 JPMorgan Chase Investor Day presentation on “Global Technology” in which AI plays a key technology and business value generation role with an associated \$1B in business impact.

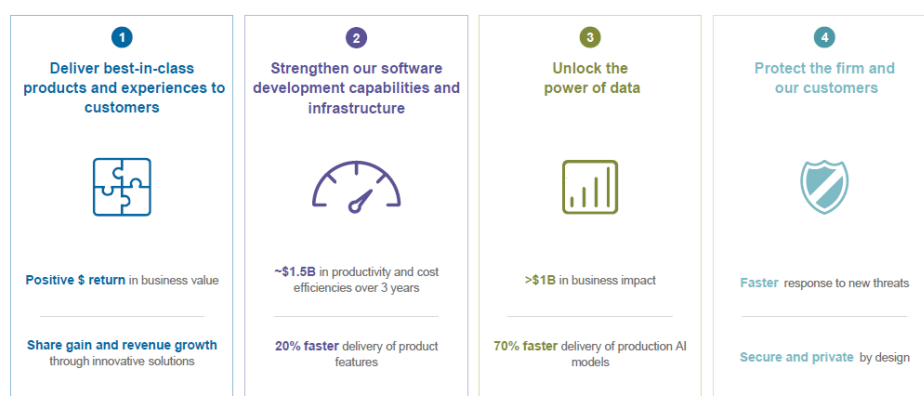
Our technology strategy is aligned to business priorities



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We are well positioned to differentiate ourselves with technology



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Conclusion

Technology economics includes a broad set of ideas. For IT leaders, it provides a framework and tools for better decision making. In this context, its most important principles are:

- Manage IT spending as an investment
- Use modern measures to assess and manage your IT spending
- Connect IT spending to business outcomes

Many large institutions today have a chief economist. Especially with the changes brought by cloud computing, expect to see some IT leaders functioning as chief technology economists. Understanding—and acting on—the changes in IT investment today requires no less.

About Dr. Howard Rubin

Dr. Howard A. Rubin is a Professor Emeritus of Computer Science at Hunter College of the City University of New York. He held the positions of being a MIT CISR Research Affiliate, a Gartner Senior Advisor, a BCG Senior Advisor, and a Nolan Norton Research Fellow. He has also advised all the world's major consultancies and technology companies on benchmarking – BCG, McKinsey & Co, Deloitte, E&Y, PWC, Cap Gemini, TCS, Wipro, IBM, Google, Microsoft, Intel, Broadcom, VMware, Intuit, and others. He is the founder and CEO of Rubin Worldwide. In 1997, Industry Week named Dr. Rubin one of the top 50 "R&D Stars to Watch . . . an individual whose achievements are shaping the future of our industrial culture and America's technology policy as a result of his bringing the IT workforce shortage to national attention".

Dr. Rubin is a pioneer in the areas of digital & technology economics and has built the world's largest database in the field consisting of business, national, and technology data captured continuously since 1994. This database (initially released as the Worldwide Benchmark Project and today is the foundation for Gartner's IT Key Metrics offering) is used by analyst firms such as Gartner Inc, among others. Using this database Dr. Rubin monitors technology-economic trends across companies and organizations in more than 20 sectors that account for roughly 20% of the world's GDP and an equivalent amount of technology spending/investment. Dr. Rubin's personal portfolio of client companies in total generate more than \$1.5T in revenue to the global economy annually and account for more than \$100B in yearly Information Technology (IT) spending. Dr. Rubin's research and technology economic models helped shape the TBM (Technology Business Management) model and has been integrated into products such as Apptio.

In addition to his global data collection encompassing more than 350 financial services companies and 270 insurance companies annually, his financial services and insurance sector clients over the years include Aegon, Aetna, AIG, Allstate, AXA, American Express, ANZ, Bank of America, Bank of New York/Mellon, Barclays, Bank for International Settlements, Bank of Montreal, Bloomberg, CIGNA, CIT Group, Citi, Commonwealth Bank of Australia, Credit Suisse, CSS, DBS, Danske Bank, Deutsche Bank, Equitable Life, Fidelity, Fannie Mae, Freddie Mac, The Federal Reserve, Goldman Sachs, HSBC, Key Bank, JPMorgan Chase, Liberty Mutual, Lincoln Life, Manulife, Mass Mutual, MetLife, Morgan Stanley, MUFG/Union Bank, New York Life, Nomura, PNC Bank, Progressive, Prudential, Raymond James, Royal Bank of Canada, Scotia Bank, Standard Charter, State Farm, State Street, Sumitomo Mitsui, TD Ameritrade, Thomson Reuters, The Principal Financial Group, Toronto Dominion, Transamerica, UBS, Webster Bank, Wells Fargo, and Westpac among others. Dr. Rubin has done extensive work in other sectors including pharmaceuticals, consumer products, technology, media, energy, healthcare, transportation, and telecommunications over his 30+ years of working in the field.

Dr. Rubin has also worked directly with heads of state or their key ministers around the world in the development of national competitive technology strategies and job creation programs (Canada, Philippines, India, Singapore, and more). His work has been used extensively in the U.S. by former President William Clinton and Secretary Hillary Clinton and has been the subject of briefings to President Obama's National Economic Council.

He is also the author of a Pearson/Financial Times video series on Technology Economics. His Technology Economics column regularly appeared in Wall Street and Technology. He also is a member of the TBM Council and on the Apptio CIO Advisory Council. Dr. Rubin possesses a Ph.D. from the City University of New York in Computer Science and Oceanography. Dr. Rubin started his academic career in one of the country's first Computer Science departments at the City College of New York School of Engineering and then went on to help establish the Department of Computer Science at Hunter College in New York where he eventually became Chair. Dr. Rubin has been an invited speaker at Harvard University and MIT's Sloan School.

Dr. Rubin also developed the first widely-used software estimation system (ESTIMACS) and one of the first mouse-interface project management systems (PROJECTMACS). To market those products, Dr. Rubin developed one of the first PC-based presentation systems in the 1980's (SOFTSLIDE) with an accompanying first-of-its-kind digital clip art library. Today's PowerPoint can trace some of its lineage and features.

Outside the world of technology Dr. Rubin is former Chair of the Board of Riverkeeper and is currently a Trustee of the Waterkeeper Alliance. He was honored in 2016 by Riverkeeper with a "Big Fish Emeritus" award along with Leonardo DiCaprio and Ralph Lauren. He is also a supporter of the Clinton Foundation, a Leadership Council member of the RFK Foundation, a major contributor to student development programs/Film Fellows at the Tribeca Film Institute – In October 2018, the Institute honored Dr. Rubin with an award presented by Robert DeNiro for his "Extraordinary Leadership" at the New York Premiere of "A Star is Born". Dr. Rubin is also a major supporter of PBS' Masterpiece Trust, a former member of The Recording Academy, a member of the NRDC's Global Leadership Council, and formerly a Business Board Member of the International AIDS Trust. He also was Executive Producer of two documentaries – "The Atomic States of America" and "Keepin' On – The Story of the Riverkeepers"

About Jed Rubin

Jed Rubin has worked in the field of technology economics for more than 10 years. In addition to providing support to hundreds of global 2000 clients, Mr. Rubin has also been involved in academic research, product development, publications, and speaking engagements in North America and across Europe.

Prior to forming Rubin Worldwide with Dr. Howard Rubin, Mr. Jed Rubin worked at Gartner, where he served as Director of the Worldwide IT Benchmark Service, a service he led since its inception at META Group in 2002. (META Group was acquired by Gartner in 2005.) During this

time, Mr. Rubin was responsible for the annual publication of the Worldwide IT Benchmark Report and META Group's IT Measurement Desk Reference, as well as other product development initiatives.

In addition, Mr. Rubin worked for Rubin Systems where he assisted in developing the Worldwide IT Benchmark Report and an IT Benchmarking Website, metricnet.com, which was acquired by META Group in 2000. Mr. Rubin also assisted in the writing of the Global New-Economy Index and the States Technology Index, both of which analyzed the technological competitiveness of several geographies. Research collaboration includes activity with MIT Sloan, INSEAD, the State of Ohio, the University of Texas, and The Property & Casualty Association of America, McKinsey, the Boston Consulting Group, and PWC.

Mr. Rubin holds a double bachelor's degree in psychology and Spanish from Oberlin College in Ohio. He earned an MBA from the Instituto de Empresa in Madrid, Spain, where has worked as an associate professor. Mr. Rubin lives in Madrid and is fluent in Spanish.

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