A Forrester Total Economic Impact™
Study Commissioned By Qt
September 2018

The Total Economic Impact™ Of Qt For Device Creation

Cost Savings And Business Benefits Enabled By Qt For Device Creation

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ABOUT FORRESTER CONSULTING

Forrester Consulting provides independent and objective research-based consulting to help leaders succeed in their organizations. Ranging in scope from a short strategy session to custom projects, Forrester's Consulting services connect you directly with research analysts who apply expert insight to your specific business challenges. For more information, visit forrester.com/consulting.

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Benefits And Costs

30% development cost reduction: $325,169 savings for the composite organization

10% hardware cost reduction: $243,877 savings for the composite organization

Total costs:
$146,213

Executive Summary

Qt for Device Creation is a complete development framework that enables organizations to build applications and user interfaces for embedded devices. The Qt Company commissioned Forrester Consulting to conduct a Total Economic Impact™ (TEI) study and examine the potential return on investment (ROI) businesses may realize with Qt for Device Creation. The purpose of this study is to provide readers with a framework to evaluate the potential financial impact of Qt for Device Creation on their organizations.

To better understand the benefits, costs, and risks associated with this investment, Forrester interviewed four customers with extensive experience of using Qt for Device Creation. The data gained from these interviews was aggregated into a model or composite organization, which originally had seven developers dedicated to embedded device creation. By using Qt, this composite organization enabled significant savings in terms of development and device hardware costs.

Prior to using Qt, interviewed customers supported either multiple versions of their applications across different platforms or complex toolchains to create software for embedded devices. Either approach requires more manpower, specific skill sets, and the means to coordinate these resources, incurring much higher costs. Some of the interviewees also provided feedback from tests they had conducted using web technologies such as hypertext markup language (HTML), but these approaches incurred additional development costs and required much costlier and more powerful hardware.

Key Findings

Quantified benefits. The following risk-adjusted present value (PV) quantified benefits are representative of those experienced by the companies interviewed:

- **On average, customers saved 30% of their software development costs by using Qt.** Development cost savings accrue in several ways, largely because Qt is platform agnostic. This means that organizations no longer need to support multiple, natively developed code stacks or complex toolchains, which saves development resources. Libraries of premade interface components, which otherwise would have to be built from scratch and/or replicated, further reduce the development time required. In addition, the single development environment simplifies the device creation process as a whole. Total PV development cost savings for the composite organization over a three-year model amount to over $325,000.
- **High-performance software lowers hardware requirements.** For a given level of device performance and capability, applications developed with Qt require less processing power and other associated hardware elements. The impact of this benefit is much higher for companies moving from an HTML approach, but less so for those developing on native or using toolchains. The composite organization, which manufactures high-end industrial automation control panels, saves $50 per device, resulting in PV benefits of nearly $244,000.

Unquantified benefits. The interviewed organizations experienced the following benefits, which are not quantified for this study:

ROI
289%

Benefits PV
$569,046

NPV
$422,833

Payback
3 months

› **Device innovations and improvements release to market sooner.** Because the development process is simpler and faster, new and improved products become available to customers sooner, resulting in an edge over competitors.

› **The Qt platform is mature, stable, and well-supported.** The software framework has been around for a long time (the first public release was in 1995) and is standardized, available as open source, and supported by a strong ecosystem.

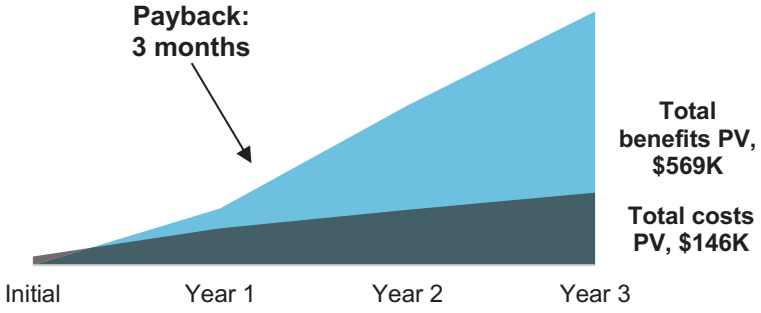
Costs. The interviewed organizations experienced the following risk-adjusted PV costs:

› **Licensing costs amount to $111,003.** Licensing costs include two elements: developer seat licensing, charged by the number of developers using Qt, and distribution licensing, charged by the volume of devices shipped.

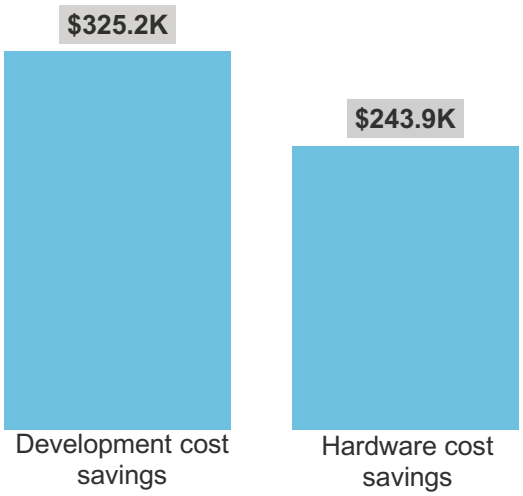
› **Operational costs amount to $35,210.** This includes the one-time upfront expenses of planning, procuring, and installing Qt, as well as the costs associated with version upgrades, which customers typically incur every 18 months. There are, however, no significant training costs: Qt is relatively easy for developers to pick up.

Forrester's interviews with four existing customers and subsequent financial analysis found that the resulting composite organization experiences benefits of $569,046 over three years versus costs of nearly $146,213, adding up to a net present value (NPV) of $422,833 and an ROI of 289%.

Financial Summary



Benefits (Three-Year)



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

TEI Framework and Methodology

Forrester has constructed a Total Economic Impact™ (TEI) framework for organizations considering adopting Qt for Device Creation.

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 Qt for Device Creation can have on an organization:

DUE DILIGENCE
Interviewed Qt stakeholders and Forrester analysts to gather data relative to Qt for Device Creation.

CUSTOMER INTERVIEWS
Interviewed four organizations using Qt for Device Creation to obtain data with respect to costs, benefits, and risks.

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

FINANCIAL MODEL FRAMEWORK
Constructed a financial model representative of the interviews using the TEI methodology and risk-adjusted the financial model based on issues and concerns of the interviewed organizations.

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

DISCLOSURES

Readers should be aware of the following:

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

Forrester makes no assumptions as to the potential ROI that other organizations will receive. Forrester strongly advises that readers use their own estimates within the framework provided in the report to determine the appropriateness of an investment in Qt for Device Creation.

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

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

The Qt For Device Creation Customer Journey

BEFORE AND AFTER THE INVESTMENT IN QT

Interviewed Organizations

For this study, Forrester conducted four interviews with Qt for Device Creation customers. The interviewed customers include the following:

INDUSTRY	REGION	INTERVIEWEE	NUMBER OF EMPLOYEES
Industrial automation	Europe	Software architect	300,000+
Marine electronics	US	Software manager	1,500
Automotive	Europe	Software team leader	350
Technology	Europe	CEO	15

Key Challenges

Interviewees faced several challenges that led to their investment in Qt for Device Creation:

- **Supporting multiple code stacks is complex and costly.** The development of an embedded device requires the software to operate on at least two platforms, one for the device itself and the other as a simulator or emulator. In many cases, additional versions are required while a platform change may also be needed from time to time. Native development on these different platforms requires teams with different skills, and these teams require management and coordination, resulting in high costs and complexity. Similarly, toolchains (a set of programming tools) or other ad hoc solutions are costly to set up and maintain, require specific skill sets, and cannot provide the capabilities of standardized software.
- **Performance requirements for the human-machine interface are increasing.** The demands on how we interact with machines are growing, driven by the increasing growth and complexity of internet-of-things (IoT) devices, automation, instrumentation, and other machine types. In the age of the smartphone, users expect fast reaction times and high-quality, touchscreen interfaces. At the same time, hardware costs must be kept low.
- **Partnerships need to be stable and long-term.** Device manufacturers need mature and stable partners who can provide reliable and future-proof technology with a strong ecosystem and comprehensive support.
- **Time-to-market pressures are not abating.** Organizations face constant pressure, both from customers and competitors, to bring new and improved products to market faster. From mock-up and prototyping to coding and testing, all parts of the development process need to be efficient to minimize costs and time-to-market.

> "To support all the platforms without Qt, we'd need to triple the number of developers."
>
> *CEO, technology developer*

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Key Results

The interviews revealed that key results from the Qt for Device Creation investment include:

- **A significant reduction in the size of the development team.** Most of the customers interviewed reported that Qt for Device Creation enabled them to reduce the number of software developers required to support their embedded devices, largely because it negates the need to support multiple platforms, but also because it provides a highly productive development environment.
- **A flexible development environment.** In addition to requiring fewer developers, a platform-agnostic approach reduces complexity, resulting in more flexibility to change. It is much easier to move from one operating system to another if the need arises. Organizations can choose optimal hardware as options widen. If circumstances change, moving to a different hardware platform is much easier.
- **Lower hardware costs and high-performance interfaces.** Qt for Device Creation enables the development of high-performance human-machine interfaces, which means not only powerful, appealing, and reliable device interaction, but also lower hardware requirements, largely because the software has lower processing power requirements.
- **Shorter time-to-market.** Not only can organizations reduce the developer team, but they can also reduce the time to develop new products and upgrade existing ones. In the design process, developers can quickly share mock-ups and prototypes, reducing the feedback cycle and facilitating collaboration. In the development process, testing and implementation need only be done on a single code stack; the same is the case with upgrades and patches, reducing time-to-market.

> "We could create a solution on our own, but it would take much more time to achieve the functionality and especially the quality that we need. I strongly believe in standing on the shoulders of giants."
>
> *Software architect, industrial automation*

Composite Organization

Based on the interviews, Forrester constructed a TEI framework, a composite company, and an associated ROI analysis that illustrates the areas financially affected. The composite organization is representative of the four companies that Forrester interviewed and is used to present the aggregate financial analysis in the next section. The composite organization that Forrester synthesized from the customer interviews has the following characteristics:

Description of the composite organization. The global enterprise provides a portfolio of industrial automation products and services. It is a multibillion-dollar business providing hardware, software, and services primarily to large businesses in the engineering, utilities, telecommunications, and manufacturing industries with process control, monitoring, and other industrial products.

Deployment characteristics. The organization sells thousands of high-end industrial panels, i.e., the human-machine interface, for factory automation, SCADA (Supervisory Control and Data Acquisition), and other process control implementations, supporting a total of 40 different product versions to address different client needs. It initially employs a team of seven software developers who design, build, and test the user interface and back-end logic of these devices.

Key assumptions

Seven developers
40 product versions
Thousands of devices

Analysis Of Benefits

QUANTIFIED BENEFIT DATA AS APPLIED TO THE COMPOSITE

Total Benefits

REF.	BENEFIT	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Atr	Development cost savings	$80,000	$160,000	$160,000	$400,000	$325,169
Btr	Hardware cost savings	$60,000	$120,000	$120,000	$300,000	$243,877
	Total benefits (risk-adjusted)	$140,000	$280,000	$280,000	$700,000	$569,046

The table above shows the total of all benefits across the areas listed below, as well as present values (PVs) discounted at 10%. Over three years, the composite organization expects risk-adjusted total benefits to be a PV of $569,046.

Benefit 1: Development Cost Savings

The key benefit that the interviewed customers highlighted was the savings in development costs. This comes about in several ways:

- Because organizations only need to support a single code stack, they require fewer developers.
- By only having to support a single code stack, it becomes much easier to coordinate software development. No longer are multiple skill sets required; tests and upgrades need only be implemented once. Organizations no longer need platform team leaders to ensure the same capabilities across the different platform versions.
- The whole development process is easier, in particular during the design phase when teams share mock-ups and prototypes with clients for feedback. All the tools are integrated into a single development environment, so there is no need to switch tools or copy files between them. Testing and profiling can be done directly on the target hardware. Furthermore, libraries are available (Qt Quick Controls 2), consisting of readymade sliders, buttons, drop-down menus, controllers, and other commonly used interface components. Therefore, no libraries need to be created from scratch.
- There are times when either the operating system or the hardware platform needs to be changed. This process is much easier with Qt because of its inherent platform agnosticism, saving on development time and resources.

The whole development process is simpler and easier with Qt.

The composite organization had seven embedded device developers initially. This reduces to six in the first year, with one supporting legacy products. For the second and third years, five developers are enough to support the entire product portfolio, a savings of two full-time equivalents (FTEs).

- The first year is a transition period, during which time the development savings are somewhat negated by the need to support the old platforms and legacy products.
- In the second and third years, we assume that five Qt developers can support the whole product portfolio.
- An average software developer based in Europe costs $100,000.

There are a number of different ways in which this benefit might impact business differently, reducing the strength of its impact:

Impact risk describes the risk of an organizations' business or technology requirements exceeding the investment, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for benefit estimates.

- In some cases, companies may still need to support more than a single platform for legacy reasons, and so the reduction in developers needed may not be so impactful.
- In other cases, there may never be a need to migrate to a different operating system or hardware platform, therefore reducing the relative benefit.
- Some businesses may not benefit as much from Qt if the ready-made graphics and capabilities are not relevant for them, reducing the degree of development cost savings.

To account for these risks, Forrester adjusted this benefit downward by 20%, yielding a three-year risk-adjusted total PV of $325,169.

Benefit 1: Development Cost Savings: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
A1	Size of development team		7	6	5	5
A2	Reduction in number of developers		0	1	2	2
A3	Developer salary		$100,000	$100,000	$100,000	$100,000
At	Development cost savings	A2*A3		$100,000	$200,000	$200,000
	Risk adjustment	↓20%				
Atr	Development cost savings (risk-adjusted)			$80,000	$160,000	$160,000

Benefit 2: Hardware Cost Savings

When developing embedded devices, keeping prices to a minimum to offer competitive prices and ensure good margins is a primary concern. Qt for Device Creation enables the development of very efficient and high-performance software, which can significantly reduce hardware requirements. This way, organizations can maintain the same level of performance with lower-cost hardware.

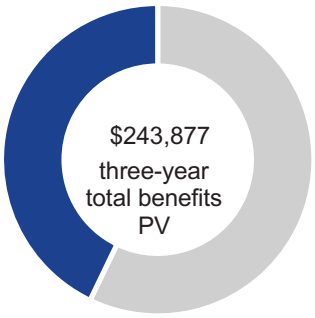
This can result in additional advantages because less hardware means space can be saved, which can enable better form factors. Furthermore, less powerful hardware requires less energy and creates less heat, which can reduce the need for heat dissipation and thus heat sinks.

Hardware cost savings are particularly relevant for organizations moving from an HTML development environment. In this case, these savings will typically be the most significant benefit, with hardware cost savings of up to 80%.

The composite organization uses Qt to develop the same high-end industrial panels as were previously developed using native development tools, so there is only a modest (10%) reduction in hardware bill of materials (BOM). However, it is also possible to develop better products, in terms of the user interface, functionality, and performance. In this case, the hardware cost savings may be less or even zero, but, as a result, the products can command a better price and/or be in higher demand.

For the composite organization, Forrester assumes that:

- Hardware cost savings average $50 per device, a reduction of 10% on the $500 BOM.



Hardware cost savings: **43%** of total benefits

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The reduction in hardware costs will vary with:

- Performance requirements of the embedded device — in the case of less powerful devices, the average hardware cost saving may be lower.
- The operating system used. For instance, proprietary software platforms can be highly efficient in themselves, significantly reducing hardware requirements.
- The importance of space, heat, and energy saving, which may be of little or no relevance for some applications.

To account for these risks, Forrester adjusted this benefit downward by 20%, yielding a three-year risk-adjusted total PV of $243,877.

Benefit 2: Hardware Cost Savings: Calculation Table

REF.	METRIC	CALC.	YEAR 1	YEAR 2	YEAR 3
B1	Volume of devices		1,500	3,000	3,000
B2	Hardware cost saving per device		$50	$50	$50
Bt	Hardware cost savings	B1*B2	$75,000	$150,000	$150,000
	Risk adjustment	↓20%			
Btr	Hardware cost savings (risk-adjusted)		$60,000	$120,000	$120,000

Unquantified Benefits

All four customer companies highlighted speed-to-market as an important benefit. Alternative methods of developing embedded software, such as native or toolchain implementations, are not as efficient across multiple platforms and cannot replicate the same quality and functionality in the same amount of time. The interviewees could not specify the amount of time saved, so Forrester has not been quantified this benefit. The net present value of generating revenues sooner tends to be limited, but there is significant value in terms of competitive edge and reaching customers earlier with product innovations and improvements.

Some of the customers also highlighted that Qt was a mature, standardized framework with a strong ecosystem. It has been around since 1995 and is also available as open source, resulting in many partners, development programs, and a large pool of experienced developers. Qt also provides strong support capabilities, as well as training and consulting services.

Some larger companies may use Qt on a number of different projects, which can result in additional benefits. One interviewee explained that one department sent developers to another that was already using Qt to evaluate it. In cases where it is used for multiple projects, there can also be procurement benefits, while having a pool of Qt developers also becomes an option.

There is significant value in a sharper competitive edge, reaching customers earlier with product innovations, and a higher speed-to-market.

Analysis Of Costs

QUANTIFIED COST DATA AS APPLIED TO THE COMPOSITE

Total Costs

REF.	COST	INITIAL	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Dtr	Licensing costs	$0	$56,500	$37,800	$37,800	$132,100	$111,003
Ftr	Operational costs	$17,160	$0	$11,440	$11,440	$40,040	$35,210
	Total costs (risk-adjusted)	$17,160	$56,500	$49,240	$49,240	$172,140	$146,213

Cost 1: Licensing Costs

The most significant cost of using Qt for Device Creation is licensing the technology. Qt for Device Creation is charged in two ways: by the number of developer seats and the volume of devices shipped.

The composite organization needs five developer seats to support the product portfolio; Qt charges for each at an annual rate. The rate of the first year is somewhat higher, falling in following years. It is this price fall after the first year that accounts for the decline in total licensing costs at this time.

The second element of licensing costs is distribution licensing. Each device developed using Qt that is shipped incurs a distribution cost; the higher the volume of devices, the lower the price per device.

For more details about developer seat and distribution licensing, please contact Qt.

In the first year, total licensing costs amount to $56,500, falling to $37,800 in the second and third years. The NPV of licensing costs is $111,003. There is no risk adjustment.

The table above shows the total of all costs across the areas listed below, as well as present values (PVs) discounted at 10%. Over three years, the composite organization expects risk-adjusted total costs to be a PV of $146,213.

Cost 1: Licensing Costs: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
D1	Licensing costs			$56,500	$37,800	$37,800
Dt	Total licensing costs			$56,500	$37,800	$37,800
	Risk adjustment	0%				
Dtr	Total licensing costs (risk-adjusted)		$0	$56,500	$37,800	$37,800

Cost 2: Operational Costs

Roughly every year to year and a half, Qt rolls out a major upgrade. Organizations require a small resource requirement to implement this upgrade. Installation and particularly testing of the upgrade typically take a single FTE four weeks. This results in an annual operational cost of $8,800 in the second and third years.

There is also an initial operational cost, comprising procurement, planning, installation, and testing. This requires one FTE for six weeks, resulting in an initial operational cost of $13,200.

All the interviewed customers reported that the upgrade process was straightforward. However, if the upgrade is not undertaken regularly, it can become more difficult, as one customer reported, requiring additional time and resources. To minimize these risks, Qt users should upgrade regularly. One of the customers also reported that the Qt upgrade cycle was incorporated into the organization's product road map at a noncritical time, so it could avoid any possible delays in new product releases. Qt publishes upgrade cycle timings so that its customers can prepare and minimize the impact on their ongoing operations.

To account for these risks, Forrester adjusted this cost upward by 30%, yielding a three-year risk-adjusted total PV of $35,210.

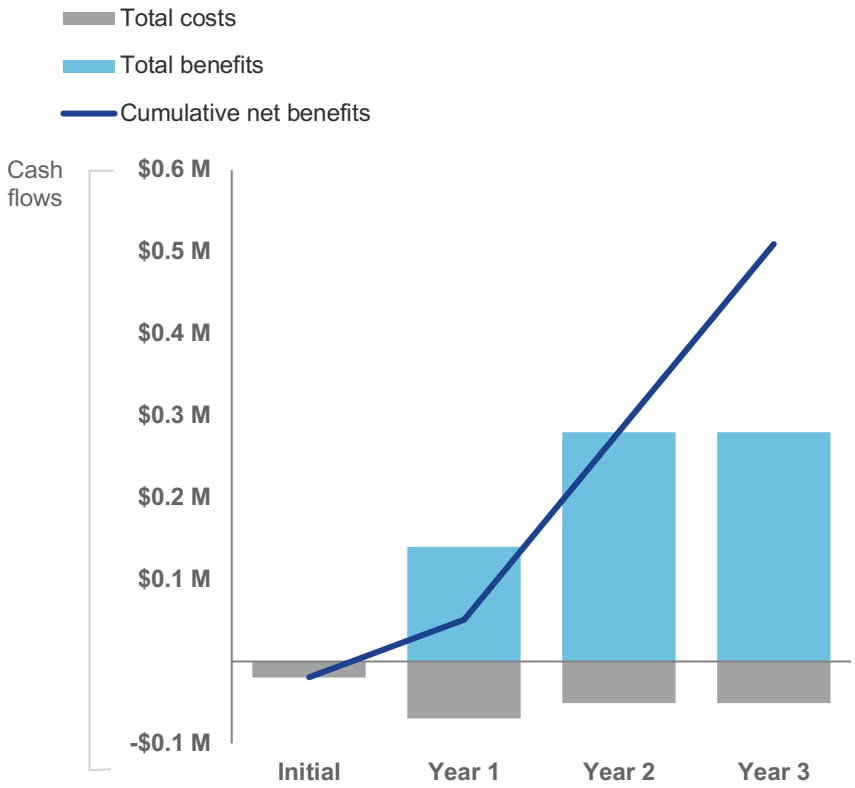
Cost 2: Operational Costs: Calculation Table

REF.	METRIC	CALC.	INITIAL	YEAR 1	YEAR 2	YEAR 3
F1	FTE weeks per Qt upgrade		6	0	4	4
F2	Cost per FTE week		$2,200	$2,200	$2,200	$2,200
Ft	Operational costs	F1*F2	$13,200	$0	$8,800	$8,800
	Risk adjustment	↑30%				
Ftr	Operational costs (risk-adjusted)		$17,160	$0	$11,440	$11,440

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 Table (Risk-Adjusted)

	INITIAL	YEAR 1	YEAR 2	YEAR 3	TOTAL	PRESENT VALUE
Total costs	($17,160)	($56,500)	($49,240)	($49,240)	($172,140)	($146,213)
Total benefits	$0	$140,000	$280,000	$280,000	$700,000	$569,046
Net benefits	($17,160)	$83,500	$230,760	$230,760	$527,860	$422,833
ROI						289%
Payback period						3 months

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Qt For Device Creation: Overview

The following information is provided by Qt. Forrester has not validated any claims and does not endorse Qt or its offerings.

Qt is a complete development framework with all the tools to easily design, develop, test, deploy, and maintain cross-platform software with native C++ performance. Qt for Device Creation includes additional features to optimize the performance and user experience on embedded systems.

Qt for Device Creation offers a number of advantages:

- A modern, high-performance framework for developing high-quality, attractive, and powerful human-machine interfaces with advanced capabilities such as touchscreen, 3D, and augmented reality. Additional tools, protocols, and libraries address specific requirements for the automotive, automation, and healthcare industries.
- Platform agnosticism: A single code stack can be used on a wide range of operating systems and hardware types, resulting in:
    - Reduced manpower, skill sets, and team coordination requirements.
    - Faster design process: Qt can turn graphical mock-ups and prototypes created by designers into code developers can reuse for testing and implementation on multiple platforms.
    - Opportunity to pick the optimal combination of operating system and hardware for a device. Moving from one operating system and/or hardware to another is easy, fast, and painless — even for less popular platforms.
- Its high performance reduces hardware requirements. Alternatives, such as HTML5, require reportedly up to 10 times more processing power for the same level of performance. This reduces hardware costs, heat production, memory, and energy use and can enable more compact and space-saving devices.

There is an open source and a commercial version of Qt. While open source incurs no licensing costs, there are compliance costs, as well as technical and IP risks. A commercial license addresses these shortcomings, offers technical support, and grants access to consultancy services and commercial-only features, which can further reduce development costs.

Appendix A: Total Economic Impact

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

Total Economic Impact Approach

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

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

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

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

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

Present value (PV)

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

Net present value (NPV)

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

Return on investment (ROI)

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

Discount rate

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

Payback period

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