

QUANTUM COMPUTING EARLY ADOPTERS: STRONG PROSPECTS FOR FUTURE QC USE CASE IMPACT

Sponsored by D-Wave

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EXECUTIVE SUMMARY

Hyperion Research, in conjunction with D-Wave, a leading supplier of quantum computing hardware, software, and services, recently conducted a study to better understand the challenges and opportunities experienced by commercial early adopters of quantum computing (QC). The study draws heavily on a survey of such QC early adopters conducted from August through October of 2022, which collected responses from 300 US and European organizations that had QC development or end use activity already in effect, 2022 total revenue estimates of at least **US\$15 million**, and overall IT budgets of **US\$5 million** or more.

Key findings of this study:

- QC early adopter activity is taking place within the majority of organizations surveyed, and they are engaged in a range of QC-related development activities. Predominant quantum computing-related activities underway include exploring options and monitoring technology developments followed by performing quantum use case analysis and prioritization.
- QC early adopters see the promise of QC for a wide range of computational workloads, including machine learning applications, finance-oriented optimization, and logistics/supply chain management. The bulk of QC early adopters were satisfied with the progress of their most important QC development activities to date.
- QC adoption hurdles are primarily non-QC technology-specific and center on complexity with integrating QC technology into existing IT infrastructure, how to demonstrate ROI, and limited QC vendor options.
- Application-level compute capabilities were considered the most critical QC vendor selection criteria while specific quantum hardware capabilities were deemed less so. The most important criterion QC early adopters cited was the vendor's ability to integrate into existing IT infrastructure, vendor's overall technical expertise, vendor's software offerings, and vendor's demonstrated performance advantage in key use cases.
- Most QC early adopters plan on continued exploration of QC capability but at a measured pace. About half are planning to move forward with modest increases in funding and internal resources commitment, while about one third are looking to aggressively move forward incorporating quantum computing into their overall compute environment.

The results of this study suggest a clear path forward that offers the best possible outcome for both QC suppliers and end users. Key elements include an emphasis on developing full-stack QC capabilities that can be readily integrated into an existing advanced computing user site, applications that can clearly demonstrate significant performance improvements, and convincing justifications for key value drivers such as spurring R&D, increasing revenue, and enabling innovation.

OVERVIEW

Hyperion Research, in conjunction with D-Wave, a leading supplier of quantum computing hardware, software, and services, recently conducted a study to better understand the challenges and opportunities experienced by early adopters of commercial quantum computing (QC). The intent of this effort was to explore and more clearly define potential quantum computing growth and expansion paths within commercial organizations that have already taken their first steps in exploring the capability of quantum computing.

This study draws heavily on the results of a Hyperion Research-directed survey sent to a wide and diverse base of QC early adopter commercial organizations across 20 different major verticals. The survey, which was conducted between August 30th, 2022, and October 11th, 2022, ultimately collected responses from 300 organizations. One of the goals of the effort was to define and identify the key QC adopter influencers within these organizations, not necessarily by job title, but by the role they play in exploring and introducing new technology into their overall company infrastructure. Finally, in order to concentrate on organizations with annual revenues and related IT budgets sufficient to commit the resources needed to adequately explore QC technology, survey participation was limited to those organizations with at least an estimated **US\$15 million** in 2022 total revenue and overall IT budgets of **US\$5 million** or more. Other key demographics (detailed in a later section as well as in the Appendix) included:

- Surveyed organizations had to have ongoing efforts in quantum computing. In order to survey 300 such organizations, a total of 485 organizations were contacted: 185 respondents (38% of the total survey set) did not pass that screening requirement and, therefore, their participation was not included in the final results.
- By design, geographic location of the survey respondent's headquarters centered on Europe and the United States, with the most representation from the US (48%), followed by the United Kingdom (22%), France (8%), Italy (8%), Germany (7%), and Spain (6%).
- The survey targeted self-identified QC key influencers within their companies, who, among other things, were defined as those who spend a significant portion of their time exploring new or emerging technologies for their company, with the average influencer committing 2-3 days per week.

The verticals in the study included:

<u><i>Advanced Manufacturing</i></u>	<u><i>Defense</i></u>	<u><i>Manufacturing Logistics</i></u>
<u><i>Aerospace</i></u>	<u><i>Financial or Financial Services</i></u>	<u><i>Pharmaceuticals</i></u>
<u><i>Automotive/Transportation/Mobility</i></u>	<u><i>Energy, excluding Oil & Gas</i></u>	<u><i>Quantum Computing</i></u>
<u><i>Biosciences</i></u>	<u><i>Oil & Gas</i></u>	<u><i>Retail/E-commerce</i></u>
<u><i>Computer-aided Engineering</i></u>	<u><i>Other Geosciences</i></u>	<u><i>Software and Internet</i></u>
<u><i>Chemicals excluding Pharmaceuticals</i></u>	<u><i>Healthcare</i></u>	<u><i>Telecommunications</i></u>
<u><i>Computer, Electronic, and Optical Products</i></u>	<u><i>Insurance</i></u>	

KEY FINDINGS

Survey results yielded a broad range of QC early adopter perspectives on their ongoing QC activity, including expectations for value and organizational advantages, key workloads, vendor selection criteria, hurdles to QC adoption, and QC-related plans for the future.

QC early adopter activity is taking place within the majority of organizations surveyed, and they are engaged in a range of QC related development activities. When asked to identify the predominant quantum computing-related activity currently underway within their organization, the majority of respondents indicated that their organization was exploring options and monitoring technology developments, followed by performing quantum use case analysis and prioritization. Roughly one in seven respondents indicated that their organization's main QC activity was either a current proof of concept research program or some form of a production use of quantum computing for one or more business processes.

QC influencers play a critical role in early QC adopter organizations, but they are not always C-suite denizens. QC influencers, those who see themselves as significant drivers of QC adoption into their commercial end-user organization, often cannot be simply identified by their job title, especially for a nascent technology like QC that can run ahead of normal organizational structures. Self-identified QC influencers spend roughly two to three days per week looking at new and/or emerging technologies such as quantum or other advanced computing technologies, and they weigh in on related organization-level decisions roughly 3-4 times per year.

QC early adopters have a range of value and organization drivers. Key value drivers for QC early adopters include enhancing business process efficiencies, increasing revenues, and improving research capabilities. In contrast, QC adoption was not seen as an effective way to drive down costs nor to reduce time to market. Key organization drivers included both potential performance improvements on critical existing workloads and potential access to new quantum-specific applications.

QC early adopters see the promise of QC for a wide range of computational workloads. Most frequently mentioned were machine learning applications and finance-oriented optimization, while logistics/supply chain management and modeling/simulation were also selected by more than four in ten respondents.

QC early adopters were highly satisfied with their most important QC development activity. Almost all QC early adopters surveyed indicated that progress to date was either very or somewhat successful, suggesting that QC early adopters have set realistic expectations for QC that closely match the current state of QC sophistication, capability, and progress.

QC adoption hurdles are primary non-QC technology specific. When asked about the greatest hurdles to exploring, testing, and investing within their organization, the most selected responses were complexity with integrating into existing IT infrastructure, concerns with demonstrating ROI, and facing limited QC vendor options. Such a finding implies that QC end users may be relying on full stack QC suppliers to offer and support fully capable, self-contained QC systems, limiting QC end user responsibility to managing existing classical infrastructure within the newly merged environment.

QC vendor selection criteria considered high-level compute performance most important with specific quantum hardware capabilities deemed less critical. The most important criterion that QC early adopters used were the vendor's ability to integrate into existing IT infrastructure, vendor's overall technical expertise, vendor's software offerings, and vendor's demonstrated performance advantage in key use cases. However, the wide range of selection criteria ultimately considered by respondent organizations suggests that QC early adopters have not yet fully honed in on key parameters of importance but instead take a somewhat broader and more holistic approach when considering the various types and nature of the QC system they ultimately select.

Most QC early adopters plan on continued exploration of QC capability but at a measured pace. About half are planning to move forward, but with modest increases in funding and internal resource commitment. About one third are looking to aggressively move forward incorporating quantum computing into their overall compute environment.

SUBSTANTIAL COMMERCIAL ACTIVITY AND INTEREST IN QUANTUM COMPUTING TECHNOLOGY

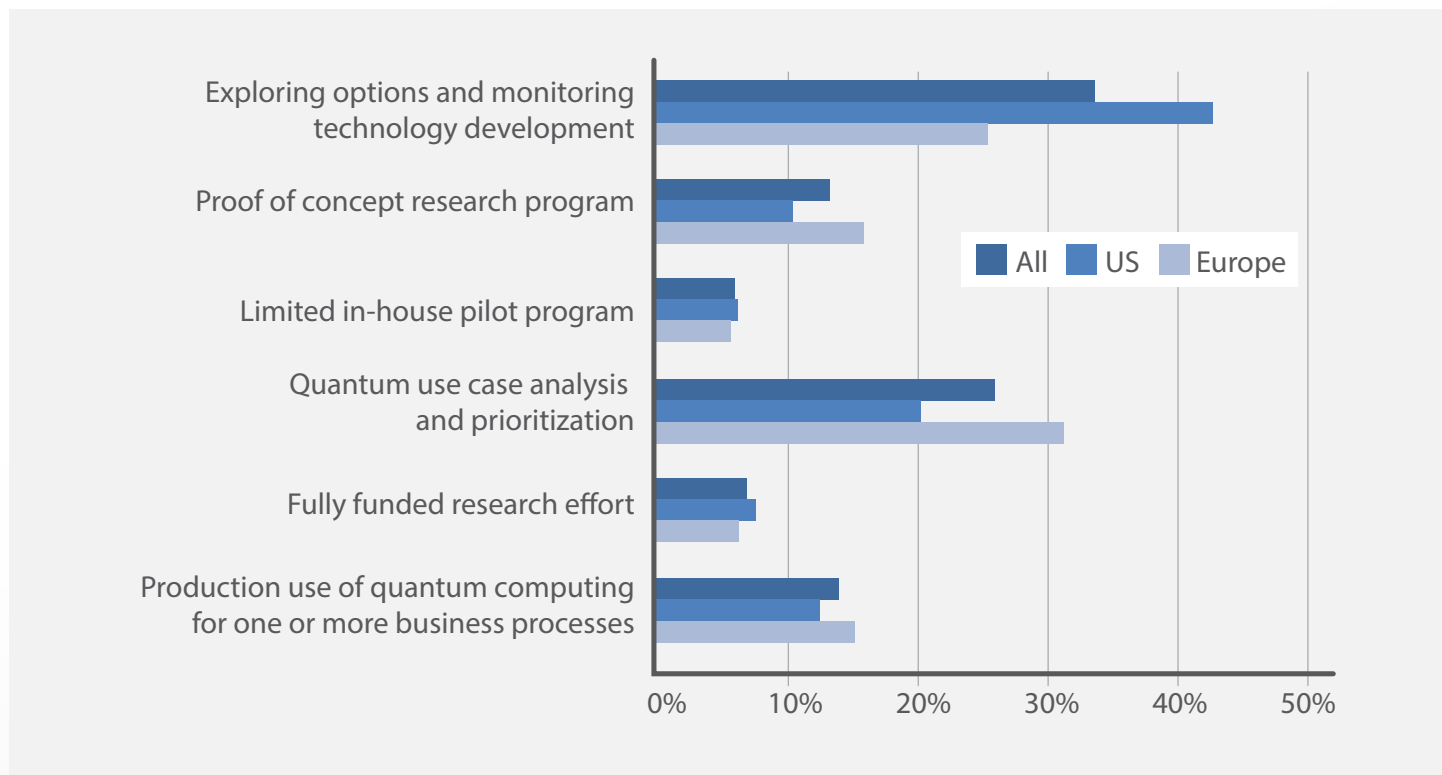
Hyperion Research survey results indicate that there already are a wide range of commercial organizations engaged in some form of quantum computing efforts. The primary goal of this study was to identify some of the most important characteristics, expectations, and intentions of such QC early adopters across a wide set of verticals, company compositions, and geographic locations. The following section identifies the current level of ongoing QC efforts within those early adopters and provides some key demographics of the survey respondent organizations.

As seen below in Figure 1, when asked to identify the predominant quantum computing-related activity currently underway within their organization, the majority of respondents indicated that their organization was exploring options and monitoring technology developments (34%), followed by performing quantum use case analysis and prioritization (26%). Roughly one in seven respondents indicated that their organization’s main QC activity was either a current proof of concept research program or some form of a production use of quantum computing for one or more business processes.

The small number of fully funded research efforts (7%) compared with the level of activity in production use of quantum computing (14%) likely is the result of select QC end user organizations pushing out limited experimental or test-bed production jobs to a cloud-based QC infrastructure as a way to explore the business potential of the technology without having to initially commit significant in-house R&D resources.

FIGURE 1

QC End User Activities: Framing Ongoing Activity



n = 300
Source: Hyperion Research, 2022

As seen in Table 1, which breaks down the list of survey respondents by their organization's main area of activity, the largest group of respondents represented the financial or financial services sector (25%), followed by the software and internet sector (14%). Ultimately, the survey successfully gathered responses from nearly every major vertical targeted, including manufacturing logistics (7%), advanced manufacturing (6%), and computer, electronic, and optical products (6%). Although the overall sample size is not large enough to support detailed analysis of any one sector, the range of responses across 20 different verticals is a strong indication as to the wide commercial interest in quantum computing.

TABLE 1
Respondents' Organization Main Area of Activity

	All	US	Europe
Financial or Financial services	25%	31%	19%
Software and Internet	14%	17%	11%
Quantum Computing	7%	3%	11%
Manufacturing logistics	7%	8%	6%
Computer, electronic, and optical products	6%	3%	9%
Retail/e-commerce	6%	6%	7%
Advanced Manufacturing	6%	6%	6%
Telecommunications	5%	3%	6%
Computer-aided engineering	4%	2%	5%
Healthcare	4%	6%	2%
Other	4%	6%	2%
Automotive/Transportation/Mobility	3%	3%	3%
Aerospace	2%	1%	4%
Biosciences	2%	0%	4%
Insurance	2%	3%	1%
Oil & gas	1%	0%	3%
Pharmaceuticals	1%	1%	1%
Chemicals excluding pharmaceuticals	1%	1%	0%
Energy, excluding oil & gas	1%	0%	1%
Defense	0%	0%	1%
Other Geosciences	0%	0%	0%
Weather and climate	0%	0%	0%

n = 300

Source: Hyperion Research, 2022

As seen in Table 2, when asked to characterize the current computing environment of their organization, the majority of respondents reported that their organization leaned heavily towards being an HPC shop, either in a research or production environment, representing about **54%** of all respondents. Roughly one in three characterized themselves as working within a mixed shop comprised of both HPC workloads, those primarily targeted towards science, engineering, and technical applications, and enterprise IT workloads, those centered on core business functions such as automated billing systems, customer relationship management, business intelligence, and enterprise resource planning.

- There was little representation (1%) from enterprise IT shops that had no HPC capabilities, suggesting that computing environments with little or no HPC capabilities are unlikely to be QC early adopters.

TABLE 2

Respondent Organization’s Current Computing Environment

	All	US	Europe
Primarily HPC in a research environment	30%	34%	26%
Primarily HPC in a production environment	24%	26%	22%
A mixed HPC and enterprise environment	31%	28%	34%
Primarily an enterprise IT shop with some HPC capabilities	13%	10%	16%
Primarily an enterprise IT shop with no HPC capabilities	1%	1%	1%

n = 300

Source: Hyperion Research, 2022

IDENTIFYING QC END USER INFLUENCERS

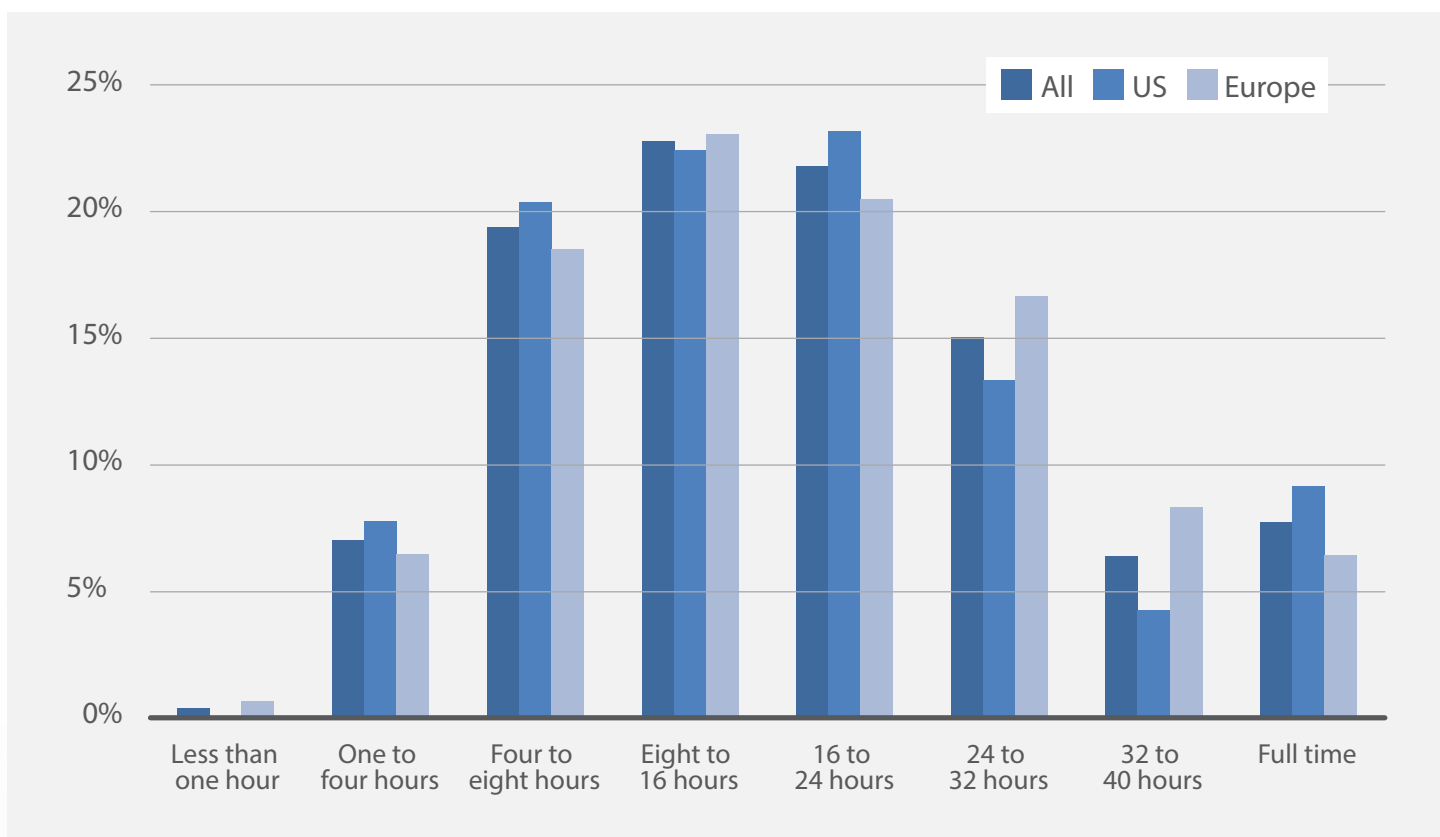
QC influencers, those that self-identified as significant drivers of QC adoption into their commercial end-user organization, often cannot be simply identified by their job title, especially for a nascent technology like QC that can run ahead of normal organizational structures. One of the goals of this study was to define and then identify the basic roles of key QC influencers within their organization, especially in cases where that role might not be obvious from their current job title or professional assignment. As part of the overall screening process, respondents were asked to self-identify as a key influencer, defined as one who drives the process of new technology adoption, including QC, within their organization; only those who answered positively were included in the survey.

Figure 2 shows the results when respondents were asked about the number of hours they spent each week looking at new and/or emerging technologies such as quantum or other advanced computing technologies. The response selected most often was eight hours to less than 16 hours per week (23%) followed by 16 hours to less than 24 hours per week (22%).

- About 30% spent three days or more per week, while about one in eleven respondents indicated that such technology exploration was their full time job.

FIGURE 2

Identifying Key QC Influencers: Time Devoted to Exploring New Technology

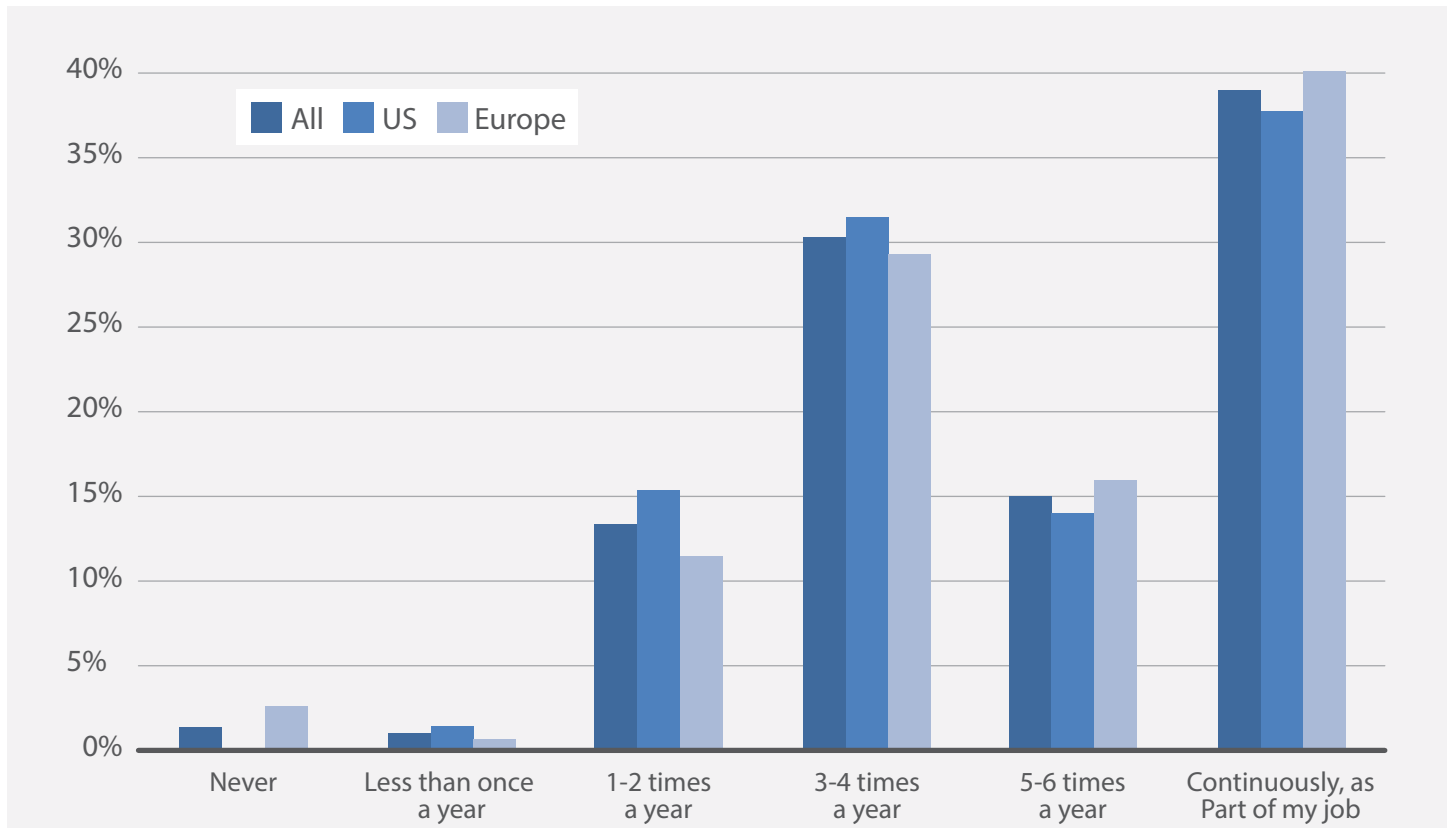


n = 300
Source: Hyperion Research, 2022

Figure 3 shows the selections when respondents were asked how often they play an active role in suggesting, advising, or otherwise influencing the adoption of new or emerging compute technology, including but not limited to QC, into their organization’s overall compute capability. The majority of influencers (**about 40%**) indicated that they played a continuous role, while the second largest group of responses (**30%**) weighed in three to four times a year, roughly every quarter. Only about **14%** indicated that they were involved once or twice a year.

FIGURE 3

Continuous Involvement: Hallmark of a Key Influencer



n = 300
Source: Hyperion Research, 2022

As seen in Table 3, when asked about their official job titles, about half the respondents indicated that they were denizens of the C-suite as either a CIO or CTO. However, the other half represented a wide collection of job titles that included Director of Innovation, QC professional, and program manager. One indication that quantum computing has not yet become a widely recognized profession within the QC end use community is that only a small percentage (**12%**) of respondents had titles that clearly identified any QC responsibilities. Instead, many of the QC influencers that took part in the survey have titles more common to the overall classical computing environment. As such, identifying these key influencers by job title alone may not be the best way to identify non-C-suite influencers within a QC end user organization.

TABLE 3
Key Influencers: Official Job Title Belies QC Impact

	All	US	Europe
CIO or IT director	35%	43%	29%
CTO	14%	11%	17%
VP of Innovation or Director of Innovation	12%	12%	12%
Quantum computing professional	12%	6%	17%
Program manager	8%	10%	7%
Software Programmer	5%	6%	4%
System administrator	2%	3%	2%
Non-technical management	2%	3%	1%
Computer scientist	2%	0%	3%
Data center staff	2%	0%	3%
Hardware Engineer	2%	2%	1%
Data scientist	1%	1%	1%
End-user of computing capabilities	1%	1%	1%
Scientific researcher/subject matter expert	1%	1%	1%

n = 300

Source: Hyperion Research, 2022

Drivers and Motivators for QC Early Adopters

One of the primary goals of this effort was to better understand some of the key influences and motivations of QC early adopters. The following section contains details on the various value and organization opportunities engendered by QC adoption, as well as expectations for the most promising workloads.

As seen in Table 4, when asked about the single greatest value driver for QC adoption, the most selected response was enhancing business process efficiencies (26%), increasing revenues (19%), and improving research capabilities (17%). In contrast, QC adoption was not seen as an effective way to drive down costs nor to reduce time to market.

- European respondents were nearly twice as interested in driving competitive advantage as US respondents, while US respondents saw improved research capabilities as an important value driver at nearly twice the rate of EU counterparts.

TABLE 4

QC Adoption: Greatest Value Driver

	All	US	Europe
Enhancing business process efficiencies	26%	23%	29%
Increasing revenue	19%	24%	13%
Improving research capabilities	17%	22%	12%
Achieving competitive advantage	16%	11%	20%
Driving innovation	15%	14%	16%
Reducing time-to-market	4%	3%	4%
Realizing cost saving	3%	1%	5%

n = 300

Source: Hyperion Research, 2022

As seen in Table 5, when asked about the greatest organization drivers responsible for standing up a QC effort, the most chosen response was potential performance improvements on key existing workloads (50%), followed closely by potential access to new quantum-specific applications (48%).

- QC end users' emphasis on improving the performance on existing classical codes likely ties directly into the high priority, and concern, they place on being able to effectively integrate new QC compute capability into existing classical systems software and related applications.
- Only about one-quarter indicated that their organization was a traditional early adopter of new technology and 14% identified fear of missing out as an impetus for exploring QC potential.

TABLE 5

QC Adoption: Greatest Organization Driver

	All	US	Europe
Potential performance improvements on key existing workloads	50%	52%	48%
Potential access to new quantum specific applications	48%	49%	46%
Strong internal influence from scientific/research/end-user staff	42%	48%	37%
Strong internal influence from technical/IT staff	42%	46%	38%
Concerns with slowing capabilities in traditional compute solutions	37%	41%	34%
Concern with falling behind competitors	33%	35%	32%
Traditional early adopter attitude	26%	26%	26%
Fear of missing out	14%	14%	15%

n = 300, Respondents could select multiple answers
 Source: Hyperion Research, 2022

As seen in Table 6, when asked about the most promising computational workloads that quantum computing could successfully address in their organization, the two most selected responses were machine learning applications (49%) and finance-oriented optimization (48%). However, logistics/supply chain management and modeling/simulation were also selected by more than four in ten respondents, suggesting that QC early adopters see the promise of QC for a wide range of computational workloads. Indeed, each survey option was selected by almost 30% or more of the respondents.

TABLE 6
Most Promising QC Workloads

	All	US	Europe
Machine learning applications	49%	51%	47%
Finance-oriented optimization	48%	54%	43%
Logistics/supply chain management	42%	39%	44%
Modeling/simulation	40%	36%	44%
Manufacturing/factory processes	38%	44%	32%
Quantum chemistry	36%	41%	32%
Material design	31%	34%	29%
Staffing/scheduling problems	29%	31%	26%
Other optimizations	0%	1%	0%
Other business problems	0%	1%	0%

n = 300

Source: Hyperion Research, 2022

QC Adoption: End User Perspectives

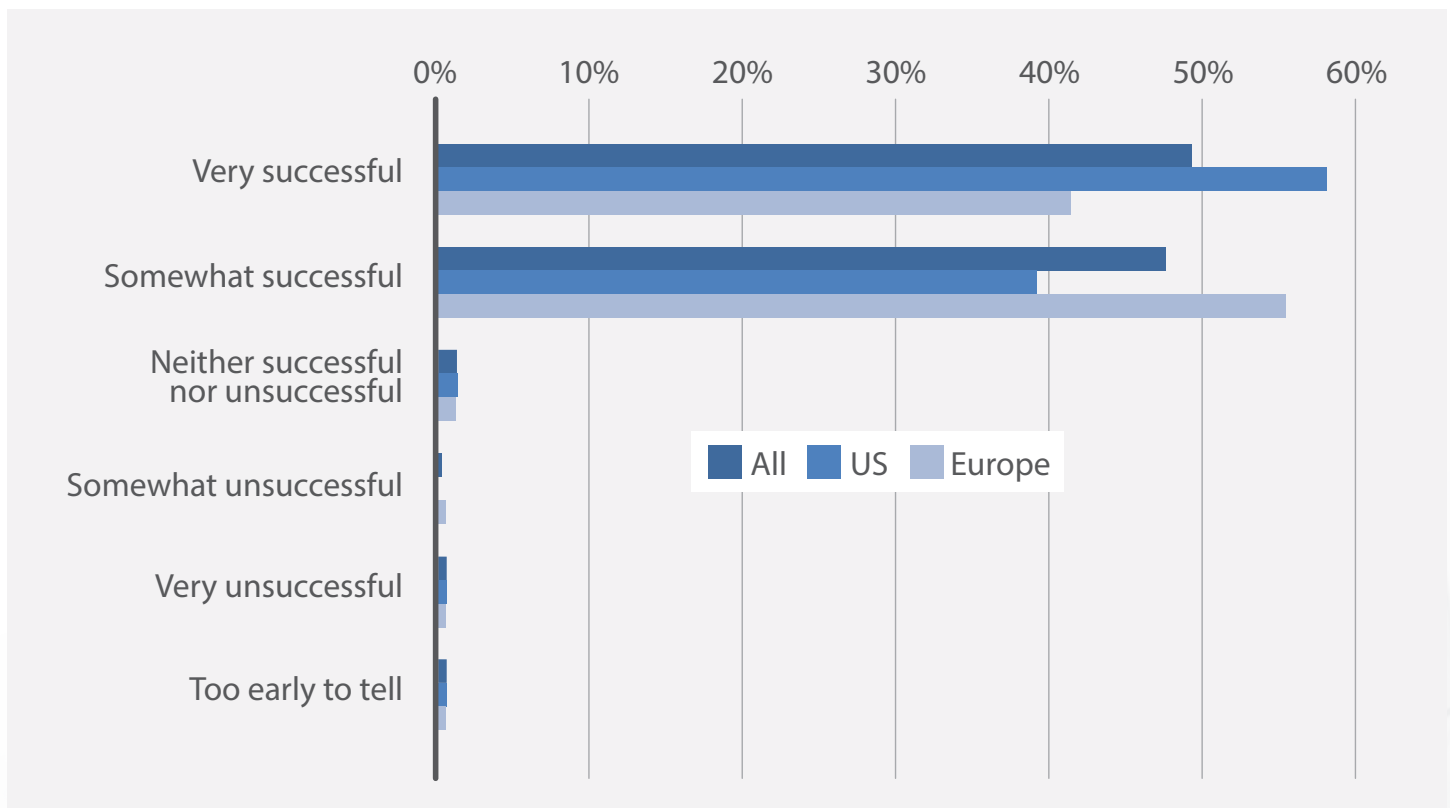
The following section outlines the various end user perspectives on QC adoption, spanning opinions on the success of their most important ongoing QC-based efforts, greatest hurdles encountered, key selection criteria, and plans for going forward.

As seen in Figure 4, when asked about how successful their most important QC-related activity was in addressing their computation requirements, respondents were overwhelmingly positive, with **49%** indicating that progress to date was very successful and **48%** indicating progress was somewhat successful. There were only a handful of QC early adopters that considered it too early to tell if their ongoing activity would be a success or not. These results suggest that regardless of the ultimate outcome of an QC-related activity, QC early adopters have set realistic expectations for QC that closely match the current state of QC sophistication and capability.

- Generally, US-located organizations were more positive than their European counterparts about the success of their most important QC effort: 58% of US vs 41% of European organizations.

FIGURE 4

Progress of Most Important QC Effort to Date



n = 300
Source: Hyperion Research, 2022

As seen in Table 7, when asked about the greatest hurdles to exploring, testing, and investing within their organization, the most selected responses were complexity with integrating into existing IT infrastructure (39%) and concerns with demonstrating ROI (31%). Respondents who indicated worries with limited QC vendor options (28%) likely were reacting to the nascent state of the QC sector, which currently lacks the range of products typical in classical counterpart offerings, which can often span numerous price/performance configurations.

- In the US, 31% of respondents expressed concerns about the overall near-term prospects for the QC sector writ large while only 18% of European firms expressed similar concerns.
- Only about one in ten respondents indicated that they have no current requirements for new computational capabilities.
- Perhaps equally instructive were the hurdles that were generally not considered problematic by the majority of respondents. For example, only 21% of respondents indicated a lack of available funding, about 18% faced skepticism from existing IT decision makers, and 16% had confusion about appropriate vendor selection.
- In general, US-based organizations were somewhat more concerned with the complexity of integrating QC into their existing IT infrastructure (46%) compared with European counterparts (32%), as well as concerns with demonstrating ROI: 41% for the US and 21% for Europe.

TABLE 7

Greatest Hurdles of QC Adoption

	All	US	Europe
Complexity with integrating into existing IT infrastructure	39%	46%	32%
Concerns with demonstrating ROI	31%	41%	21%
Limited QC vendor options	28%	31%	25%
Concerns with overall near-term prospects for the QC sector writ large	25%	31%	18%
Lack of in-house QC expertise and domain knowledge	24%	21%	27%
Slow progress in the demonstrated QC performance gains	21%	19%	23%
Lack of available funding	21%	20%	22%
Lack of demonstrated use case performance advantage	21%	23%	18%
Unproven performance advantages over classical counterparts	20%	15%	25%
Resistance/skepticism from existing IT decision makers	18%	22%	15%
Reluctance to embrace new technology	17%	19%	15%
Confusion over appropriate vendor selection	16%	15%	18%
Low business priority	11%	10%	13%
No requirements for new computational capabilities	11%	9%	13%
Don't Know/Not sure	2%	0%	3%
Other	0%	0%	1%

n = 300

Source: Hyperion Research, 2022

Table 8 shows the results when survey respondents were asked to identify the most important criterion their organization used to select a commercial QC vendor/solution. The most cited, and near equally selected responses, were the vendor's ability to integrate into existing IT infrastructure, most likely centered on middleware and application software (39%), vendor's overall technical expertise (32%), vendor's software offerings (32%) and vendor's demonstrated performance advantage in key use cases (32%).

- Software offerings, including those specific to a sector, as well as related demonstrated use case capabilities and performance advantages, were considered more important selection criteria than those targeting specific hardware features.
- However, the wide range of selection criteria considered by respondent organizations suggests that QC early adopters have not yet fully honed in on key parameters of importance but instead take a somewhat broader and more holistic approach when considering the various types and nature of QC system they ultimately select.
- Overall, QC hardware specifications, especially at the qubit level, did not appear to be a significant driving factor in vendor selection. For example, qubit specifications and/or performance metrics (qubit counts, gate fidelity, etc.) were used in selection criteria by roughly one in five respondents' organizations, and specific qubit modality was considered a key selection criteria by about one in seven.
- Finally, business consideration, such as vendor market share and low cost, were not highly considered criteria, selected by 17% and 13% of respondents, respectively.

TABLE 8

QC Vendor Selection Criteria

	All	US	Europe
Vendor ability to integrate into existing IT infrastructure	37%	41%	34%
Vendor's overall technical expertise	32%	38%	27%
Vendor's software offerings	32%	38%	26%
Vendor's demonstrated performance advantage in key use cases	32%	34%	30%
Vendor's sector-specific expertise	29%	29%	30%
Vendor's range of available use cases	28%	32%	25%
Vendor reputation/visibility	28%	36%	20%
Vendors' range of application software support	27%	31%	24%
Vendors cloud access options	26%	31%	22%
Vendor's follow-on support and service	26%	28%	24%
Vendor's hardware offerings	25%	27%	24%
Organization's specific key performance indicators and benchmarks	25%	27%	22%
Qubit specifications and/or performance metrics (qubit counts, gate fidelity, etc.)	21%	18%	24%
Vendors on-premises options	19%	19%	18%
Vendor's market share	17%	20%	15%
Qubit modality option	15%	15%	15%
Low cost	13%	15%	12%

n = 300

Source: Hyperion Research, 2022

Table 9 shows respondent organizations' plans for in-house QC capability in the next two to three years, with more than **80%** looking to move forward with an increased commitment to QC. Specifically, about half are planning to move forward but at a measured pace with modest increases in funding and internal resources commitment, while about one third are looking to aggressively move forward incorporating quantum computing into their overall compute environment.

- About 13% plan to maintain their current level of funding and resources commitment for the next two to three years.
- About 1% each are looking to either reduce or cease all QC efforts for at least the next two to three years.

TABLE 9

QC Early Adopter Plans for the Future

	All	US	Europe
Aggressively move forward incorporating quantum computing into our overall compute environment	32%	34%	30%
Move forward, but at a measured pace with modest increases in funding and internal resources commitment	51%	51%	52%
Maintain current level of effort for funding and resources commitment for the next two to three years	13%	10%	17%
Moderately reduce current level of QC efforts	2%	2%	1%
Drastically reduce QC efforts for at least the next two to three years	1%	1%	1%
Cease all QC efforts for at least the next two to three years	1%	1%	0%

n = 300

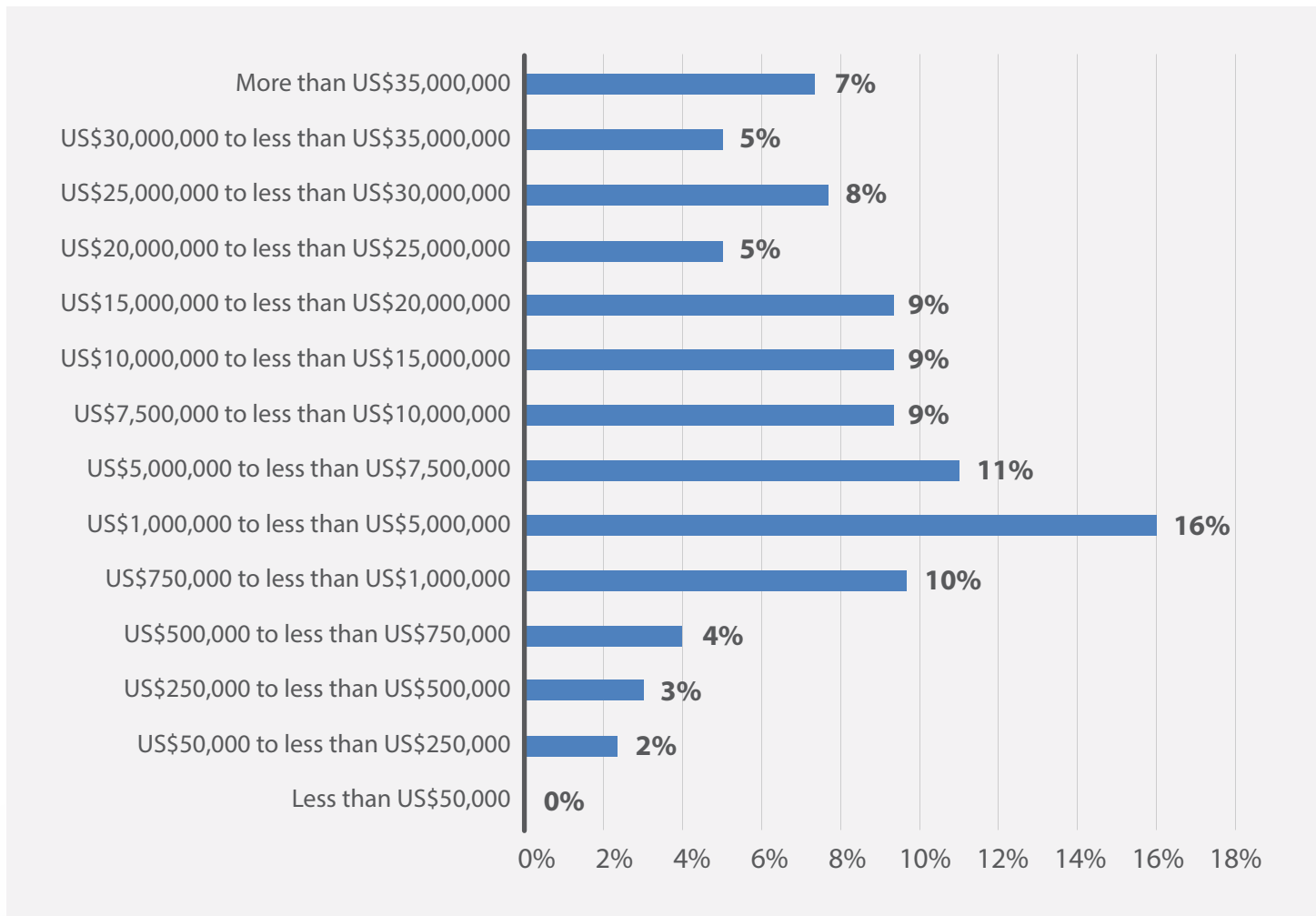
Source: Hyperion Research, 2022

Figure 5 below details respondents' annual budget expectations for standing up and maintaining a production-level QC capability within their organization, with the range of the expected budget varying widely with some commitment at almost every price band offered.

- The most selected option, albeit by only 16% of respondents, was US\$1 million to US\$5 million.
- About one third of respondents foresaw annual budgets that exceeded US\$15 million, and one fifth that exceeded US\$25 million.

FIGURE 5

QC End User Anticipated Annual Budgets



n = 300
Source: Hyperion Research, 2022

LOOKING FORWARD

QC early adopters, spanning almost every major vertical native to the overall advanced computing realm, are looking to quantum computing to address some of their most vexing computational problems, expecting to either accelerate their existing classically based problems or expand into new quantum-enabled counterparts. A substantial number of QC early adopters are already exploring the potential of quantum computing, and most see their current efforts as being successful. At least for the bulk of QC early adopter organizations represented in this study, future exploration and, indeed, stand-up production use of quantum systems, will likely continue to expand. Continued and long-term success of the sector will hinge on the ease with which QC can be readily integrated into existing advanced computing centers to deliver demonstrated performance gains on critical end uses.

The results of this particular study suggest a clear path that offers the best possible outcome for both QC suppliers and end users. Key elements include an emphasis on developing a full-stack QC capability that can be readily integrated into an existing advanced computing user site, applications that can clearly demonstrate significant performance improvements, and certifiable justifications for key value drivers such as spurring R&D, increasing revenue, and enabling innovation. In such a situation, the most successful QC vendors will be those best able to interact with QC early adopters and future mainstream QC end users in ways that combine the right mix of technology, products, and services.

APPENDIX: ADDITIONAL RESPONDENT ORGANIZATION DEMOGRAPHICS

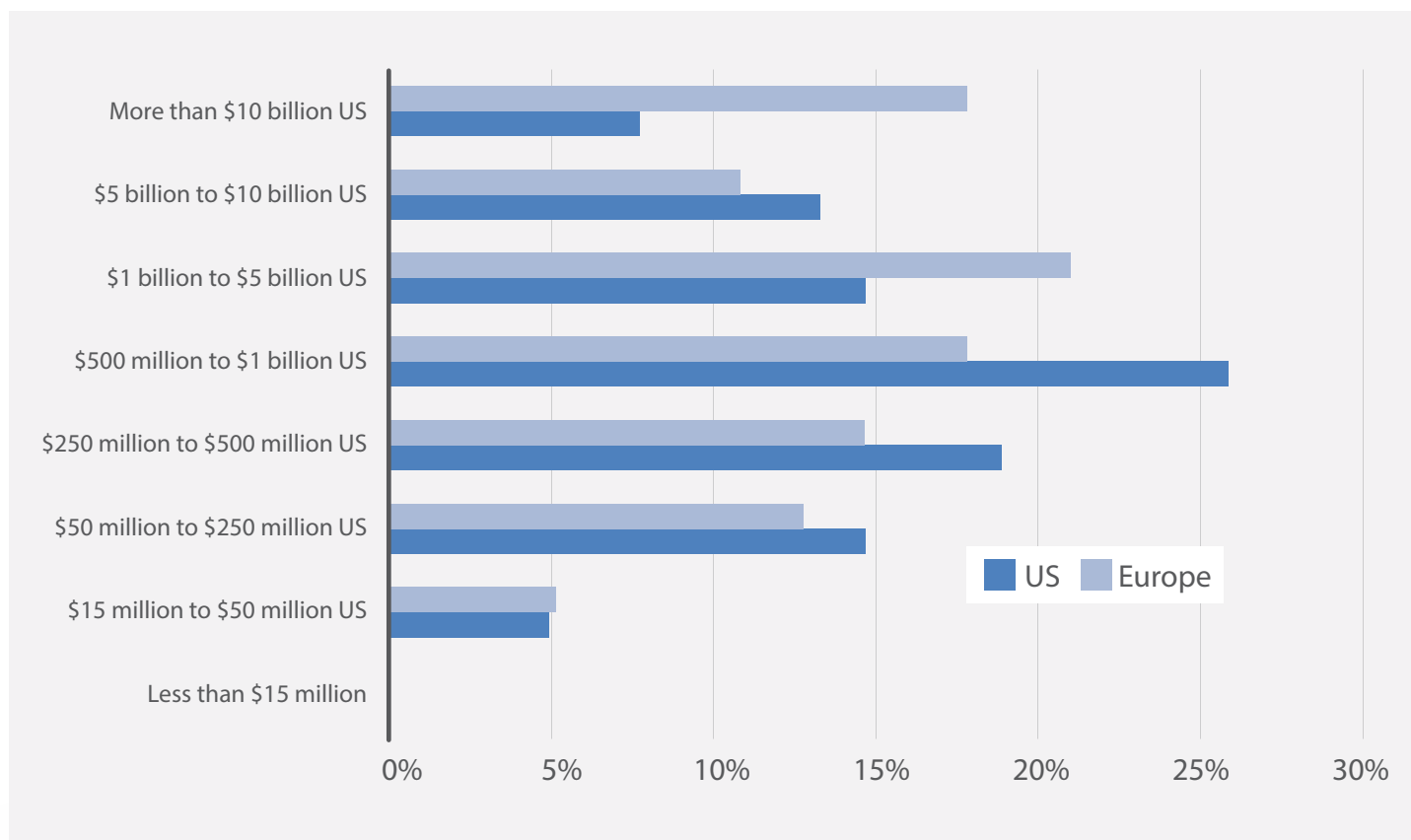
This appendix contains additional details about the total revenue and IT budgets of the organizations participating in the survey.

As seen in Figure 6, expected 2022 revenues ranged from a low of US\$15 million to US\$50 million (5%) to more than US\$10 billion (13%) overall. The largest US revenue band was between US\$500 million to US\$1 billion (26%), while the largest European group ranged from US\$1 billion to US\$5 billion (21%).

- Ultimately 25% of the companies included in the survey had estimated total 2022 revenues that exceeded US\$5 billion.

FIGURE 6

QC End User Companies Expected 2022 Total Revenues

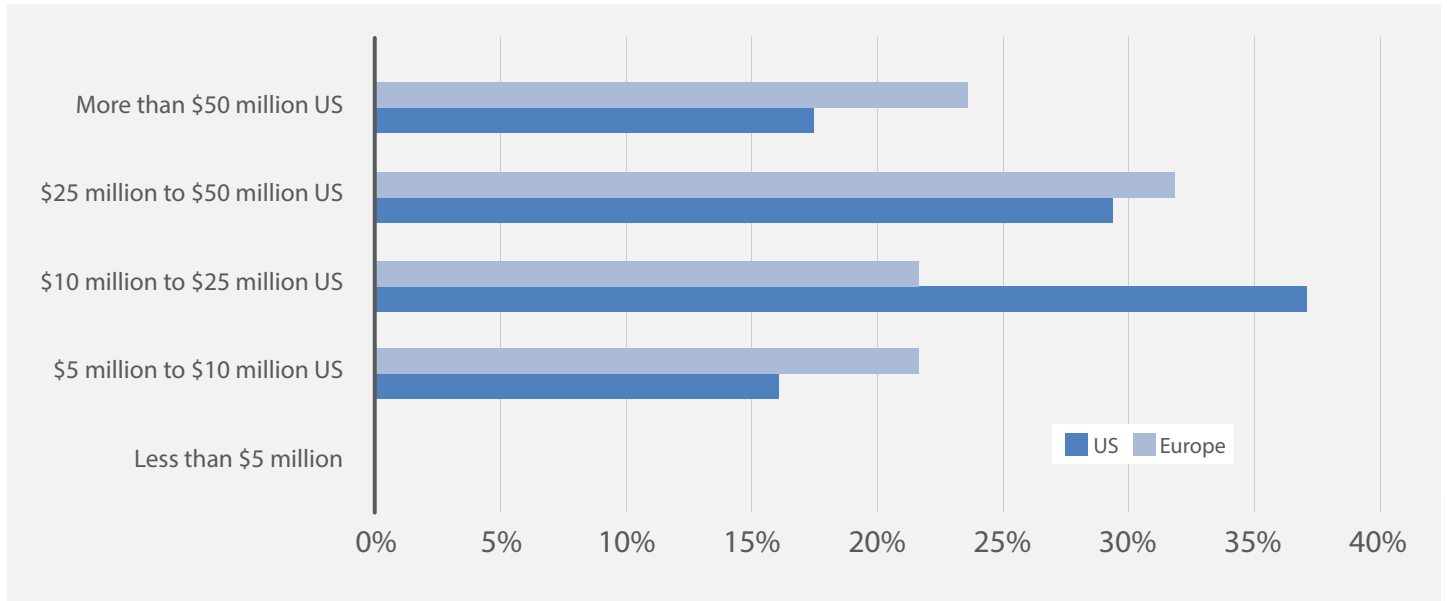


Source: Hyperion Research, 2022

As seen in Figure 7, expected 2022 IT revenues ranged from a low of US\$5 million to US\$1 million (**19%**) to more than US\$50 million (**21%**) overall. The largest US revenue band was between US\$10 million to US\$25 million (**37%**), while the largest European group ranged from US\$25 million to US\$50 million (**32%**). Half of all companies represented in the survey had expected 2022 IT revenues greater than US\$25 million.

FIGURE 7

QC End User Companies Expected 2022 IT Budgets



Source: Hyperion Research, 2022



About Hyperion Research, LLC

Hyperion Research provides data-driven research, analysis and recommendations for technologies, applications, and markets in high performance computing and emerging technology areas to help organizations worldwide make effective decisions and seize growth opportunities. Research includes market sizing and forecasting, share tracking, segmentation, technology, and related trend analysis, and both user and vendor analysis for multi-user technical server technology used for HPC and HPDA (high performance data analysis). Hyperion Research provides thought leadership and practical guidance for users, vendors, and other members of the HPC community by focusing on key market and technology trends across government, industry, commerce, and academia.

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