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The Total Economic Impact™ Of GE Digital Asset Performance Management For Oil And Gas Operations

Cost Savings And Business Benefits Enabled By GE Digital Asset Performance Management For Oil And Gas Operations

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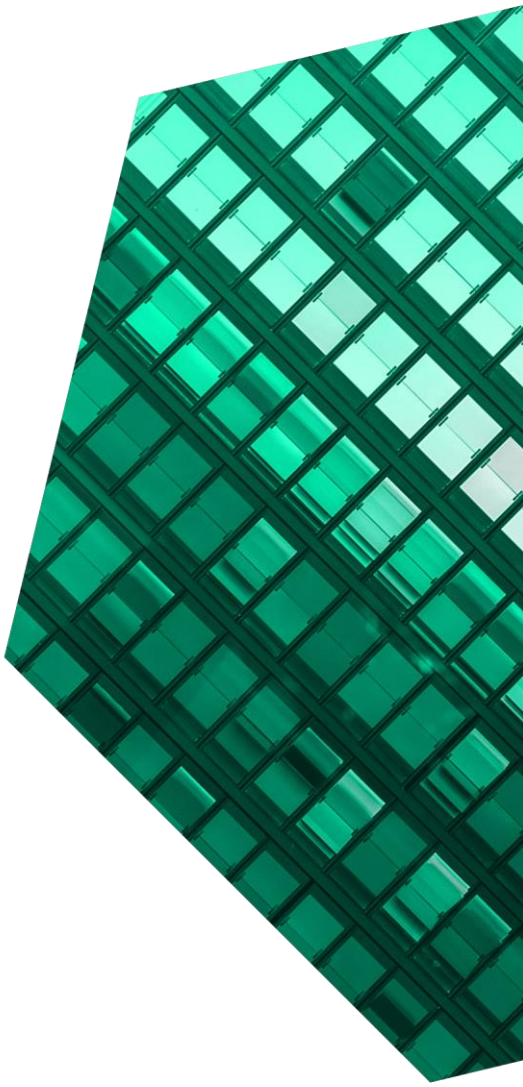


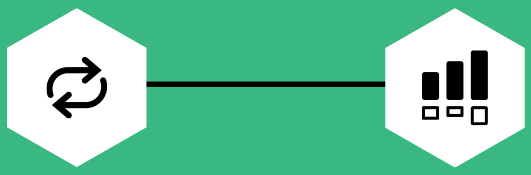
Executive Summary

Oil and gas operations are large-scale in terms of the volume of assets involved and the global expanse of their operations. The commonality of merger and acquisition activity and the various affiliate partnerships that round out the space further complicate the asset landscape. Oil and gas organizations must surmount these obstacles to harness their collective asset monitoring and maintenance data, and inform processes and strategies that improve asset efficiency and reliability.

GE Digital Asset Performance Management (APM) extends various diagnostic and analytics tools across large-scale oil and gas operations to collect and monitor asset data and ultimately provide an enterprisewide, holistic view of the asset landscape. The consolidated view of asset data informs maintenance cycles, equipment strategies, and other key decision areas to provide efficiencies and identify cost saving opportunities while improving reliability.

GE Digital APM includes multiple components, starting with their foundational offering of Essentials, which aids in data management, processing, and visualization as well as asset monitoring and alerts. Additional components include APM Health, which provides a unified view of asset health and current states; APM Reliability, which analyzes the data collected to predict equipment issues; APM Strategy, which helps with strategy management to reduce risk and optimize life cycle costs; APM Integrity, which helps operators reduce risk, lower inspection costs, and ensure regulatory compliance; and APM Safety, which provides a view of the criticality of safety instrumented systems. The solution components of GE Digital APM can be deployed either on-premises or in the cloud.

KEY STATISTICS



Return on investment (ROI)
292%

Net present value (NPV)
$24.77M

Reduction in unplanned downtime by Year 5:

10%

GE Digital commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) enterprises may realize by deploying APM within the oil and gas industry.[1] The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of GE Digital's APM on their oil and gas organizations.

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed four respondents and surveyed 55 respondents with experience using GE Digital APM for oil and gas. For the purposes of this study, Forrester aggregated the experiences of the interviewees and survey respondents and combined the results into a single

composite organization that represents all three sub-industries of oil and gas from upstream production and midstream transportation, through to downstream refineries. Additionally, although GE Digital APM can be deployed on-premises, the composite organization deploys the solution in the cloud.

Prior to implementing GE Digital APM, the interviewees noted that their organizations faced disparate asset monitoring technology landscapes that contributed to high technology costs for redundant systems as well as for the resources required to manage them. As none of these systems were connected, manual data collection and reporting processes were required to form a comprehensive view of asset performance data. However, relying on manual efforts to bridge gaps in technology created single points of failure and led to errors that ultimately impacted the interviewees' organizations' abilities to make informed business decisions around asset performance. As a result, organizations experienced higher failure rates and more incidents that contributed to lower asset reliability.

With GE Digital APM, the interviewees created a consolidated data repository for APM data and standardized their approaches to data collection and reporting. The better insights and decision-making afforded from creating an enterprisewide view of APM data enabled the interviewees to shift away from reactive, time-based maintenance to predictive, optimized maintenance cycles. The result was greater efficiencies, a reduction in downtime, and improved reliability.

KEY FINDINGS

Quantified benefits. Five-year, risk-adjusted present value (PV) quantified benefits for the composite organization include:

- **Avoided revenue loss from reducing unplanned downtime of $26 million.** More informed, preventative maintenance decisions and the transition to predictive analytics that identifies potential incidences before they occur contribute to the reduction in unplanned downtime for the composite organization. Unplanned downtime halts operations and results in revenue loss that totals $470,000 an hour per site. With a 5% to 10% reduction in unplanned downtime over the investment period, the composite experiences a cumulative total business impact of $26 million in avoided revenue loss over five years.
- **Greater resource efficiencies from 5% to 10% reduction in unplanned maintenance and 6% to 10% reduction in planned maintenance.** Increased data transparency surfaces both the unusually unreliable assets in the asset landscape and the assets that require less maintenance. Resources can optimize maintenance cycles for the composite organization to focus on asset needs versus a time-based and preventative approach to maintenance. The efficiencies result in cost savings that total $2.5 million over the five-year investment.
- **Confidently extending asset lifetimes by 10 to 26 weeks to save on asset replacement costs.** Resources optimize maintenance cycles to spend less overall time on asset maintenance without negatively impacting reliability. The results encourage the composite organization's decision-makers and regulatory bodies alike to allow lifetime extensions on certain assets. Cost savings from extending asset lifetimes and avoiding the associated replacement spend total $1.9 million over the five-year investment.
- **Additional operational efficiencies for data collection, data cleaning and normalization, and data analysis and reporting efforts totaling $73,000.** Moving from previously manual processes to GE Digital APM creates operational efficiencies for the composite organization's resources involved in data collection, cleaning,

and normalization, as well as data analysis and reporting. Time savings for the impacted, and notoriously squeezed, resources total $73,000 over the five-year investment.

- **Eliminating $380,000 of legacy solution spend and 8 FTEs by consolidating to a single APM solution.** The composite organization decommissions prior disparate APM solutions, resulting in both technology and resource cost savings. Technology cost savings include those for maintenance contracts, licensing fees, and production costs, while eliminating regionally specific database administrators (DBA) create resource cost savings. In total, the cost savings are $2.6 million over the five-year investment.

Unquantified benefits. Benefits that are not quantified for this study include:

- **Creating more fungible resources and eliminating single points of failure.** Centralizing the APM data repository to a single solution across all regions and sites allows for more streamlined and consistent processes. Resources therefore become more fungible across different sites and assets, eliminating many single points of failure. The downstream impacts include protection from turnover, more efficient training processes, and improvements to overall communication workflows.
- **Improved data quality.** Less manual interventions and a more comprehensive and transparent view of the asset landscape results in better data quality. Decision-makers feel more informed, demonstrate confidence in their analyses, and make better business decisions.
- **Improved ability to meet regulatory and compliance standards.** There are many regulatory bodies involved in the oil and gas industry with unique standards and reporting requirements. GE Digital APM serves up asset data for flexible reporting formats and historical archiving guidelines to better meet regulations.
- **Better customer experiences.** GE Digital APM enables real-time information exchange to facilitate business processes while minimizing delays and errors that lower productivity and impact customer experiences.

Costs. Five-year, risk-adjusted PV costs include:

- **Costs to GE Digital total $5.9 million.** Costs to GE Digital include cloud licensing fees and annual support costs. Additionally, ongoing services fees cover both the initial implementation and ongoing, phased implementations, solution expansions and updates. In total, costs paid to GE Digital for the APM solution accrue to $5.9 million over five years.
- **Internal resource time spent on implementation, management, and training totals $2.6 million.** Internal resources are required to face off with GE Digital for the initial implementation of the five APM solutions, as well as for ongoing management of the solutions and training. Internal resource time spent on these activities totals $2.6 million in labor costs.

The financial analysis which is based on the interviews and survey found that a composite organization experiences benefits of $33.24 million over five years versus costs of $8.48 million, adding up to a net present value (NPV) of $24.77 million and an ROI of 292%.

Average asset lifetime extension:

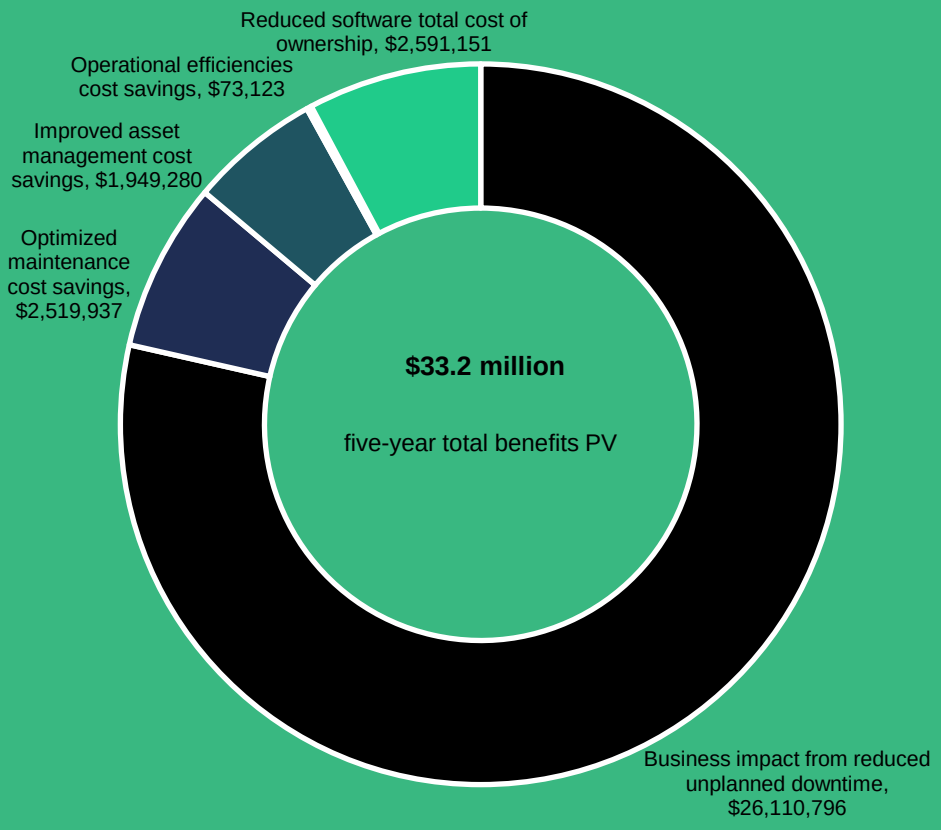
Year 2
10 weeks

Year 5
26 weeks

ROI
292%

BENEFITS PV
$33.24M

NPV
$24.77M



TEI FRAMEWORK AND METHODOLOGY

From the information provided in the interviews and survey, Forrester constructed a Total Economic Impact™ framework for those organizations considering an investment in GE Digital Asset Performance Management for oil and gas.

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 GE Digital APM can have on an oil and gas organization.

DUE DILIGENCE

Interviewed GE Digital APM stakeholders and Forrester analysts to gather data relative to the technology, APM, and the oil and gas industry.

INTERVIEWS AND SURVEY

Interviewed four interviewees and surveyed 55 respondents at oil and gas organizations using GE Digital APM to obtain data with respect to costs, benefits, and risks.

COMPOSITE ORGANIZATION

Designed a composite organization based on characteristics of the interviewees and survey respondents.

FINANCIAL MODEL FRAMEWORK

Constructed a financial model representative of the interviews and survey using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the interviewees and survey respondents.

CASE STUDY

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

The GE Digital APM For Oil And Gas Operations Customer Journey

Drivers leading to the APM investment

KEY CHALLENGES

Forrester interviewed four representatives and surveyed 55 respondents with experience using GE Digital APM at their oil and gas organizations. For more details on these individuals and the organizations they represent, see Appendix B.

Both interviewees and survey respondents noted how prior disparate asset monitoring technologies resulting from siloed regional operations and legacy solutions inherited from mergers and acquisitions caused common challenges, such as:

- **High technology costs for ineffective solutions.** Legacy APM solutions operated in silos by region. Given the large scale of most oil and gas operations, this meant that there were multiple redundant solutions in place for APM. As a result, organizations paid high costs for the technology and the individual resources required to run and maintain the technology in each region. Additionally, most of the legacy solutions were unable to scale effectively to support more than one region given data volume and bandwidth restrictions in terms of network and resource capacity.
- **Manual data collection and reporting processes created inconsistencies and led to errors.** Organizations turned to manual data collection and reporting efforts to fill technology gaps and construct an enterprisewide view of asset performance. Not only did manual work extend timelines and negatively impact data quality, but it also restricted capacity for already squeezed resources, such as field technicians and control engineers, to perform more value-add work. Additionally, the processes previously constructed around asset performance data varied greatly from region to region, creating single points of failure that could at best lead to bottlenecks and, at worst, result in tacit knowledge walking out the door through turnover.
- **Inhibited business decisions and negatively impacted asset performance.** The lack of technology and process standardization negatively impacted data quality, stakeholder confidence in that data, and the ability to glean valuable insights. As a result, interviewees' organizations relied most heavily on routine, reactive maintenance that was built on a standard timeline versus a needs-based approach. This approach left valuable cost savings on the table for maintenance efficiencies and inventory spend. Additionally, limited data transparency made the interviewees'

"The first affiliate we rolled out to had five different databases for managing their asset integrity and their asset performance and that wasn't counting the spreadsheets. Some of the systems in place were from party vendors, some of them were homegrown, and some of them weren't network connected. I'm not even talking about connected to the [enterprise resource planning] (ERP), but I'm talking about network connected period."

Global system owner, upstream oil and gas

organizations more vulnerable to higher incident counts and missed inspection dates that deteriorated asset reliability.

INVESTMENT OBJECTIVES

The interviewees and survey respondents searched for a solution that could:

- Consolidate existing systems for asset performance management to a single, holistic system and reduce associated technology spend.
- Enable the standardization of data management and reporting processes and encourage resources to enforce standard practice to, ultimately, optimize productivity and improve data quality.
- Monitor critical assets and protect from threats.
- Implement predictive and preventative maintenance.

Ultimately, the interviewees and survey respondents engaged with GE Digital APM over competitive solutions in the market due to GE Digital's:

- Reputation of demonstrated credibility.
- Experience in all related operating areas of a nuanced industry (oil and gas).
- Modern platform that extends to different operating areas within the industry and varying use cases, and its ability to scale across the organization.
- Key integration capabilities with core systems, field technologies, and tools, some of which GE Digital also supplies.
- Repeatable and flexible architecture that enables a phased approach to implementation.

COMPOSITE ORGANIZATION

Based on the interviews and survey, Forrester constructed a TEI framework, a composite company, and an ROI analysis that illustrates the areas financially affected. The composite organization is representative of the four interviewees and the 55 survey respondents, and it is used to present the aggregate financial analysis in the next section. The composite organization has the following characteristics:

"You need a system of record for all your equipment and your functional locations. If you're working with a bunch of disparate APM type products around the world or with spreadsheets, how do you tap in to make sure that you have your equipment list up to date and that equipment that's been deleted gets deleted in your system, etc.?"

Global system owner, upstream oil and gas

Description of composite. The composite organization is a global oil and gas organization that includes upstream, midstream, and downstream operations across eight regions. Total revenue for the organization is $10 billion and the total asset value is $100 billion.

Operations span three sites per region for a total of 24 sites. Each site has 1,500 assets monitored with GE Digital APM. The organization considers an asset as an individual, but complete piece of equipment. For example, the assumption is that an asset is a full motor versus the coils or compressor pieces that make up the motor. For the composite organization, critical assets are those that contribute to revenue

generation and are comprised of mostly tier-one and tier-two assets. Therefore, only 25% of the total asset volume are critical assets.

Deployment characteristics. The composite organization deploys GE Digital APM in a software-as-a-service (SaaS) model in the cloud and implements it in phases on a site-by-site basis. The organization effectively rolls out all five solutions — Health, Reliability, Strategy, Integrity, and Safety — that make up GE Digital APM to 25% of total sites in Year 1, 50% in Year 2 and 100% in Year 3 and for the remainder of the five-year investment period.

Key Assumptions

- **$10 billion annual revenue**
- **24 sites globally**
- **1,500 assets per site**
- **25% critical assets**
- **100% implementation by Year 3**

Analysis Of Benefits

Quantified benefit data as applied to the composite

Total Benefits								
Ref.	**Benefit**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**	**Present Value**
Atr	Business impact from reduced unplanned downtime	$1,677,900	$3,355,800	$9,396,240	$9,396,240	$13,423,200	$37,249,380	$26,110,796
Btr	Optimized maintenance cost savings	$156,528	$313,056	$1,004,352	$1,004,352	$1,092,480	$3,570,768	$2,519,937
Ctr	Improved asset management cost savings	$0	$194,712	$623,077	$1,012,500	$1,012,500	$2,842,788	$1,949,280
Dtr	Operational efficiencies cost savings	$6,792	$13,566	$27,132	$27,132	$27,132	$101,755	$73,150
Etr	Reduced software total cost of ownership	$240,300	$480,600	$961,200	$961,200	$961,200	$3,604,500	$2,591,151
	Total benefits (risk-adjusted)	$2,081,520	$4,357,734	$12,012,001	$12,401,424	$16,516,512	$47,369,191	$33,244,314

BUSINESS IMPACT FROM REDUCED UNPLANNED DOWNTIME

Evidence and data. GE Digital APM enabled the interviewees' organizations to reduce unplanned downtime and, therefore, avoid the associated revenue loss that can occur. In the early days of the investment, GE Digital APM's monitoring capabilities alerted the interviewees' organizations of imminent incidents and enabled them to take corrective actions sooner. Additionally, GE Digital APM harnessed historical asset data for analysis to identify previous patterns and inform future strategies that further mitigate unplanned downtime. The biggest impact occurred when the interviewees' organizations shifted to predictive analytics that allowed them to avoid future failures.

- A global system owner from an upstream oil and gas organization described how improved APM data transparency and monitoring capabilities brought potential problems to light that could have contributed to unplanned downtime: "I identified this area of corrosion in a pipe that we wouldn't have caught if we wouldn't have [invested in GE Digital APM]. If we didn't have this process in place that might still be sitting in the data that we haven't looked at yet."
- A former deployment director from another upstream oil and gas organization emphasized the important shift to predictive analytics that they experienced with GE Digital APM: "The biggest benefit that came out of the investment [in GE Digital APM] was the predictive analytics rather than the historical analysis. Historical analysis is here to say that a failure occurred and where it happened, when it happened, and what kind of corrective actions need to be taken to prevent it in the future. That's looking backwards. The key thing here is having seen these failures in the past, can I predict what is going to be failing in the future so I can avoid it from even happening? We did get to that point [with GE Digital APM]."
- The same former deployment director from an upstream oil and gas organization also indicated that while predictive analysis was the goal, the historical analysis provided benefits in the interim, stating, "The historical analytics part and

the real-time monitoring allowed us to not only reduce the number of people who had to look up the data, but also made it easier to identify coherent corrective actions and when to take them."

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- The avoided revenue loss focuses on a reduction in unplanned downtime and assumes that this is where the financial impact will come from and not from reducing planned downtime. Planned downtime is already occurring during off hours and would be scheduled in a way to avoid significant revenue loss.
- For unplanned downtime, the calculation considers a rolling implementation across sites (25% in Year 1, 50% in Year 2, and 100% of sites by Year 3). Therefore, the benefit scales as the organization goes live at more sites and harnesses the data from a higher volume of assets.
- Unplanned downtime is reduced by 5% in Years 1 and 2 to account for the limited implementation as well as the learning curve for users to identify normal behavior before they can accurately predict problems. By Year 3, APM is fully rolled out and the users are attuned to the data and trust the outputs and, therefore, can start shifting to predictive analysis to avoid failures more effectively than by pattern spotting across historical data. As such, unplanned downtime reduces by 7% in Year 3 and 10% in Year 5.
- The composite uses the example of a downstream oil refinery to calculate the expected revenue loss during downtime. In this case, emergency downtime results in the refinery missing expected production targets for volumes of barrels of oil produced per day. As a result, the organization loses out on the associated market price for the barrels not produced during downtime.
- As such, the average operating revenue loss per hour per site is $3.9 million dollars. There is a 12% operating margin applied to this amount to account for resource time spent working during downtime to achieve the $470,000 value used in the model.

Risks. The business impact from reduced unplanned downtime may vary depending on the following:

- The scale and geographical region(s) of the operation will impact the avoided revenue loss. Larger operations in terms of number of sites, total asset value, and annual revenue are likely at risk to lose more revenue per hour of unplanned downtime than smaller operations.
- Unplanned downtime per year per site before GE Digital will vary depending on the industry segment of oil and gas (upstream, midstream, or downstream) as well as the maturity of the operations. For instance, downtime will look different for small petrochemical plants versus offshore semisubmersibles.
- Unplanned downtime is not always the equivalent of a catastrophic event; there might also be smaller events that contribute to unplanned downtime in the before state.
- There are additional levels of variability that impact operating revenue loss associated with unplanned downtime such as, weather, seasonality, and other market impacts like world events.

Results. To account for these risks, Forrester adjusted this benefit downward by 30%, yielding a five-year, risk-adjusted total PV (discounted at 10%) of $26.1 million.

Business Impact From Reduced Unplanned Downtime							
Ref.	**Metric**	**Source**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
A1	Number of sites live with GE Digital APM	Composite	6	12	24	24	24
A2	Annual unplanned downtime hours per site before GE Digital APM	Survey	17	17	17	17	17
A3	Reduction in annual unplanned downtime hours per site	Survey	5%	5%	7%	7%	10%
A4	Average operating revenue loss per hour of unplanned downtime per site	Survey	$470,000	$470,000	$470,000	$470,000	$470,000
At	Business impact from reduced unplanned downtime	A1*A2*A3*A4	$2,397,000	$4,794,000	$13,423,200	$13,423,200	$19,176,000
	Risk adjustment	↓30%					
Atr	Business impact from reduced unplanned downtime (risk-adjusted)		$1,677,900	$3,355,800	$9,396,240	$9,396,240	$13,423,200
Five-year total: $37,249,380				**Five-year present value: $26,110,796**			

OPTIMIZED MAINTENANCE COST SAVINGS

Evidence and data. Having consolidated APM data repositories afforded the interviewees' organizations the ability to harness data centrally and craft an enterprise-level and data-driven approach to maintenance. This approach reduced unplanned downtime and maximized the effectiveness of planned maintenance. GE Digital APM enabled the interviewees' organizations to identify the unusually unreliable assets and focus maintenance efforts on the higher risk assets versus relying on a reactive maintenance — or firefighting — and a time-based approach to maintenance cycles. The interviewees' organizations used the data to confidently extend maintenance cycles thereby reducing time spent on maintenance overall, while still improving reliability.

- A former deployment director at an upstream oil and gas organization indicated that overall, they reduced the total time spent on maintenance by about 15% to 20% while realizing reliability improvements with GE Digital APM.
- A global system owner from an upstream oil and gas organization linked having an enterprise-based approach to equipment strategy with more efficient maintenance cycles. They stated: "Equipment strategy is a list of risks on your equipment and the mitigating actions to take to avoid having those risks lead to failures. When we had our various affiliates using different systems that were disconnected in every way, we couldn't efficiently take advantage of our economy scale because, for instance, people in Malaysia might host a one-week equipment, gas turbine reliability workshop, and not know that people in Germany are having the same workshop."
- An IT director from a midstream oil and gas organization explained how making more informed decisions about maintenance time allocation allowed them to hone their maintenance efforts and reduced time spent over all: "The process efficiency we saw [around maintenance cycles] could be translated into a reduction in the number of field visits that had to be conducted by a field technician or a field engineer to go look at the health status of the equipment. Now, they could look at that data

based on the readings, which is a better use of their time and allows them to understand when to do certain inspections or maintenance related activities verses conducting random checks and visits out of caution."

- That same interviewee also indicated that these cautionary maintenance visits were expensive as they involved large teams of resources including field technicians, field supervisors, maintenance crews, and even sometimes third-party vendors.
- A reliability enablement specialist at an upstream and downstream organization said that labor costs were even larger when unplanned downtime was considered: "Conservatively, we know that reactive maintenance is three times more costly than proactive maintenance."

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- Cost avoidances from optimized maintenance increases in Year 3 when GE Digital APM is successfully rolled out to all sites and the organization begins to benefit from an enterprisewide view of its assets.
- For planned maintenance, the benefit plateaus after Year 3, as it is assumed that by this stage, most tier-one and tier-two assets are monitored across all sites.
- The labor cost per hour of planned maintenance considers time spent by a large team of resources.
- The unplanned maintenance hours for this benefit mirror those experienced in Benefit A. The assumption is that, while there might be maintenance cycles that don't result in revenue loss downtime, there is also downtime when maintenance can't be performed due to a part delay and the like.
- The labor costs per hour of unplanned downtime also assumes a large team of resources are involved. However, there is also an uptick of 3.5 to four times to account for overtime, the typically odd hours of maintenance required for unplanned incidents, and less accessibility of replacement parts and associated spend on logistics.

Risks. Cost savings from optimized maintenance may vary depending on the following:

- The scale and geographical region(s) of the operation, as well as the approach to implementation, will impact the maintenance efficiencies experienced for both planned and unplanned maintenance.
- Unplanned and planned downtime per year per site before GE Digital will vary depending on the industry segment of oil and gas (upstream, midstream, or downstream) as well as the maturity of the operations.

Results. To account for these risks, Forrester adjusted this benefit downward by 20%, yielding a five-year, risk-adjusted total PV of $2.5 million.

Optimized Maintenance Cost Savings							
Ref.	**Metric**	**Source**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
B1	Number of sites live with GE Digital APM	A1	6	12	24	24	24
B2	Annual planned maintenance hours per site before GE Digital APM	Survey	160	160	160	160	160
B3	Reduction in planned maintenance hours per site with GE Digital APM	Survey	6%	6%	10%	10%	10%
B4	Average hourly cost of planned maintenance labor	Survey	$2,600	$2,600	$2,600	$2,600	$2,600
B5	Subtotal: Labor savings from reduced planned maintenance	B1*B2*B3*B4	$149,760	$299,520	$998,400	$998,400	$998,400
B6	Annual unplanned maintenance hours per site before GE Digital APM	A2	17	17	17	17	17
B7	Reduction in unplanned maintenance per site with GE Digital APM	Survey	5%	5%	7%	7%	10%
B8	Hourly cost of unplanned maintenance labor	Survey	$9,000	$9,000	$9,000	$9,000	$9,000
B9	Subtotal: Labor savings from reduced unplanned maintenance	B1*B6*B7*B8	$45,900	$91,800	$257,040	$257,040	$367,200
Bt	Optimized maintenance cost savings	B5+B9	$195,660	$391,320	$1,255,440	$1,255,440	$1,365,600
	Risk adjustment	↓20%					
Btr	Optimized maintenance cost savings (risk-adjusted)		$156,528	$313,056	$1,004,352	$1,004,352	$1,092,480
	Five-year total: $3,570,768			**Five-year present value: $2,519,937**			

IMPROVED ASSET MANAGEMENT COST SAVINGS

Evidence and data. The interviewees' organizations leveraged the central repository of equipment data to make more informed decisions around equipment strategies and maintenance cycles. Additionally, they referenced their more effective maintenance cycles and improved reliability to convince regulatory bodies and other organizational leaders to safely extend equipment lifetimes. As a result, they saved on the costs required to replace equipment and equipment components for the assets that were safely extended. These cost savings included costs of the parts as well as tangential costs for shipping and logistics.

- A reliability enablement specialist at an upstream and downstream oil and gas organization saw

"We can identify certain assets as bad actors and then make more frequent inspections on those. It's about taking your maintenance dollar and making it work for you on the highest risk items. It also means that we identify lower risk assets as well and we extended those intervals."

Global system owner, upstream oil and gas

tangible value from optimizing inspection cycles, stating, “Logically, using the [risk-based inspection] (RBI) module to perform analysis helps us convince leaders and regulatory bodies that we can extend the life of certain assets and increase the inspection intervals on others.”

- A global system owner from an upstream oil and gas organization corroborated that sentiment, stating: “We have been able to use our risk-based inspection processes to work with regulators to show hard data that allows us to extend inspection intervals beyond the regulatory minimum. Instead, we prove to those regulators that we could save that money and go inspect something else that needs it more.”
- The same global system owner explained how the central repository for APM data allowed them to take advantage of their economy of scale given their sprawling operations: “When you have a global system, you can share enterprise-based strategies. I know for a fact that everybody in our company that has access to our equipment strategies and can see templates from around the world.” The organization shared enterprise-based equipment strategies to further understand the risk levels of its assets and make more informed decisions about maintenance cycles.

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- Each site has an average of 1,500 assets using reliability plus (deployed in the cloud) and 25% of those assets are considered critical. An asset is a full piece of equipment, and critical assets are those that contribute to revenue generation.
- Prior to GE Digital APM, 15% of critical assets require either a full or partial replacement on an annual basis.
- The average cost to replace a critical asset also considers both full and partial replacements. Partial replacements occur more frequently and cost less.
- With GE Digital APM, the composite organization extends the lifetime of 20% of their critical assets.
- Asset lifetimes are not extended in Year 1 as the program is still getting up and running. Starting in Year 2, the average number of additional weeks of assets lifetimes scales each year of the investment until capping out at 26 weeks in Year 4.

Risks. Cost savings from improved asset management may vary depending on the following:

- The definition of an asset varies across industry segments and even between individual organizations. The definition of an asset will impact both the frequency of replacement experienced before the investment as well as the cost to replace the asset. For example, the larger the defined asset, the less frequently it will be replaced, but the more expensive it will be to replace. Similarly, the smaller the defined asset, the more often it will be replaced, and the less expensive it will be to fulfill.
- The cost to replace an asset will also vary depending on inventory management and whether the part is readily available or requires ordering, shipping, etc. The associated inventory costs will vary depending on the geographic location of the asset and the accessibility of the replacement pieces.

Results. To account for these risks, Forrester adjusted this benefit downward by 25%, yielding a five-year, risk-adjusted total PV of $1.9 million.

Improved Asset Management Cost Savings							
Ref.	**Metric**	**Source**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
C1	Number of sites live with GE Digital APM	A1	6	12	24	24	24
C2	Number of assets per site	Composite	1,500	1,500	1,500	1,500	1,500
C3	Percentage of assets considered critical	Composite	25%	25%	25%	25%	25%
C4	Percentage of critical assets replaced annually before GE Digital APM	Interview data	15%	15%	15%	15%	15%
C5	Average total cost of critical asset replacement	Survey data	$10,000	$10,000	$10,000	$10,000	$10,000
C6	Total annual spend on critical asset replacements before GE Digital APM	(C1*C2)*C3*C4*C5	$3,375,000	$6,750,000	$13,500,000	$13,500,000	$13,500,000
C7	Percentage of critical asset replacements postponed annually with GE Digital APM	Interview data	20%	20%	20%	20%	20%
C8	Average critical asset replacement postponement with GE Digital APM (weeks)	Survey data	0	10	16	26	26
Ct	Improved asset management cost savings	(C6*C7*C8)/52	$0	$259,615	$830,769	$1,350,000	$1,350,000
	Risk adjustment	↓25%					
Ctr	Improved asset management cost savings (risk-adjusted)		$0	$194,712	$623,077	$1,012,500	$1,012,500
	Five-year total: $2,842,788			**Five-year present value: $1,949,280**			

OPERATIONAL EFFICIENCIES COST SAVINGS

Evidence and data. The interviewees' organizations also indicated that they experienced process efficiencies outside of those associated with maintenance planning and execution. Prior to the investment in GE Digital APM, internal resources were tasked with manually collecting data to bridge technology gaps. Additionally, in the prior state, data originated from various systems and tools as well as manual collection efforts. As such, more time was required to clean and normalize the data to perform data analysis and generate reports. The high level of variability in the data inputs translated into variable data outputs and, therefore, complicated the interviewees' organizations' ability to perform analysis and build accurate reports.

- A former deployment director at an upstream oil and gas organization discussed how internal resource involvement delayed reporting and analysis efforts and implementing GE Digital APM made data readily accessible in an easy format for analysis: "A big advantage is that you don't need to wait for somebody to actually look for the data, pull that data, format it on your spreadsheet, and then do the analysis, because the analytics are there on your screen. We built several analytics dashboards that present the data engineers wanted and now we support those on an ongoing basis."

- Instead of using manual resources, utilizing GE Digital APM tools and solutions greatly reduced the volume of employees required to participate in the end-to-end data collection, normalizing, and reporting process. For example, the former deployment director at an upstream oil and gas organization stated, “With GE Digital APM, we no longer need a control engineer in every location looking at historical data.” Resources such as control engineers were expensive and busy. Giving any time back to such squeezed resources was a big benefit according to many of the interviewees.
- An IT director at a midstream oil and gas organization also saw efficiencies, citing: “Our resources have gotten time back from eliminating previous paper-based systems for data collection wherein they would go out to the field, take readings on a piece of paper and drive back to their regional office, to manually enter the data into their local system. But today, we've enabled field devices with LTE connectivity, so the numbers can be plugged directly into the system and the data is synced automatically with GE Digital APM.”
- The same interviewee also explained how, even with a reduction in time spent, the impact to data quality is positive, stating: “Now, there are more checks and balances in the process. We have sensor data that can be read and pulled directly by our corporate systems. This eliminates all kinds of manual errors by eliminating manual processes. Now that you’re automating a lot of those processes, you’re taking out every error or single point of failure in the system.”

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- The hours spent on each data-related process consist of multiple resources’ time.
- The reduction in time spent in the first three years of the investment is indicative of the phased approach to implementation. As more sites go live with GE Digital APM, the efficiencies impact more resources across the composite organization.

Risks. Cost savings from operational efficiencies may vary depending on the following:

- The APM tools and systems in place prior to the GE Digital APM investment.
- The size of the team and amount of labor spent on data collection, data cleaning and normalization, and data analysis and reporting before the investment in GE Digital APM.
- The percentage and composition of an organization’s individual assets that APM monitors.
- The structure and level of integration between GE Digital’s APM solution and an organization’s other data frameworks or workflows.
- Compensation amounts and structures for employees and contract workers and recapture rates of productivity on saved time.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a five-year, risk-adjusted total PV of $73,000.

Operational Efficiencies Cost Savings							
Ref.	**Metric**	**Source**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
D1	Annual hours spent on enterprisewide data collection in field before GE Digital APM	Survey	672	672	672	672	672
D2	Reduction in time spent on data collection in field with GE Digital APM	Survey	17%	33%	66%	66%	66%
D3	Subtotal: Reduction in annual hours spent on data collection enterprisewide	D1*D2	111	222	444	444	444
D4	Annual hours spent on data cleaning and normalization before GE Digital APM	Survey	960	960	960	960	960
D5	Reduction in time spent on data cleaning and normalization with GE Digital APM	Survey	18%	35%	70%	70%	70%
D6	Subtotal: Reduction in annual hours spent on data cleaning and normalization	D4*D5	168	336	672	672	672
D7	Annual hours spent on data analysis and reporting before GE Digital APM	Survey	672	672	672	672	672
D8	Reduction in time spent on data analysis and reporting with GE Digital APM	Survey	16%	32%	64%	64%	64%
D9	Subtotal: Reduction in annual hours spent on data analysis and reporting	D7*D8	108	215	430	430	430
D10	Average fully burdened hourly rate	Assumption	$39	$39	$39	$39	$39
D11	Productivity recapture rate	Assumption	50%	50%	50%	50%	50%
Dt	Operational efficiencies cost savings	(D3+D6+D9)*D10*D11	$7,547	$15,074	$30,147	$30,147	$30,147
	Risk adjustment	↓10%					
Dtr	Operational efficiencies cost savings (risk-adjusted)		$6,792	$13,566	$27,132	$27,132	$27,132
	Five-year total: $101,755		**Five-year present value: $73,150**				

REDUCED SOFTWARE TOTAL COST OF OWNERSHIP

Evidence and data. Prior to GE Digital APM, the interviewees' organizations had multiple regions that operated their own point solutions for APM. With GE Digital APM, the interviewees' consolidated those local systems to eliminate the associated maintenance contracts and licensing costs as well as to reduce related production costs. Additionally, there was cost savings from avoiding the individual FTE responsible for DBA in the prior local environments.

- A reliability enablement specialist at an upstream and downstream oil and gas organization consolidated seven to eight point solutions that were performing some APM functionality when they invested in GE Digital. As a result, they estimated savings of $300,000 annually.
- A global system owner at an upstream oil and gas organization measured additional cost savings from eliminating DBA resources associated with prior point solutions, stating: "Before [the investment in GE Digital APM], each affiliate [per region] required a database person to manage the system and data full time. This totaled 15 FTEs that we were able to consolidate into a single, centrally managed group.

Additionally, we eliminated the maintenance contracts and reduced licensing and production costs that resulted in tens of thousands of dollars of savings per application."

- The same global system owner considered an alternative situation to investing in GE Digital APM where they would have had to hire "a bunch more people to get familiar with all the idiosyncrasies of each affiliates' data and the way they manage it." This alternative solution would have created more single points of failure and further siloed asset data across the organization.

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- The organization eliminates one system and one DBA resource per each of the eight regions.
- Cost savings for eliminated systems are inclusive of maintenance contracts, licensing, and production costs.

Risks. Reduced software total cost of ownership (TCO) may vary depending on the following:

- The size and scope of operations as well as the number of eliminated point solutions and resources.
- The costs associated with eliminated systems as well as the fully burdened salaries for eliminated resources.

Results. To account for these risks, Forrester adjusted this benefit downward by 10%, yielding a five-year, risk-adjusted total PV of $2.6 million.

Reduced Software Total Cost Of Ownership

Ref.	Metric	Source	Year 1	Year 2	Year 3	Year 4	Year 5
E1	Eliminated spend on legacy point solutions (maintenance contracts, licensing, production costs)	Interviews	$95,000	$190,000	$380,000	$380,000	$380,000
E2	Eliminated DBA (FTEs)	Interviews	2	4	8	8	8
E3	Average fully loaded annual salary for DBA FTE	Assumption	$86,000	$86,000	$86,000	$86,000	$86,000
Et	Reduced software total cost of ownership	E1+(E2*E3)	$267,000	$534,000	$1,068,000	$1,068,000	$1,068,000
	Risk adjustment	↓10%					
Etr	Reduced software total cost of ownership (risk-adjusted)		$240,300	$480,600	$961,200	$961,200	$961,200
	Five-year total: $3,604,500				**Five-year present value: $2,591,151**		

UNQUANTIFIED BENEFITS

Additional benefits that customers experienced but were not able to quantify include:

- **Creating more fungible resources and fewer single points of failure.** Centralizing asset data and standardizing processes around maintenance, performance, and equipment strategies allowed interviewees' organizations to institutionalize the knowledge so that it was no longer localized by region, asset, or even shift. In that way, resources became more fungible, creating the following downstream improvements:
    - **Protection from turnover.** A former deployment director at an upstream oil and gas organization indicated that having more fungible resources not only contributed to efficiencies, but also protects from turnover implications. They stated, "If you look at job turnover, which has never been more on people's minds than it is right now, and if you don't have a global system that contains all your asset data, and one of your engineers leaves, the new engineer that comes in wouldn't know anything. If they have to come in and learn a spreadsheet, they might not even be able to find it."
    - **More efficient training efforts.** Not only did institutionalizing knowledge create a more fungible and flexible resource set, but it also resulted in a more efficient training process. A former deployment director at an upstream oil and gas organization stated: "[Our employees] can rely on their training as they move from one asset to another and still know how things work. You get an overall streamlining effect."
    - **Improved communication workflows.** A reliability enablement specialist at an upstream and downstream oil and gas organization stated: "Ninety percent of the organization uses GE Digital APM. They talk the same language. Knowledge is now slowly being institutionalized versus being localized, as it was before." Additionally, a survey respondent indicated that they streamlined workflows to make them 70% faster.
- **Improved data quality.** Interviewees' organizations cited more efficient workflows around asset data collection, normalization, and reporting from having the right tools in place to streamline the effort and eliminate manual intervention. As a result, data quality improved. Heightened transparency and confidence in a more complete, enterprisewide data set enabled interviewees' organizations to form better business decisions rooted in data.
    - An IT director from a midstream oil and gas organization summarized the benefit, stating: "From a metrics perspective and from C-level perspective, you're now presenting executives with just one view when it comes to all of the assets under their portfolio. That is the number one benefit. As opposed to looking for data that could be sitting in silos and several different business units, now, here you have a unified platform, or I think of it like a huge data lake, which is neatly compartmentalized with regards to the individual modules that represent your assets out in the field."
- **Improved ability to meet regulatory and compliance requirements.** The interviewees' organizations were beholden to the standards of many different regulatory governing bodies such as Fire And Emergency Manufacturers And Services Association (FEMSA) and Occupational Safety And Health Administration (OSHA). GE Digital APM increased data transparency and

enabled more flexible reporting and data archiving opportunities to meet various regulation requirements. Additionally, survey respondents indicated that any required compliance testing was reliable and repeatable as well as more efficient thanks to remote access capabilities.

- **Better customer experiences.** GE Digital APM enabled real-time information exchange to facilitate business processes while minimizing delays and errors that lower productivity and impact customer experiences. Better customer experiences improved engagement and increased customer satisfaction. In turn, organizations gained a competitive advantage.

FLEXIBILITY

The value of flexibility is unique to each customer. There are multiple scenarios in which a customer might implement GE Digital APM for oil and gas and later realize additional uses and business opportunities, including:

- **Continued scalability.** One of the key investment drivers for the interviewees' organizations was the ability to scale the APM investment across global operations. They accomplished this goal for their critical assets as quantified through this study. Now, they are staged to consider what future scalability looks like, including re-examining the definition of a critical asset. GE Digital APM proved it could support large volumes of asset data and, when deployed on the cloud, could readily extend to new assets, sites, and regions. As such, interviewees' organizations considered adding asset monitoring capabilities to their assets beyond the traditional tier-one and tier-two assets to further benefit from economies of scale and a form a more detailed view of their asset landscape.

  The interviewees expected additional future value deploys in the cloud, such as staying current to the latest releases without manual upgrade intervention and further reductions in capex spend from divesting of legacy hardware and the like.

Flexibility would also be quantified when evaluated as part of a specific project (described in more detail in Appendix A).

Analysis Of Costs

Quantified cost data as applied to the composite

Total Costs									
Ref.	**Cost**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**	**Present Value**
Ftr	GE Digital costs	$1,650,000	$1,125,696	$1,125,696	$1,125,696	$1,125,696	$1,125,696	$7,278,480	$5,917,274
Gtr	Implementation, management, and training labor costs	$386,672	$662,302	$636,174	$690,897	$404,432	$404,432	$3,184,908	$2,560,962
	Total costs (risk-adjusted)	$2,036,672	$1,787,998	$1,761,870	$1,816,593	$1,530,128	$1,530,128	$10,463,388	$8,478,236

GE DIGITAL COSTS

Evidence and data. GE Digital licensed its APM solution on a subscription model with a mixture of fixed costs and per-site pricing. The subscription included support, but ongoing professional services were priced separately. GE Digital offered cloud-based or on-premises deployment options, and pricing differed between the different components of the full APM solution (APM Health, APM Reliability, APM Strategy, APM Reliability, and APM Safety) and between cloud or on-premises deployments. GE Digital APM deployment often began with a basic investment in Essentials and APM Reliability with predictive diagnostics.

- The interviewees' organizations represented cloud, on-premises, and hybrid deployments.
- Between organizations with similar deployment components and types, subscription costs vary mainly depending on the subindustry, size of operations and average capacity produced. The interviewees' organizations faced a large range of implementation and licensing costs depending on the scope of their deployment in terms of APM components and number of assets monitored.

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- The organization deploys all five APM solutions including Health, Reliability, Strategy, Integrity, and Safety, as well as Essentials, on the cloud.
- Annual licensing costs are paid for the five APM solutions and Essentials based on pricing for 24 small sites.
- Annual support costs are a percentage of total licensing costs.
- Ongoing services fees consider fees to GE Digital for initial implementation, expansions to additional sites for the first three years, and general updates in subsequent years.
- Pricing may vary. Contact GE Digital for additional details.

Risks. Costs to GE will vary depending on the size of the operations in terms of size and volume of total sites, the deployment type, as well as the solution components of APM that are deployed.

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a five-year, risk-adjusted total PV (discounted at 10%) of $5.9 million.

GE Digital Costs								
Ref.	**Metric**	**Source**	**Initial**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
F1	Annual fees (cloud license and support for all 5 APM solutions)		$0	$923,360	$923,360	$923,360	$923,360	$923,360
F2	Ongoing services fees (covers initial implementation and ongoing expansion, updates)		$1,500,000	$100,000	$100,000	$100,000	$100,000	$100,000
Ft	GE Digital costs	F1+F2	$1,500,000	$1,023,360	$1,023,360	$1,023,360	$1,023,360	$1,023,360
	Risk adjustment	↑10%						
Ftr	GE Digital costs (risk-adjusted)		$1,650,000	$1,125,696	$1,125,696	$1,125,696	$1,125,696	$1,125,696
	Five-year total: $7,278,480				**Five-year present value: $5,917,274**			

IMPLEMENTATION, MANAGEMENT, AND TRAINING LABOR COSTS

Evidence and data. In addition to costs paid to GE Digital for the APM solutions, the interviewees' organizations dedicated internal resources to solution implementation, ongoing management of tools, and training.

A former deployment director for an upstream oil and gas organization described the benefit of deploying APM in the cloud. While the initial implementation took a few months, once the architecture was established, the deployment was easily scaled across all remaining sites. The interviewee noted: "Once the first site was live, the subsequent implementations were smooth. It was like clockwork and my role could transition to governance."

Modeling and assumptions. For purposes of the financial model, Forrester assumes the following:

- The initial implementation period spans eight months and requires resources to face off with GE Digital to design the architecture for all five APM solutions at the initial site.
- Internal resource time is dedicated to implementations through Year 3 of the investment and stay on for further expansions to additional assets and asset classes in Year 4 and Year 5.
- Internal resource time is dedicated to the ongoing management of the APM solutions. Time dedicated to ongoing management increases over the investment period to account for having more sites live with APM and, therefore, higher data volumes to manage.
- For training purposes, the model considers both heavy and light users of APM. Heavy users are generally centralized, corporate users of the data. Light users are field technicians and the like that are using the tools to gather and collect data for analysis.

Risks. Labor costs for implementation, ongoing management, and training will vary depending on the size and scope of the deployment as well as the GE Digital services that are engaged, such as managed services. Additionally, the resource types involved in each activity and their associated salaries will vary as well.

Results. To account for these risks, Forrester adjusted this cost upward by 10%, yielding a five-year, risk-adjusted total PV of $2.6 million.

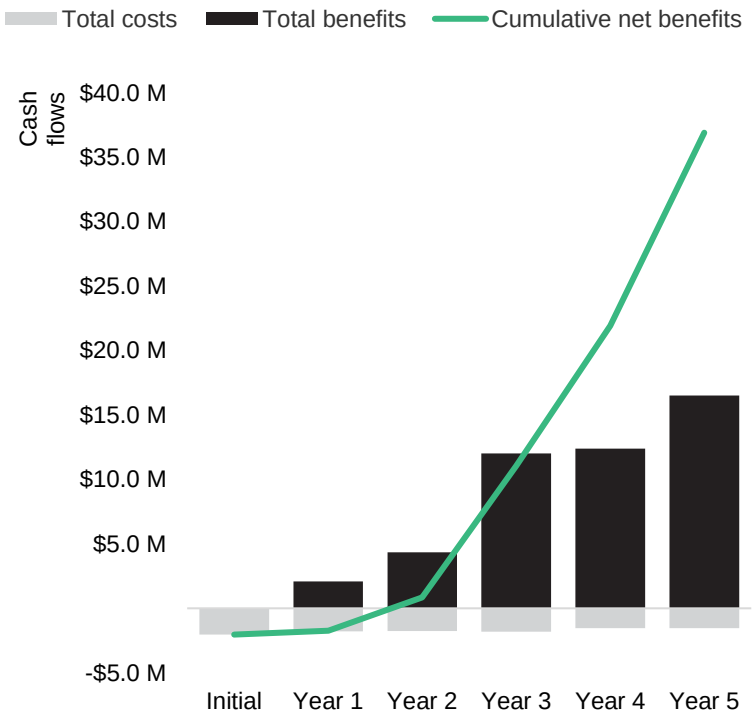
Implementation, Management, And Training Labor Costs

Ref.	Metric	Source	Initial	Year 1	Year 2	Year 3	Year 4	Year 5
G1	Number of months	Interviews	8	12	12	12	12	12
G2	Internal FTE resources dedicated to implementation	Interviews	5	5	5	5	2	2
G3	Internal FTE resources dedicated to ongoing management	Interviews	1.5	1.5	2.0	2.5	2.5	2.5
G4	Average fully burdened monthly salary for FTE	Assumption	$6,760	$6,760	$6,760	$6,760	$6,760	$6,760
G5	Subtotal: Implementation and ongoing management labor costs	G1*(G2+G3)*G4	$351,520	$527,280	$567,840	$608,400	$365,040	$365,040
G6	Number of heavy APM users requiring training annually (FTEs)	Interviews		50	1	1	1	1
G7	Training hours required for heavy users of APM	Interviews		30	30	30	30	30
G8	Number of light APM users requiring training annually (FTEs)	Interviews		21	21	42	3	3
G9	Training hours required for light users of APM	Interviews		10	10	10	10	10
G10	Average fully burdened hourly rate for APM users	Assumption		$44	$44	$44	$44	$44
G11	Subtotal: Training labor costs	(G6*G7*G10)+(G8*G9*G10)		$74,813	$10,500	$19,688	$2,625	$2,625
Gt	Implementation, management, and training labor costs	G5+G11	$351,520	$602,093	$578,340	$628,088	$367,665	$367,665
	Risk adjustment	↑10%						
Gtr	Implementation, management, and training labor costs (risk-adjusted)		$386,672	$662,302	$636,174	$690,897	$404,432	$404,432
	Five-year total: $3,184,908			**Five-year present value: $2,560,962**				

Financial Summary

CONSOLIDATED THREE-YEAR RISK-ADJUSTED METRICS

Cash Flow Chart (Risk-Adjusted)



The financial results calculated in the Benefits and Costs sections can be 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.

These risk-adjusted ROI, NPV, and payback period values are determined by applying risk-adjustment factors to the unadjusted results in each Benefit and Cost section.

Cash Flow Analysis (Risk-Adjusted Estimates)

	Initial	Year 1	Year 2	Year 3	Year 4	Year 5	Total	Present Value
Total costs	($2,036,672)	($1,787,998)	($1,761,870)	($1,816,593)	($1,530,128)	($1,530,128)	($10,463,388)	($8,478,236)
Total benefits	$0	$2,081,520	$4,357,734	$12,012,001	$12,401,424	$16,516,512	$47,369,191	$33,244,314
Net benefits	($2,036,672)	$293,522	$2,595,864	$10,195,408	$10,871,297	$14,986,385	$36,905,803	$24,766,078
ROI								292%

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

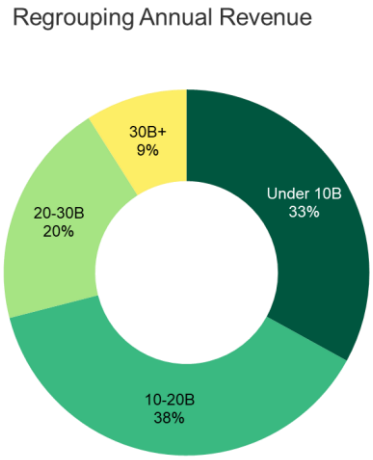
The interest rate used in cash flow analysis to take into account the time value of money. Organizations typically use discount rates between 8% and 16%.

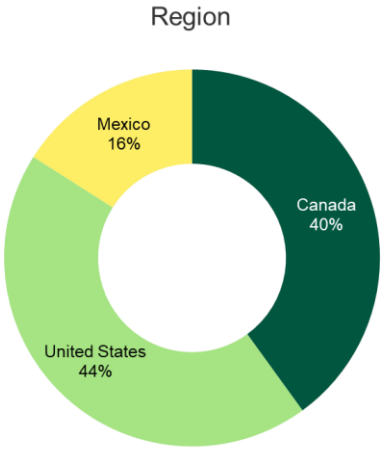
Appendix B: Interview And Survey Demographics

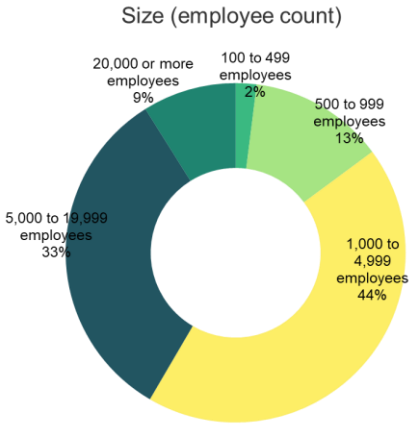
Interviews

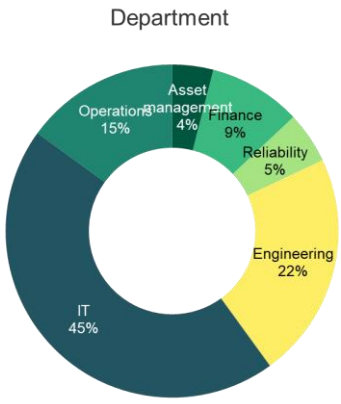
Role	Industry	Operating Region And Count	Asset value
Global system owner	Upstream oil and gas	Global; 15 regions	$167 billion (upstream only)
Former deployment director	Upstream oil and gas	Global; 8 regions	$114 billion (upstream only)
IT director	Midstream oil and gas	North America; 3 regions	$91 billion (all segments)
Reliability enablement specialist; project manager (fixed inspection asset management)	Upstream and downstream oil and gas	North America; N/A	$68 billion (all segments)

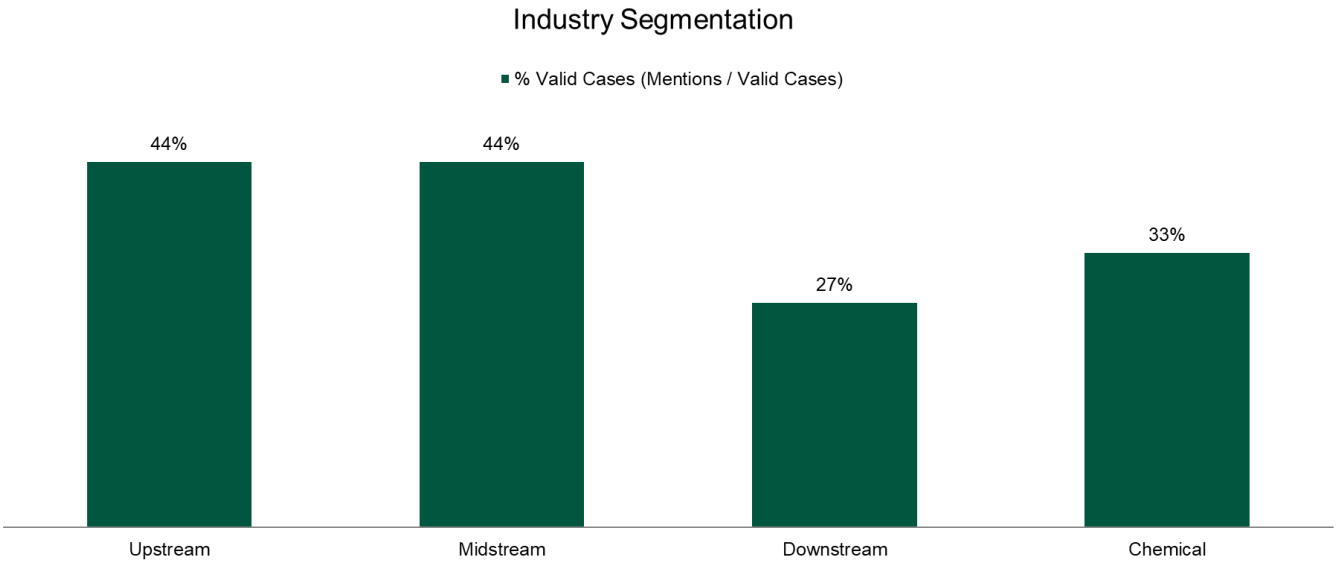
Survey Demographics











Base: 55 North American decision-makers at oil and gas organizations

Source: A commissioned study conducted by Forrester Consulting on behalf of GE Digital, May 2022

Appendix C: Endnotes

[1] 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.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