FMI/CMAA Ninth Annual Survey of Owners

SofO

BEYOND THE BELL CURVE

A Report On

MANAGING CAPITAL PROJECT RISK

FMI
Management Consulting • Investment Banking
for the CONSTRUCTION INDUSTRY

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Acknowledgements

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EXECUTIVE SUMMARY

Complexity creates risk and drives an increase in both its frequency and impact. In a world that is growing more complex, global and interconnected in ways poorly understood but recently revealed during the U.S. financial crisis, a better way to manage construction risk is a necessity. The focus of the FMI/CMAA *Ninth Annual Survey of Owners* is to begin the process of providing this better way.

Owners, contractors, engineers/architects and material or equipment suppliers are just a few of the players that are involved and participate in the construction of facilities and infrastructure. While this study is targeted at understanding owners' perspectives, the risk mitigation strategies they choose to employ and their ramifications are applicable to all players. These risk mitigation strategies are divided into four categories and described in greater detail in the body of the report: Accept and Manage, Accept and Transfer, Recognize and Ignore, and Avoid. Within each category are numerous potential strategies, five of which are listed at right and used most frequently by respondents.

Favorite Strategies, Tactics and Processes

1. Integrate Risk into the Contract
2. Use Standardization
3. Hire Internal Staff
4. Increase Team Meeting Frequency
5. Request Budget Increases

Four risks exhibited both very high frequency and major impacts to capital construction projects and are instructive to better understand: governmental regulation, inaccurate budgeting or estimating by the owner, availability of qualified construction firms and worldwide commodity demand. The first is forced upon many owners and requires strategies focused in influencing the development and application of these regulations and the second is self-created in many instances due to a lack of recognition of the improbable event, what Nassim Nicholas Taleb describes as a Black Swan in his recent book, *The Black Swan*. The latter two revolve around market supply and demand issues. The frequency of all four of these risks dictate that they are routinely managed by owners and when possible transferred.

The reader is encouraged to keep the following in mind as they consider how to mitigate risk in today's capital construction world.[1]

- Using past history as a guide for understanding future risk is necessary but not all encompassing – history is less applicable today because complexity is changing the nature of the game.

[1] *Adapted from The Black Swan (The Impact of the Highly Improbable)*, Nassim Nicholas Taleb, Random House, 2007, pg 50.

- The design and construction mind searches for historical order and patterns to better understand the environment yet random events will happen – the most severe impacts to capital construction programs noted by the survey respondents fall into the Cost Other = Unanticipated Costs category where they related unpredicted, one-time events that devastated the project or program.

- It is much easier to plan, obtain financing and hire service providers by ignoring the possibility that a "Black Swan" type event may take place — but take place they will.

- History takes the sharp edges off of unpredicted, one-time events that devastated the project compelling practitioners to underestimate the probability that a one-time event is not really a one-time event — the destruction of the Wheeling Suspension Bridge in 1849 and subsequent destruction of the Tacoma Narrows Bridge in 1940 is an example.

- Focusing on the well-defined sources of uncertainty is the normal practice in the industry where numerous experts prepare writing and research to identify an all encompassing list of design and construction risk — we must see the forest *and* trees for success, recognizing that the most devastating risks will originate from the forest which is harder to see and discuss.

Survey Highlights

- **Throwing Money At the Problem:** 33 percent of the time owners request a budget increase to manage project or program risks

- **Application of Leverage:** 75 percent of the time owners use some form of program level purchasing power to transfer or manage project or program risks

- **Hammer Looking for a Nail:** 25 percent of the time owners use the same strategy, tactic or process to address both frequency and impact (severity) without recognizing the different challenges of each

- **Tunneling:** 7 of 28 survey risks were rated with both low frequency and impact indicating a focus on a few well-defined sources of risk

- **Black Swans Do Exist:** With only two exceptions, an "immense" impact was reported by multiple survey respondents in every risk description presented indicating that every risk has the potential for catastrophe

- **The Impact of the Highly Improbable:** "Major" and "Immense" impact was most frequently reported in "Cost Other = Unanticipated Risks" category where respondents described unpredicted, one-time events that devastated a project or program 22 percent of the time

- **Greatest Fear:** Schedule impact was described as the greatest negative outcome to project or programs; nearly twice as many "Major" and "Immense" impacts were described versus the other impact categories of financial (cost) or qualitative (public or internal reputation, quality or safety)

- **Size Matters:** The biggest capital construction programs choose to "Accept and Manage" risk nearly 70 percent of the time (50 percent more than the smallest programs that "Avoid" or "Accept and Transfer" nearly 60 percent of the time)

- **Risk Appetite Matters:** Financial institutions, real estate developers, and sport authorities have the lowest risk appetite and frequently choose to "Avoid" or "Accept and Transfer" risk, while chemical companies, energy firms and various types of manufacturers tend to have the highest risk appetite and "Accept and Manage" risks frequently

- **Consistent Strategy Use:** Owners elect to either "Accept and Manage" or "Accept and Transfer" the 28 risks included in the survey 61 percent and 22 percent of the time, respectively

- **Avoidance:** 41 percent of the time when inability to effectively plan is perceived as a risk, owners prefer to avoid the project rather than ignore, manage or transfer the risk.

- **Management:** 38 percent of the time when inability to estimate accurately is perceived as a risk, owners prefer to accept and manage the risk rather than avoid, ignore or transfer

- The highest observed frequency and impact risks along with the favorite strategies, tactics and processes to address them are detailed in **Exhibit 1**.

EXHIBIT 1 Top 5 Risks and Strategies

Highest Frequency Risks	Highest Impacting Risks*	Favorite Strategies, Tactics and Processes
1. Commodity Demand	1. Estimating Accuracy	1. Integrate Risk into the Contract
2. Energy Prices	2. Government Regulations	2. Use Standardization
3. Skilled Craftsmen	3. Commodity Demand	3. Hire Internal Staff
4. Estimating Accuracy	4. Construction Firms	4. Increase Team Meeting Frequency
5. Construction Service Demand	5. Construction Service Demand	5. Request Budget Increase

* excluding self-selected other responses

RISK MANAGEMENT FOCUS

The focus of the FMI/CMAA *Ninth Annual Survey of Owners* is on understanding how program- or project-level risks are assessed and managed prior to or during project execution (planning through turnover) and how they impact an owner's overall capital program. FMI analyzed the frequency of occurrence and severity of impact of specific risks and, more broadly, how owners tend to manage construction risks by electing to use certain strategies, tactics or processes.

FMI/CMAA worked with a team of highly experienced industry professionals to establish a common definition of risk management in the survey. Though the general topic of risk management in the construction industry covers a broad range in scope (e.g., insurance, bonding, litigation, operations, economic, etc.), we settled on the following definition:

> *"Risk management for projects in the construction industry consists of a process where risks are identified, quantified, and opportunities for mitigation are discovered. Owners involved in construction will make decisions about how to mitigate risks, which may include elements of accepting, reducing, sharing, transferring or avoiding the risk. Ultimately, risk management involves the implementation of the mitigation plan."*

FMI/CMAA designed the survey in order to develop a basic understanding of how owners today are managing risk in construction projects. In order to accomplish this, we set out to understand owner behavior when faced with a given set of risks. FMI and CMAA believe owners make risk mitigation decisions in their capital construction programs according to the degree of assumed ownership and the selection of a passive or active risk management approach. These decisions fall within a two-by-two matrix as proposed in **Exhibit 2**.

EXHIBIT 2 **Risk Mitigation Decision Matrix**

Accept and Manage – Accept the risk as a threat to success and choose to internally manage it to reduce its frequency and/or impact.

Accept and Transfer – Accept the risk as a potential threat to success and choose to transfer this risk to an external party to reduce its frequency and/or impact. External can mean to a supplier, service provider, contractor, designer, insurer, etc.

Avoid – Recognize the risk as a potential threat to success and take action to avoid the risk. (e.g. Nigeria is a dangerous place to build, select a different country for the project)

Recognize and Ignore – Recognize the risk as a potential threat to success and take no action to reduce its frequency and/or impact.

"Recognize and Ignore" along with "Accept and Manage" represent categories where the risk management strategies, tactics or processes employed result in a high degree of ownership exhibited by the owner. Risks that owners perceive as difficult to influence are typically recognized and ignored, including security requirements or energy prices. In extreme cases, this risk can destroy a project. Risks that are believed to be subject to influence are typically accepted and managed. These include construction management talent or estimating accuracy.

"Avoid" along with "Accept and Transfer" represent categories where the risk management strategies, tactics or processes employed result in a low degree of ownership exhibited by the owner. Risks that owners perceive as severe and uncontrollable are the most actively analyzed and likely to be avoided.

"Accept and Transfer" along with "Recognize and Ignore" represent categories where the risk management strategies, tactics or processes employed are more passive. In the first case, the owner pushes responsibility to actively manage the risk onto a third party. In the second case, ignoring the risk requires no action.

"Accept and Manage" along with "Avoid" represent categories where the risk management strategies, tactics or processes employed are more active. In the first case, the owner actively takes on responsibility to manage the risk for his/her own account with his/her own staff. In the second case, an active investigation of the risk indicates that it is severe and uncontrollable and dictates the owner must take action to remove the exposure to the risk.

"Accept and Transfer" and "Accept and Manage" are opposites of one another in the owner's perspective in that the first pushes risk to an external party for active management while the second retains the risk internally for active management.

"Avoid" and "Recognize and Ignore" are opposites of one another in the owner's perspective in that the first requires action to remove the exposure to the risk while the second requires no action.

While owners prepare lists of known risks that may occur, research suggests that owners are reluctant to consider pessimistic scenarios while performing risk assessments.[2] These pessimistic scenarios are outside of this matrix, in that they are not considered. Nassim Nicholas Taleb refers to these pessimistic scenarios as little Black Swans and he describes a set of more severe outcomes as the Unknown Unknowns or true Black Swans.

> "There is also the nerd effect, which stems from the mental elimination of off-model risks, or focusing on what you know. You view the world from within a model. Consider that most delays and cost overruns arise from unexpected elements that did not enter into the plan – that is, they lay outside of the model at hand – such as strikes, electricity shortages, accidents, bad weather or rumors of Martian invasions. These small Black Swans that threaten to hamper our projects do not seem to be taken into account. They are too abstract – we don't know how they look and cannot talk about them intelligently."
>
> — Nassim Nicholas Taleb, The Black Swan

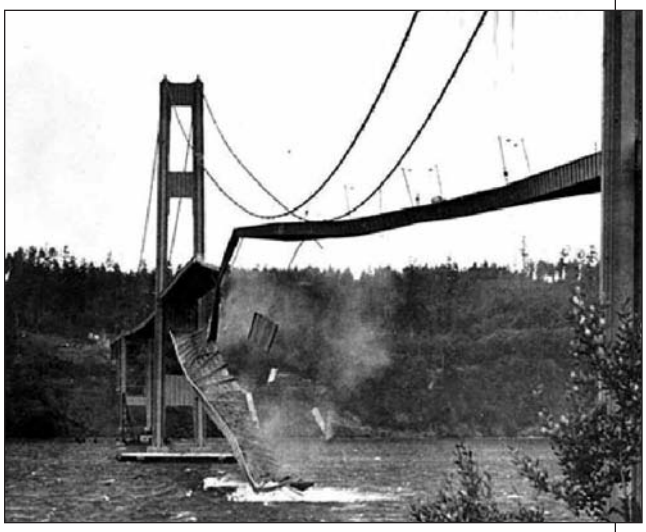
[2] "Owners Risk Reduction Techniques Using a CM," Ali Touran, Department of Civil and Environmental Engineering, Northeastern University, August 2006. CMAA-sponsored research.

A Construction Black Swan

The Tacoma Narrows Bridge was one of the most spectacular failures in engineering history. This suspension bridge used a stiffened-girder design rather than the customary and necessarily deeper open truss. This innovative design gave a slender silhouette whose appearance was dramatic and graceful, albeit inappropriate for the site conditions. The last spectacular undulating motions of the roadway being twisted to destruction were recorded on newsreel film even as engineers were trying to understand the phenomenon of its aerodynamic instability.

Othmar Ammann, designer of the George Washington and other monumental bridges wrote:

> *"…the Tacoma Narrows bridge failure has given us invaluable information…It has shown [that] every new structure which projects into new fields of magnitude involves new problems for the solution of which neither theory nor practical experience furnish an adequate guide. It is then that we must rely largely on judgment and if, as a result, errors or failures occur, we must accept them as a price for human progress."* [3]



The possibility of failure of the Tacoma Narrows Bridge because of a steady crosswind of 42 miles per hour was unforeseen by its designers, what Nassim Nicholas Taleb refers to as tunneling[4] or "we focus on a few well-defined sources of uncertainty… at the expense of the others that do not easily come to mind."

If the designers of the Tacoma Narrows had known the story of the Wheeling Suspension Bridge, the longest span in the world when it was completed in 1849, they would have anticipated that wind could be a possible cause of failure. The Wheeling bridge was destroyed in a storm. In this older incident, the technical literature on the design and ultimate failure of this bridge was not well-documented even though a local reporter made detailed observations of the bridge as it experienced similar undulation due to relatively modest crosswinds.

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[3] *To Engineer is Human, The Role of Failure in Successful Design*, Henry Petroski, Vintage Books, 1992, pp. 163-171.

[4] *The Black Swan (The Impact of the Highly Improbable)*, Nassim Nicholas Taleb, Random House, 2007, pg. 50.

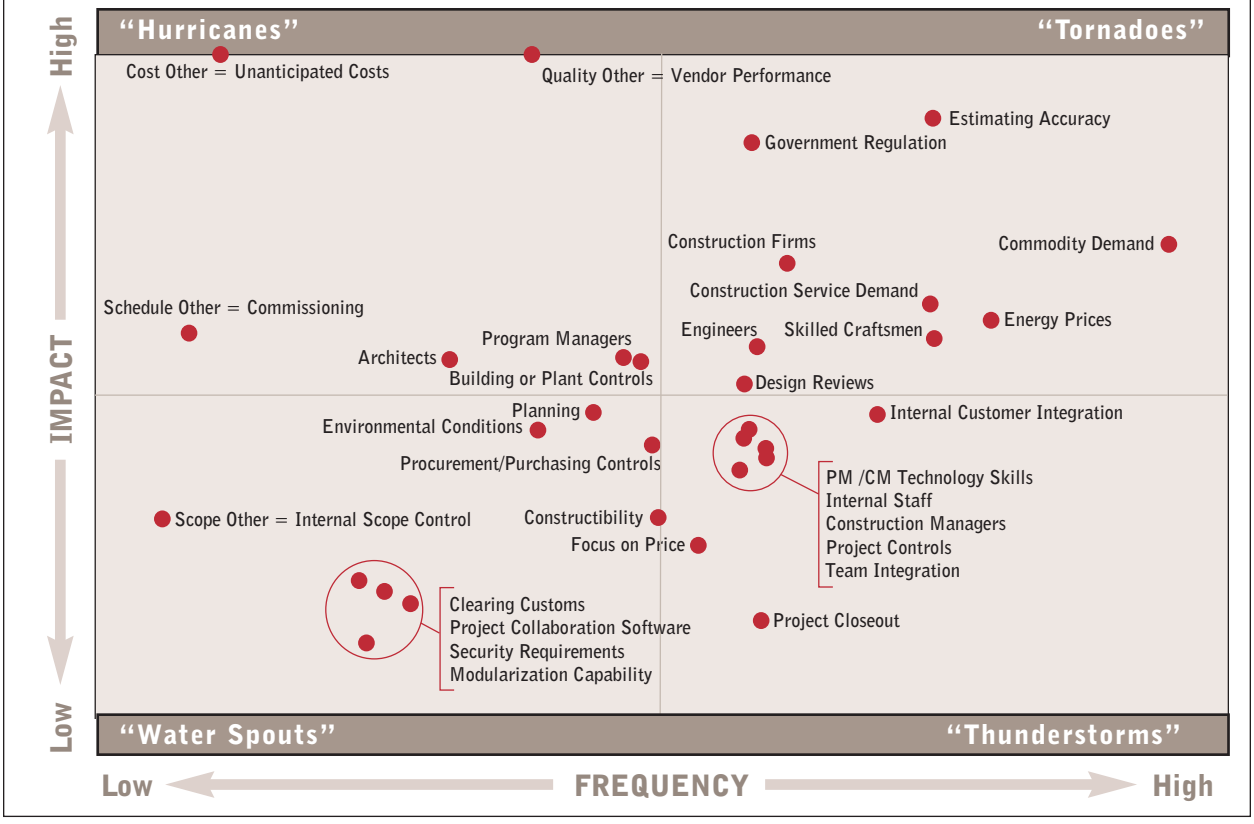
Risks

A meaningful discussion about program and project level risks is undertaken in the context of the perceived frequency and impact of that risk. There are hundreds, if not thousands, of possible risks that an owner may face when managing a construction project or program. A considerable effort was made to narrow the list of risks based on the idea that owners tend to focus on what they have previously experienced as opposed to what they have not experienced. Said a different way, what they know as opposed to what they do not know. FMI selected 28 specific risks and an additional four respondent-chosen risks which were tied to four areas of impact to the owner: Quality, Cost, Schedule and Scope.

Respondents were asked to define any other risks that impact them in the areas of quality, cost, schedule and scope. A host of risks were described and based on frequency of mentions, FMI selected a name for the risks: Quality Other = Vendor Performance, Cost Other = Unanticipated Costs, Schedule Other = Commissioning or Turnover and Scope Other = Internal Scope Control.

In **Exhibit 3**, FMI plotted each of the original 28 risks along with the four self-described risks into quadrants describing their perceived frequency and impact. High frequency and high impact risks are referred to as "Tornadoes". Nine risks fall into this quadrant with governmental regulation and inaccurate budgeting or estimating by the owner, and commodity demand exhibiting the combined highest frequency and severity. Risks where their perceived frequency was high and impact was low are referred to as "Thunderstorms". Nine risks fall into this quadrant with internal customer integration representing the greatest frequency and one of the highest impact in this quadrant.

EXHIBIT 3 **Frequency vs. Impact Aggregate Scores**



Risks where their perceived frequency was low and impact was low are referred to as "Water Spouts". Eight risks fall into this quadrant with a group of four perceived as exhibiting little impact including Clearing Customs, Project Collaboration Software, Security Requirements and Modularization Capability. There can be two explanations for the perception of both low impact and frequency: 1) These risks actually result in an insignificant impact, or 2) The assessment of impact is incomplete. As described previously, the fact that a particular risk is perceived as having low impact is not the same as saying it cannot have high impact – we must see the forest *and* trees for success, recognizing that the most devastating risks will originate from the forest which is harder to see and discuss. Risks where their perceived frequency was low and impact was high are referred to as "Hurricanes". Six risks fall into this quadrant with two exhibiting major or immense impacts, Cost Other = Unanticipated Costs and Quality Other = Vendor Performance. In **Exhibit 3**, these two risks are not depicted to scale and exibited an impact twice as high as estimating accuracy.

> "The services of a professional CM can, for many owners, mean the opportunity to execute a project successfully that might otherwise have been severely constrained by unrecognized or misunderstood risks…"

Highest Impact Risks

FMI studied how each risk impacted overall project success through the three basic attributes of the job: Cost (financial), time (schedule), and qualitative (e.g., quality, reputation, and safety) areas. Participants were asked to score each attribute as either not applicable, no impact, minimal impact, moderate impact, major impact or immense impact.

Each risk was ranked from the highest to lowest total impact for each attribute, and this is shown in **Exhibit 4**. For example, the risk of Cost Other = Unanticipated Costs ranks the highest in both Financial and Schedule impacts, whereas Quality Other = Vendor Performance ranks the highest in Schedule impacts. Impacts to the schedule were twice as high (bad) on average as the financial impacts and the qualitative impacts. Therefore, schedule impacts proportionately influenced the total overall impact rank.

Describe Parts of Your Risk Management Process

John Baldwin, Children's Healthcare Atlanta

1. Analyze the financial feasibility with the department requesting capital improvement/building.
2. Always hire experts to help manage risks that may be encountered during the process.

Schedule impacts are damaging, because in some cases there is little that can be done by a project manager to rescue a project once a major schedule delay occurs. These delays cannot be easily resolved with a scalar approach such as requesting a budget increase.

EXHIBIT 4	Impact Ratings for Each Risk			
Risk Category	Financial Impact Rank	Schedule Impact Rank	Qualitative Impact Rank	Total Impact Rank
Quality Other = Vendor Performance	2	2	**1**	**1**
Cost Other = Unanticipated Costs	**1**	**1**	2	2
Estimating Accuracy	3	4	3	3
Government Regulations	14	3	4	4
Commodity Demand	4	6	7	5
Construction Firm	8	8	5	6
Construction Service Demand	13	7	12	7
Energy Prices	5	10	9	8
Schedule Other = Commissioning	21	5	17	9
Skilled Craftsmen	7	14	11	10
Engineers	12	15	6	11
Program Managers	17	12	10	12
Architects	6	9	15	13
Building or Plant Controls	9	11	14	14
Design Reviews	10	19	8	15
Planning	25	13	26	16
Internal Customer Integration	22	17	18	17
Construction Managers	11	22	16	18
Environmental Conditions	24	16	19	19
Project Controls	15	20	25	20
Focus on Price	19	21	21	21
Internal Staff	18	18	22	22
PM/CM Technology Skills	20	25	13	23
Team Integration	16	23	24	24
Scope Other = Internal Scope Control	26	24	27	25
Procurement/Purchasing Controls	27	26	23	26
Constructibility	23	27	29	27
Modularization Capability	28	29	28	28
Security Requirements	29	31	20	29
Project Collaboration Software	30	28	32	30
Project Closeout	31	30	30	31
Clearing Customs	32	32	31	32

Participants were further asked to identify the specific qualitative impact type as either Public or Internal Reputation, Quality, Safety or Other as a self-selected impact. The results in **Exhibit 5** rank the risks in the qualitative impact rank order in **Exhibit 4**. For each risk, the bar length represents perceived severity (e.g. estimating accuracy is perceived to have a major reputational impact, moderate quality impact and minimal safety impact).

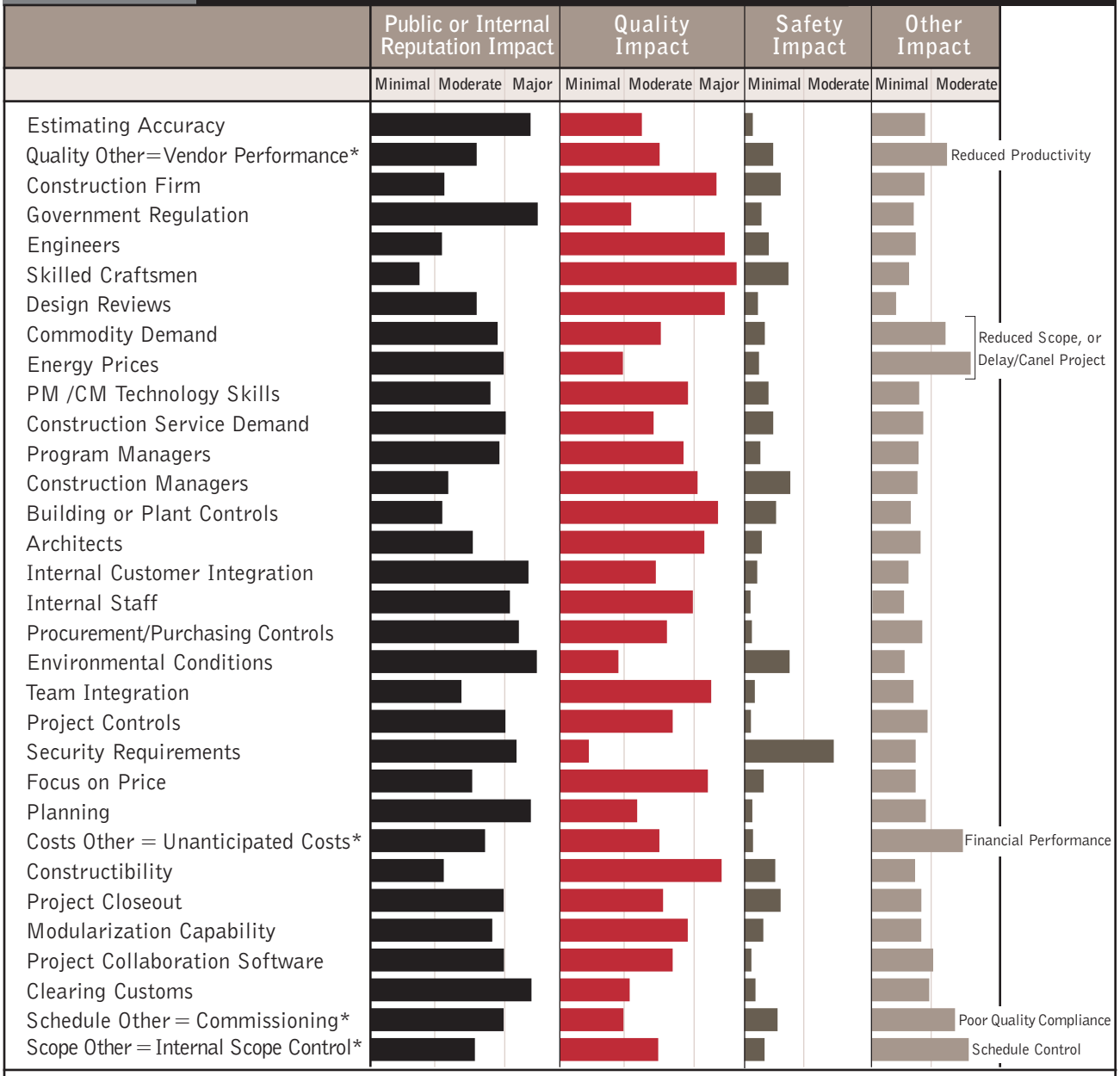
The risk with the largest public or internal reputation impact is government regulation. The risk with the largest quality impact is an inability to find or attract sufficient and trained skilled craftsmen, and the risk with the largest safety impact is, not surprisingly, security requirements.

The Easy Way Out

Manager, Partner Alliances
Large Utility (Fossil Power)

"Some firms create risk because they don't want to do more work, but they justify their decision to shareholders by saying they got the lowest bid."

EXHIBIT 5 Qualitative Impacts for Each Risk



* FMI selected name

An example of public perception impacts is the scenario of constructing highly pressurized lines snaking under farms and past residential areas. This will raise fears about safety and environmental impacts in communities along these pipeline routes. Companies building pipelines face lawsuits, eminent-domain battles and jurisdictional fights among the local, states and federal authorities that oversee the projects. Two New England projects have been held up or canceled in recent months because of local opposition.[5]

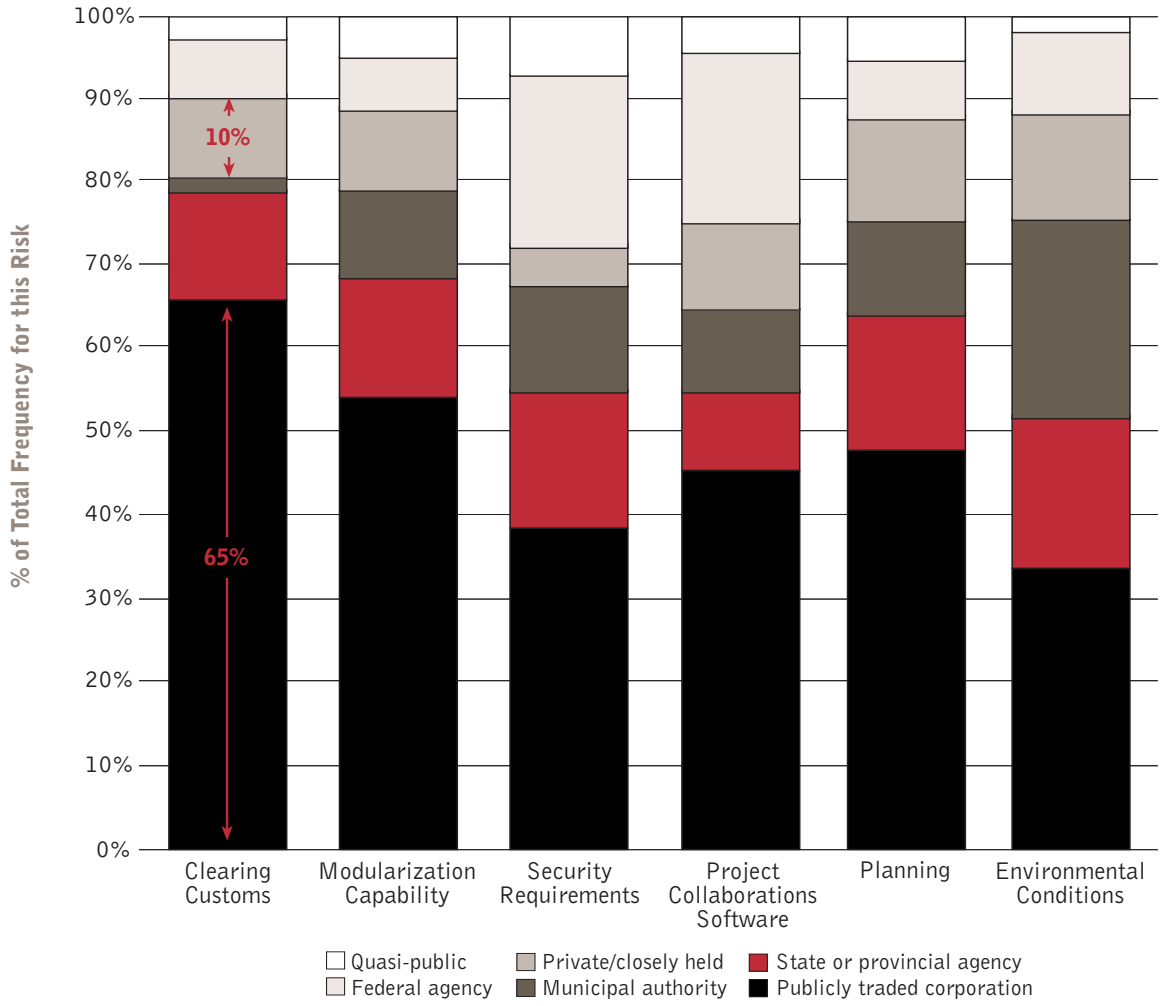
Skilled craftsmen carries the highest Quality impact potential. Kenneth D. Simonson, chief economist for the Associated General Contractors of America said, "To the extent that people are picking college, they're turning down construction."[6]

[5] "Expansion of Pipeline Stirs Concerns Over Safety," Ben Casselman, *Wall Street Journal,* August 4, 2008.

[6] "Skilled Trades Seek Workers," Anton Troianovski, *Wall Street Journal* August 19, 2008.

Risks rated with a combination of low frequency and impact may represent potential for Black Swan-type events. **Exhibit 6** displays a select list of low-frequency and low-impact risks (Water Spouts) from **Exhibit 3** and breaks down the frequency of observation for each type of owner. Public and private entities make up nearly 75 percent of the frequency rating of clearing customs risks. Put another way, government agencies do not observe clearing customs issues, which suggests that their projects source materials and equipment domestically.

EXHIBIT 6 **Percent of Risk Observation Frequency by Organization Type**



Modularization capability (capital construction program at risk due to inexperienced modularization installation contractor) scored 38 percent of the impact by respondents (firms) with the average project size of $15 million to $50 million. Meanwhile, projects between $100 million and $500 million expect to see 40 percent of the impacts related to project collaboration software (capital construction program at risk due to ineffective use of project collaboration software) than any other risk. *Engineering News Record*[7] reports that many are fearful of the transition to Building Information Management (BIM), outlining a long list of possible and increased exposure. FMI's *Eighth*

[7] "Strategies for Managing Risk in a New Era of Project Delivery," Vicki Speed, *Engineering News Record*, March 31, 2008.

Annual Survey of Owners[8], however, concluded that approximately "35 percent of all respondents have used BIM processes and technology to reduce the frequency and severity of loss." Interestingly, projects between $5 million and $15 million perceive 38 percent of the impacts as a result of planning (capital construction program at risk due to no or ineffective use of pre-project, resource, and short-interval planning techniques) than any other respondent's average project size. Projects in this range may experience major or immense cost and schedule impact if the scope changes dramatically. This is described further in **Exhibit 7**.

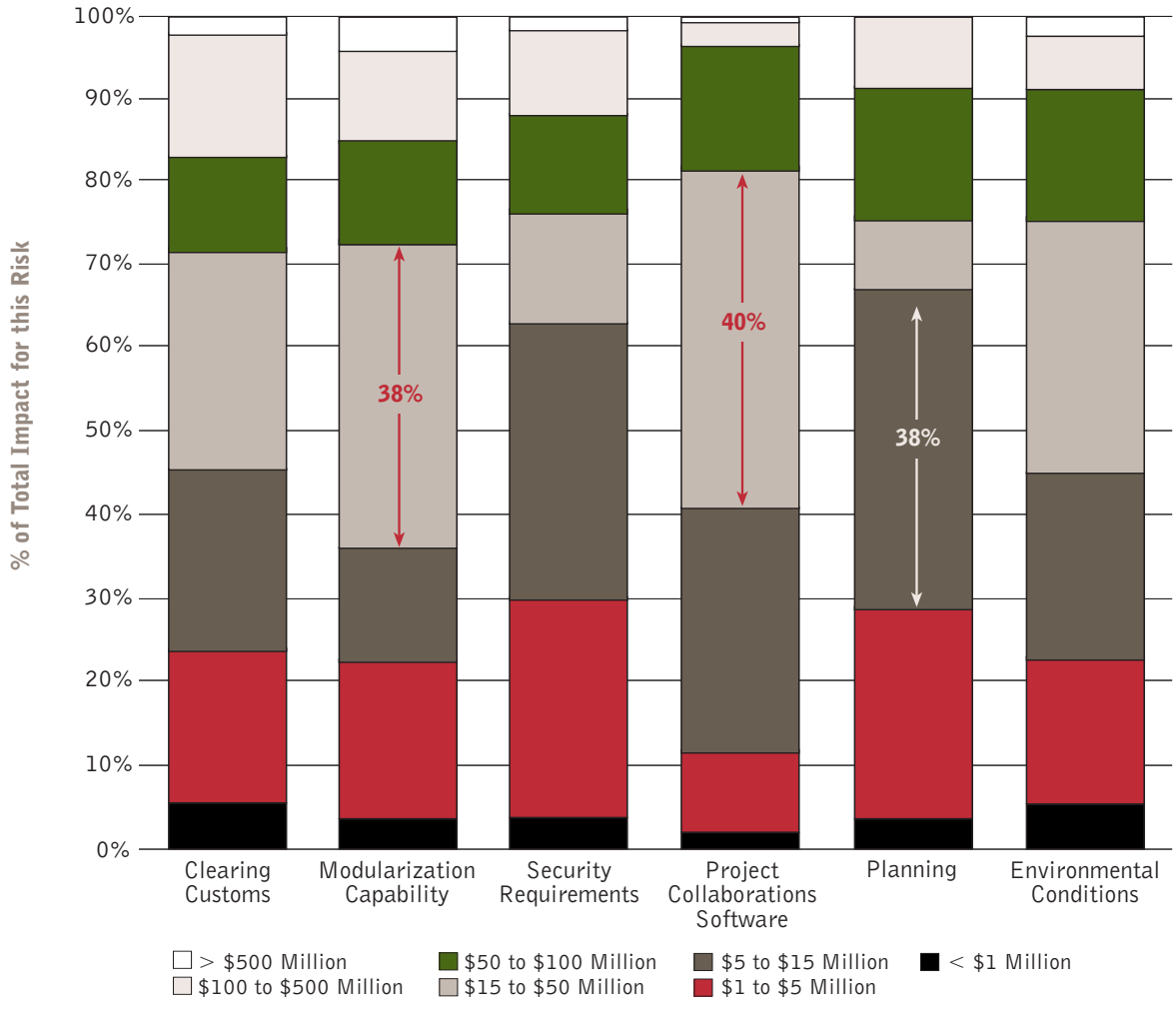
Overlooked Risks

Engineering Manager, Large Chemical Company

"Import/export refers to protecting intellectual property and technology. This wasn't an issue 20 years ago, but we have to manage the risk that our knowledge will find its way into our competitors' hands through the use of foreign-based consultants, engineers and contractors."

[8] FMI/CMAA *Seventh Annual Survey of Owners*; C2 + 2C = LC, The solution to low cost capital programs, Fall 2006 publication, pp. 1-3.

EXHIBIT 7 **Percent of Impact of Select Risks by Average Project Size**



Strategies, Tactics and Processes

The strategies, tactics and processes are included in the mitigation plan for each risk, along with ownership assignment, costs and timing. Unique strategies for mitigating capital project risk likely number in the hundreds. When respondents were asked which strategies they use most often, they integrate risk into contracts 74 percent of the time while requiring an equity involvement only 10 percent of the time. This trend should continue as traditional financing is harder to obtain and Public Private Partnerships (P3) become more acceptable. **Exhibit 8** demonstrates that owners continue to transfer risks to service providers through contractual mechanisms and language more frequently than any other approach. Using a standardized process or approach was the second most popular method at 71 percent of the time. Owners could select and apply more than one strategy at a time.

FMI/CMAA found that on average, 61 percent of the time, owners are accepting and managing risks, 22 percent of the time owners are accepting and transferring risks, and the balance of time they avoid risks as shown in **Exhibit 9**.

EXHIBIT 8 **Ratio of Usage of Strategies, Tactics and Processes**

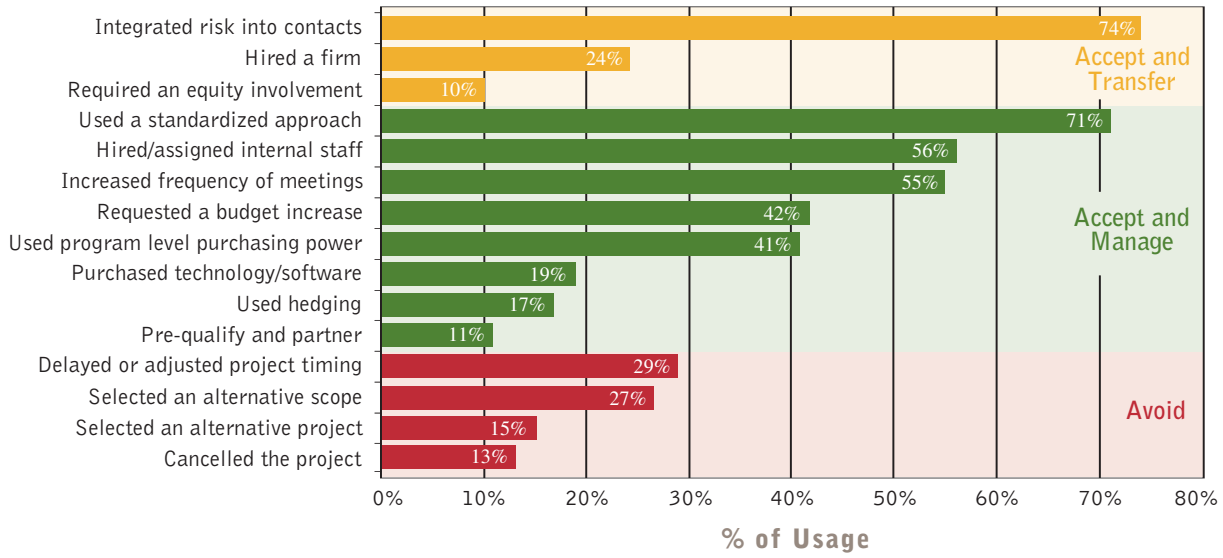


EXHIBIT 9 **Choice of Strategy**

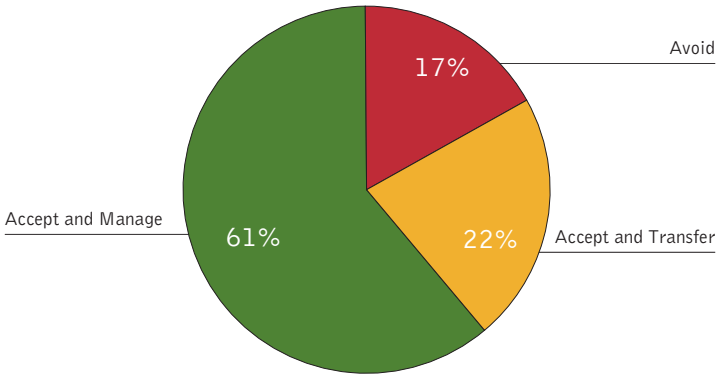


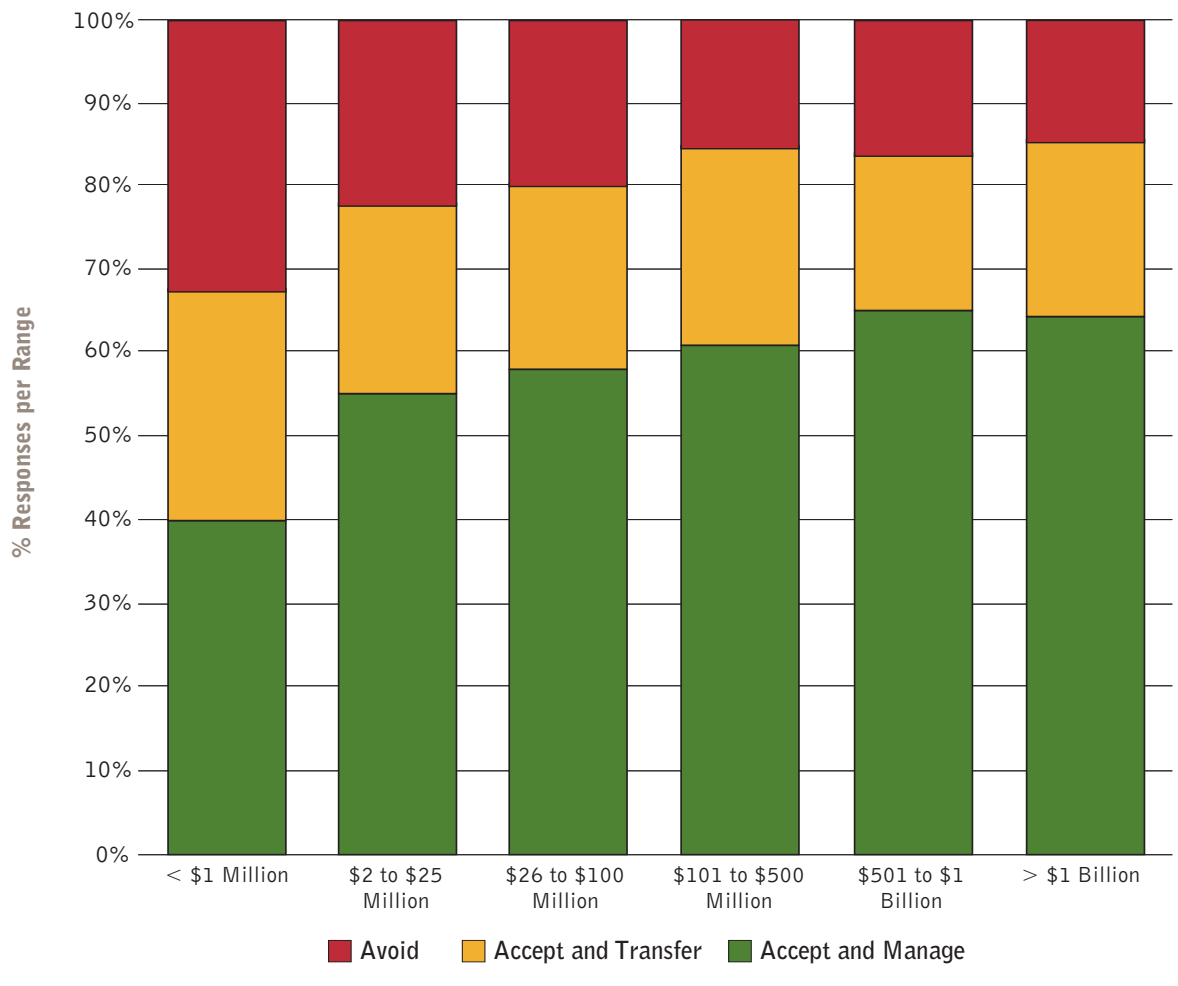
Exhibit 10 indicates an increasing desire to manage risks internally by the owner as the size of the capital program increases. Owners with less than $1 million spending manage their own risks 40 percent of the time, whereas owners that exceed $1 billion spending tend to accept and manage risks 65 percent of the time. This trend also parallels declining appetite to avoid risks. Owners become less likely to avoid a risk as their budget for capital projects increases. This suggests that owners with large capital programs are seeking larger returns and are more willing (or blind) to subject themselves to the risks inherent in these types of projects.

Why Use a Particular Strategy?

Mark Schwartz, CCM
University of Miami Medical Campus

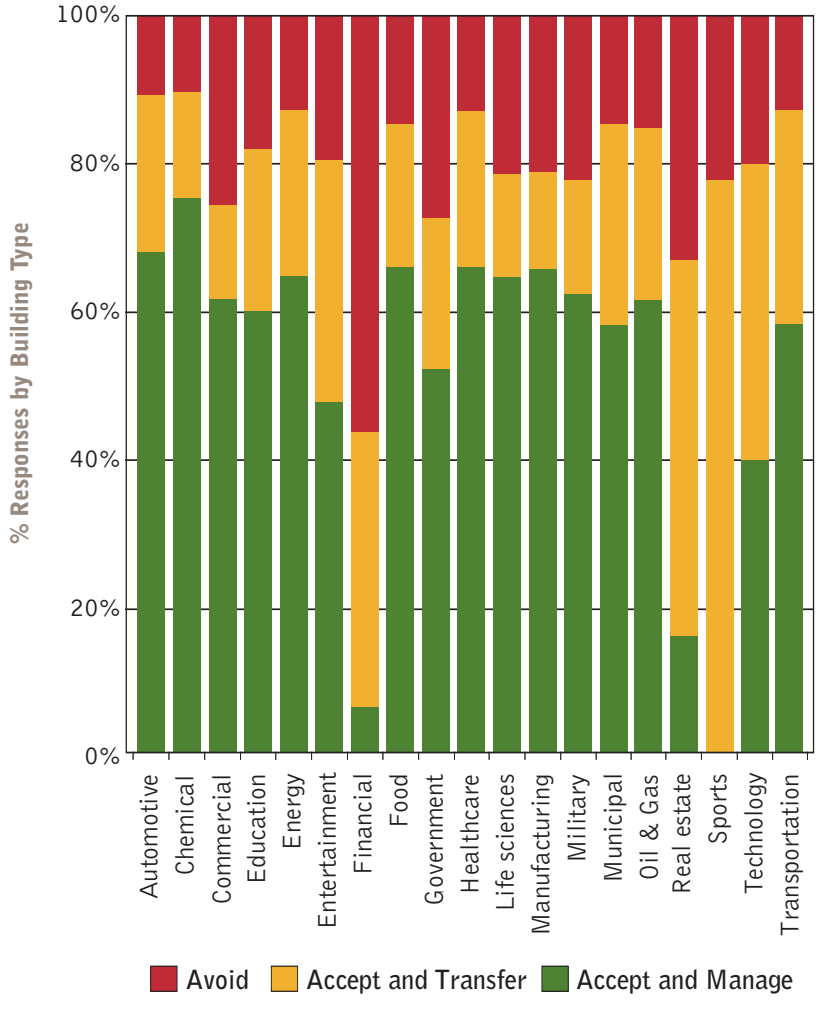
"We tend to avoid a public or political hassle of going back to the Board and asking for more money. As such, we tend to apply an appropriate level of contingency which considers the impacts of price escalation."

EXHIBIT 10 Strategies Used by Capital Program Size



Each survey participant was categorized by FMI into one construction type to analyze their approach to risk management by this construction type. The segregation ignores the fact that many owners complete construction of multiple types in the same project (e.g., a typical life sciences facility might have both laboratory and commercial building space.) This is a refinement in the categories highlighted in **Exhibit 17** in the Demographics section, where participants self-selected the type of construction they undertook. **Exhibit 11** shows that financial, real estate and government types of construction all take a more conservative approach to risks and avoid them as a preferred strategy. Real estate and sports-oriented projects tend to use a risk transfer strategy more often than other types of strategies. These types of projects are frequently one-time interactions between owner, designer and contractor, and pushing risk to another party has minimal long-term consequences for the owner. In the case of owners that have programmatic work year-in and year-out, the more aggressive movement of risk to other parties tends to have more severe consequences.

EXHIBIT 11 **Strategic Action by Building Type**



Strategies to Mitigate Risks

Participants in the survey were not directly asked how they addressed each risk. The results in this section are derived from statistical correlations of the risk frequencies, risk impacts and use of particular risk mitigation strategies. We studied how owners react to risks based on 1) only the frequency of occurrence, and 2) only the potential impact that the risk would have upon their program. Participants were also not asked about any particular strategies related to ignoring risks because it is assumed that if an owner ignores a risk, no strategy, tactic or process is used to mitigate it, thus, measurement would not be feasible. The results were inferred by low correlation coefficients associated with the other three classifications. Refer to **Exhibit 12** and **Exhibit 13** for this analysis.

EXHIBIT 12 Connecting Strategies and Risks Based on Frequency of Occurrence

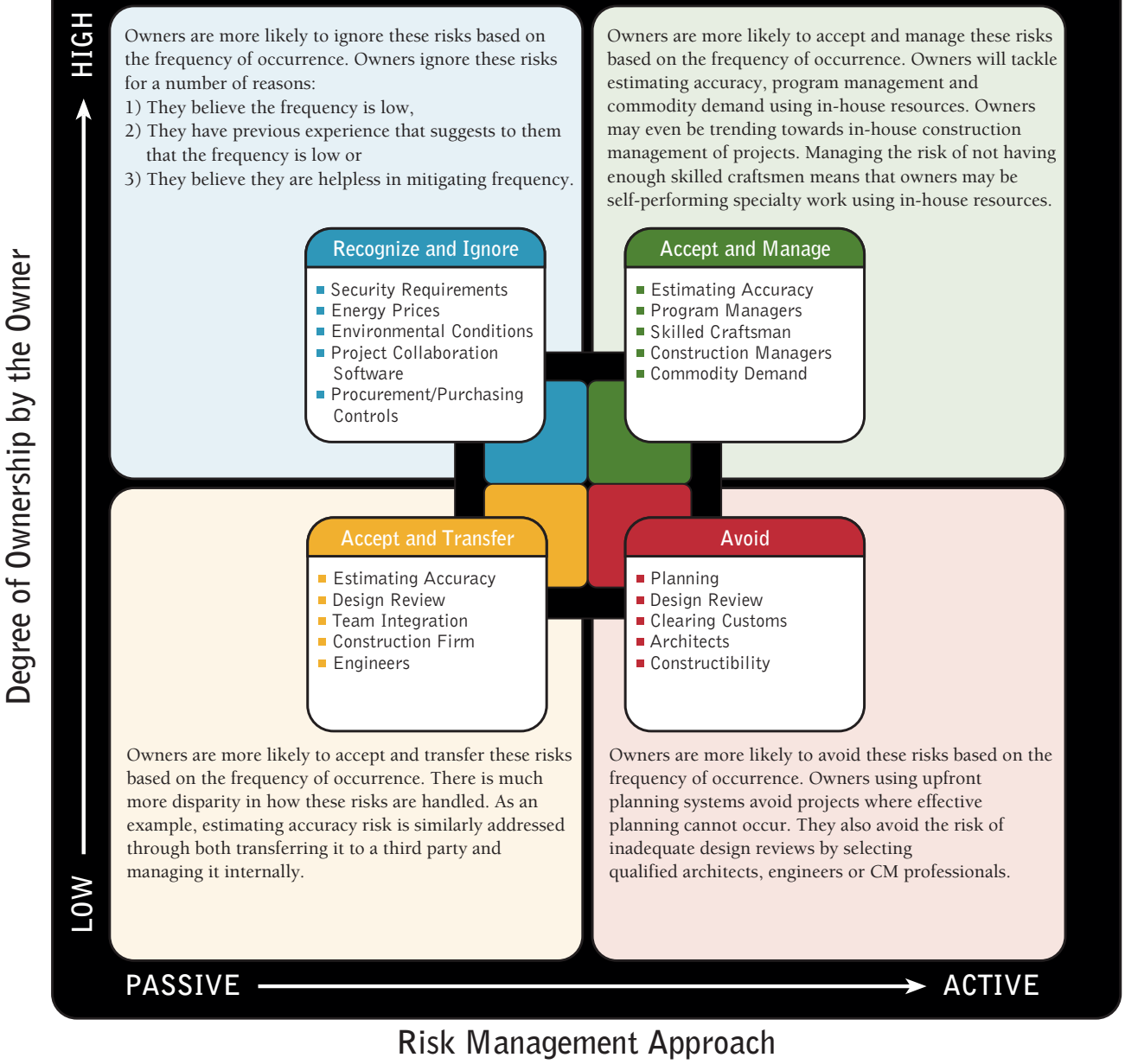
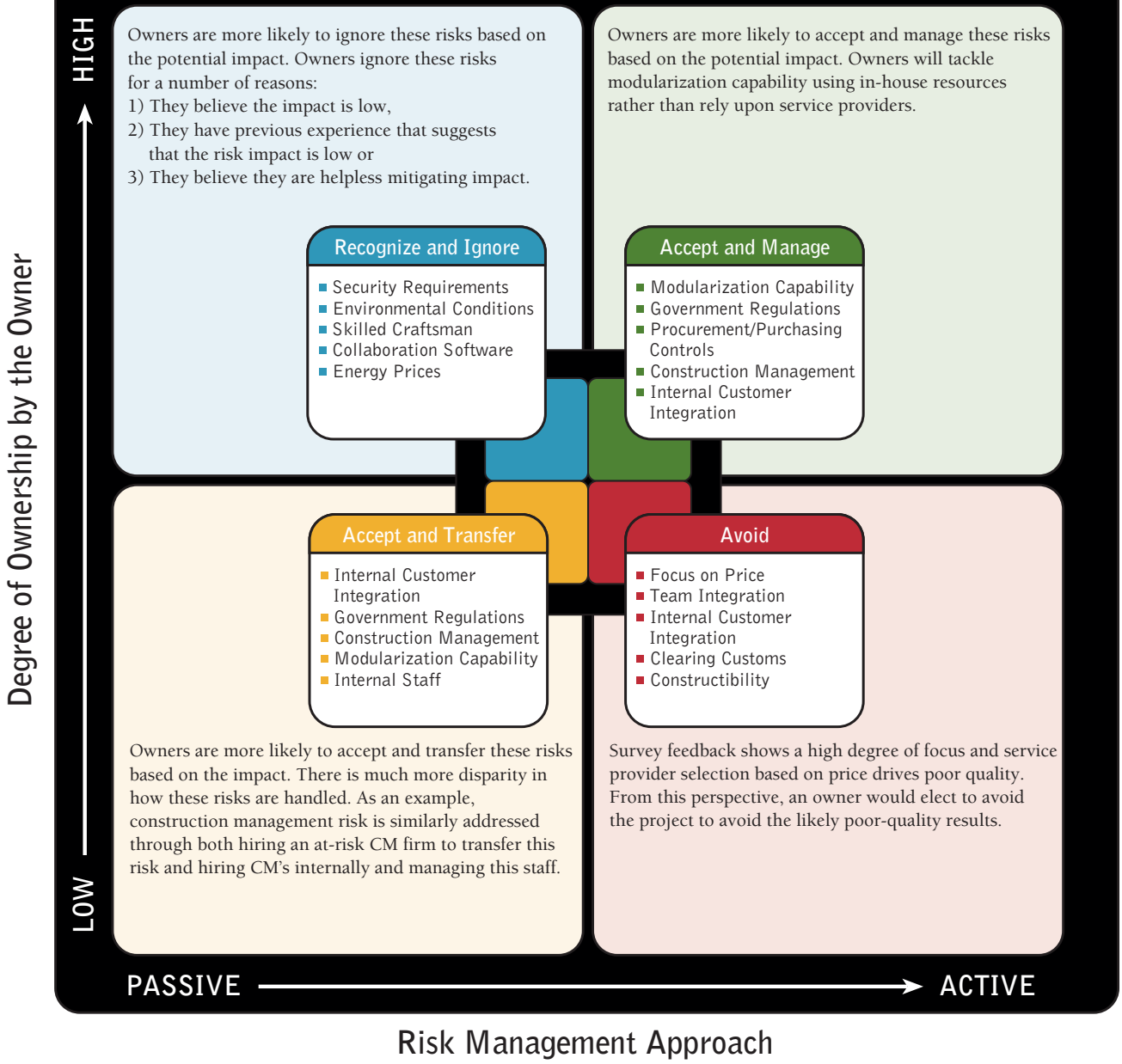


EXHIBIT 13 Connecting Strategies and Risks Based on the Potential Impact



The top strategies, tactics or processes that were most consistently applied to address a particular risk are shown in **Exhibit 14**. The risks that were originally scored as low frequency and low impact are italicized for emphasis. For example, if a capital construction program is at risk due to an inability to control the planned scope of work due to ineffective constructibility reviews, then the participant in the survey most often chose to request a budget increase.

In 11 out of 32 risks evaluated in the survey, requesting a budget increase was the most employed strategy, tactic, or process – throwing money at the challenge. If project directors know that the tactic of getting more money is an accepted practice, they are going to be less concerned about cost-related impacts from risks. This explains the observation made in connection with **Exhibit 4** in which schedule impacts are of more concern to owners compared to financial and qualitative impacts.

EXHIBIT 14 How Specific Risks Are Addressed

Strategy, Tactic or Process	Most Often Applied to Address these Risks
Selected an Alternative Scope	*Planning*
Requested a Budget Increase	Energy Prices Team Integration Estimating Accuracy *Environmental Conditions* Project Closeout Government Regulations Focus on Price Constructibility Design Reviews Internal Customer Integration
Cancelled the Project	Building or Plant Controls
Delayed or Adjusted Project Timing	Architects Internal Staff PM/CM Technology Skills *Clearing Customs*
Used Hedging	Construction Demand
Used Program Level Purchasing Power	Engineers Skilled Craftsmen Construction Firms Commodity Demand *Project Collaboration Software* Project Controls *Modularization Capability*
Purchased Technology/Software	Procurement/Purchasing Controls
Increased Frequency of Meetings	Program Managers Construction Managers *Security Requirements*

FUTURE NEEDS

Participants identified the top three opportunities for improvement for both themselves and their service providers in two open-ended questions. The objective was to learn what areas need improvement to support their capital construction program in the next five years.

In **Exhibit 15**, better planning and budgeting processes had the highest overall number of responses for both the owner and the service providers. In contrast, FMI's *Sixth Annual Survey of Owners*, discovered that "planning and scheduling capabilities of construction managers and contractors ranked only eighth among a list of characteristics used to choose these same professionals."[9] The discrepancy might be explained by the increasing complexity of today's projects where risk cannot be as easily spread to service providers through lump sum contracts. We see inadequate levels of planning and budgeting that result from an increased volume of work coupled with a shortage of experienced staff applied to projects by owners.

"We need to move our Procurement and Legal departments into the direction of a collaborative delivery method to improve risk management."

Looking forward, respondents suggested that their teams need to "manage expectations of what can be successfully executed and what the industry can support." Further complicating matters, these project teams can now expect that their management has limited experience with large engineering or construction programs as part of their established careers.

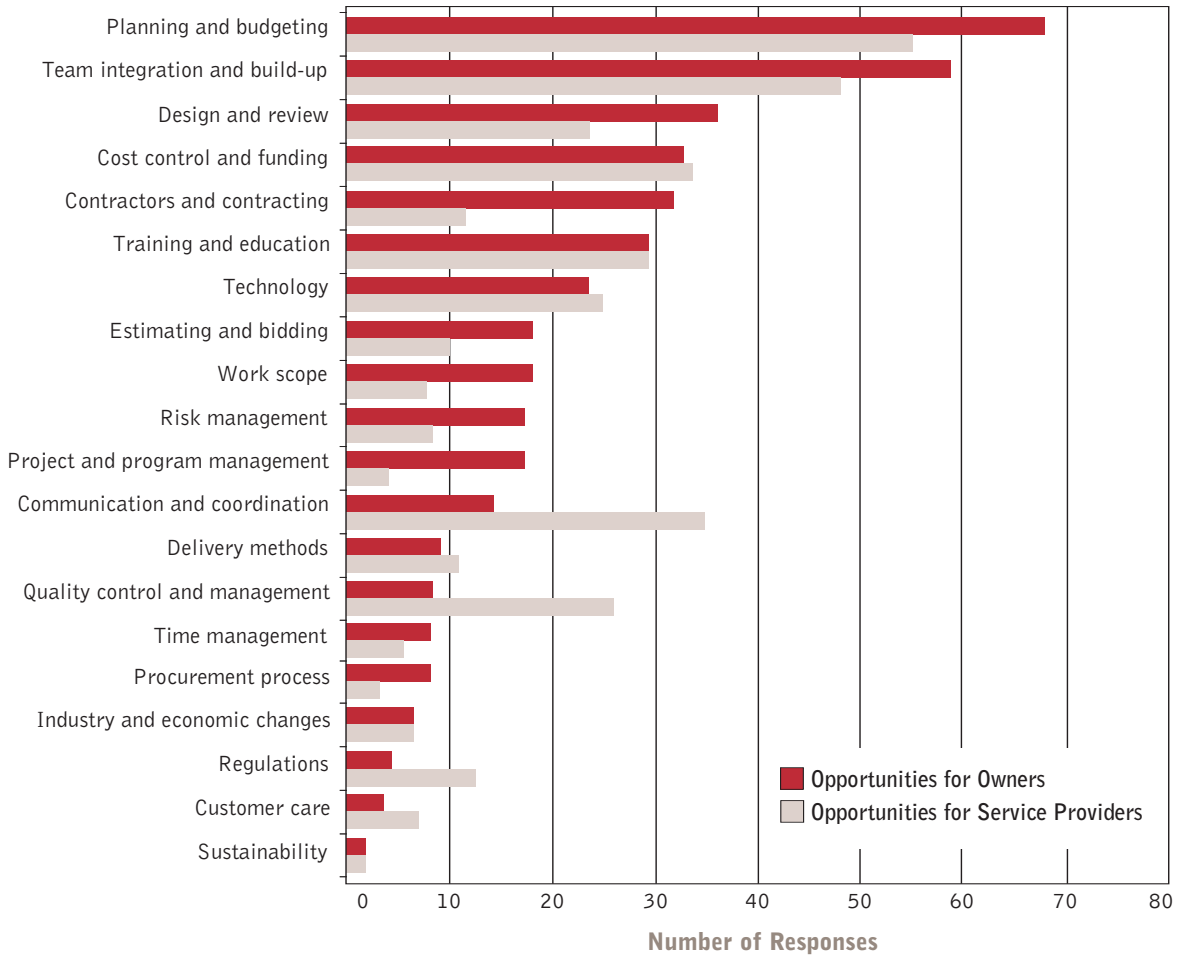
The most striking difference between owners' opportunities and service providers' opportunities is where service providers can improve the level of communication and coordination. One respondent wrote they want contractors that provide "brutally honest communication."

Owners perceive some opportunities (independent of service provider) to improve designs and reviews. This opportunity was most often suggested by Federal agencies. Interestingly, improved risk management processes and programs were ranked in the middle third of areas of importance.

"We want to see a greater emphasis placed on training and knowledge transfer. Consider progressive concepts, such as reaching out to the community to augment training staff"

[9] FMI/CMAA *Sixth Annual Survey of Owners*, Fall 2005 publication, pg. 15.

EXHIBIT 15 Where are the Opportunities for Improvement?



"Service providers can offering private equity or innovative funding options as one way to differentiate themselves"

DEMOGRAPHICS

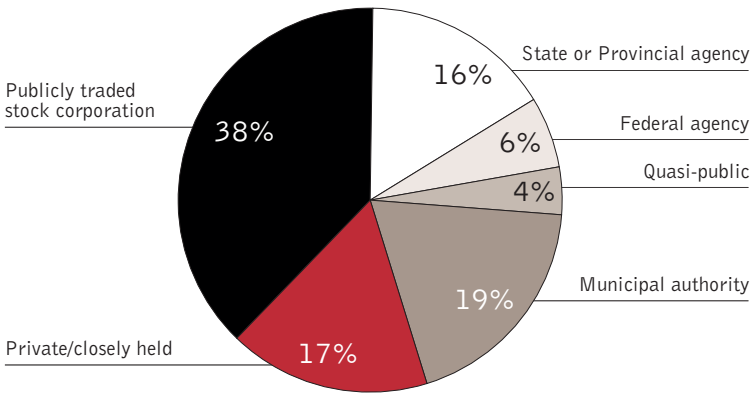
The participants in the FMI/CMAA *Ninth Annual Survey of Owners* were again this year among the largest owners in the worldwide construction industry with annual construction capital expenditures totaling approximately $233.9 billion worldwide. The capital spend represented in this survey covers an estimated 18,000 projects per year with an average project size of $12.0 million. Forty-seven owners, or 24 percent, reported capital construction programs more than $1 billion, nearly double the number from 2007, with the largest single construction program reported at nearly $20 billion globally. Fifty-nine percent of survey respondents reported capital budgets in excess of $100 million, with the remainder of owner respondents spending smaller amounts.

More than 200 participants shared data on their spending and risk management approaches, including approximately 170 reporting spending in the U.S. The spending in the U.S. of approximately $87.6 billion represents 14 percent of the approximately $600 billion spent annually on nonresidential construction in the U.S. The respondents represent nearly every owner type and perform nearly every type of construction. The combination of the number of responses and representation of more than 14 percent of all nonresidential construction spending leads us to believe that the conclusions drawn are representative of the entire industry.

Internationally, the participation in this study was up over the past two years with a total capital expenditure of approximately $146.2 billion (excluding North America), with more than $25.0 billion originating from the Middle East. The preponderance of the international responses is involved in the energy market sector.

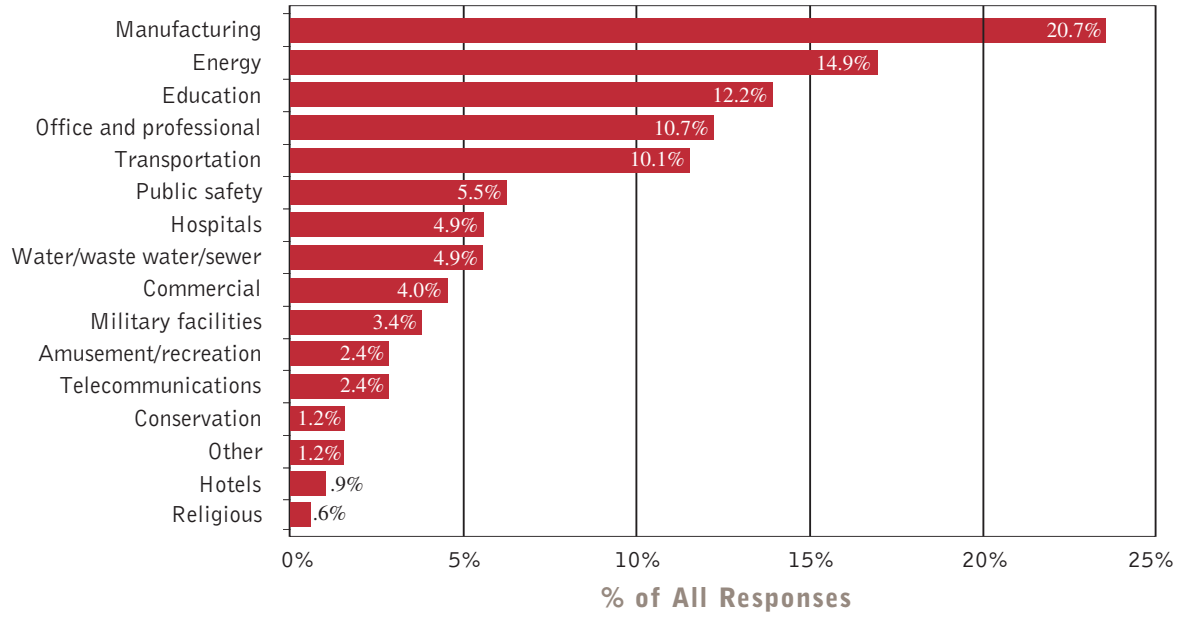
FMI/CMAA received responses from a broad sampling of organizations based on type of owner, size of capital program and variety of construction projects. **Exhibit 16** indicates that no single type of organization dominated the results, but government entities in various forms and publicly traded stock corporations were highly represented, while private/closely held and quasi-public organizations represented 17 percent and 4 percent of the responses, respectively.

EXHIBIT 16 **Survey Respondents Segmented by Type of Owner**



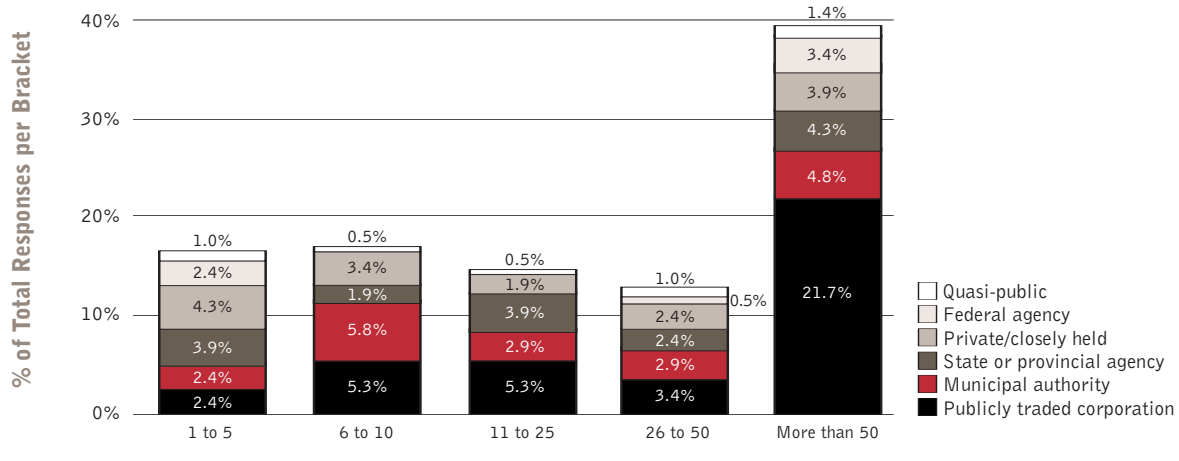
Responding firms identified every type of construction they undertake. **Exhibit 17** shows that Manufacturing (20.7 percent) and Energy (14.9 percent) dominate the responses. Education (12.2 percent), Office and Professional (10.7 percent), and Transportation (10.1 percent) rounded out the top five industry sectors served. The "Other" category represented approximately 1 percent of the sample and includes only residential or multi family construction.

EXHIBIT 17 Survey Respondents Segmented by Type of Construction



Capital project activity level, as measured by the number of projects per year in **Exhibit 18**, demonstrates that 40 percent of all owners surveyed complete more than 50 projects annually. Approximately 15 percent undertook 26 to 50 projects, and the remaining 45 percent of firms completed fewer than 25 jobs annually.

EXHIBIT 18 Number of Projects Constructed Annually



Publicly traded corporations dominated the category, which consists of owners completing more than 50 projects annually with every type of owner represented at this high level of activity. Private and closely held businesses tended to have either very small or very large work programs. Public agencies, including federal, state, municipal and quasi-public organizations have the largest number of projects and tend to perform between 11-50 projects annually. Municipal authorities tended to have the smallest programs of all the owner types showing 10 or fewer projects annually. Manufacturing facilities and energy-related construction dominated more than 50 projects category with educational and office and professional also making significant contributions to this group. Interestingly, the "1 to 5 projects" group was also led by the education- and manufacturing-related construction.

Exhibit 19 and **Exhibit 20** show that construction programs more than $500 million are dominated by publicly traded stock corporations and make up more than 90 percent of all the spending reported. Various governmental organizations dominated the categories of spending up to the $500 million.

EXHIBIT 19 **Capital Program Spending by Number of Responses**

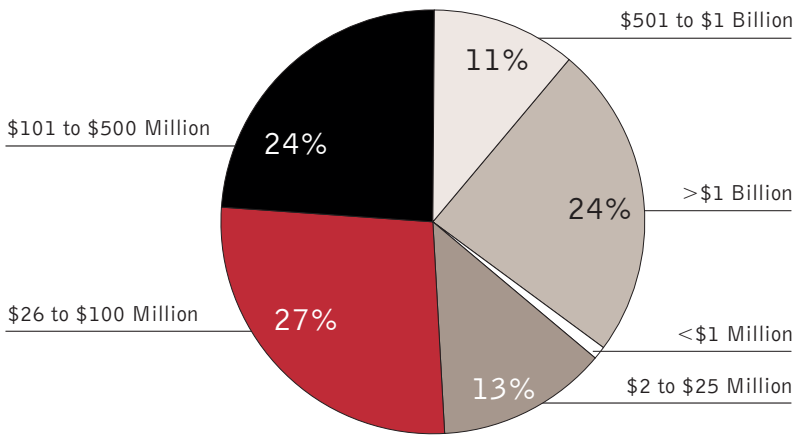
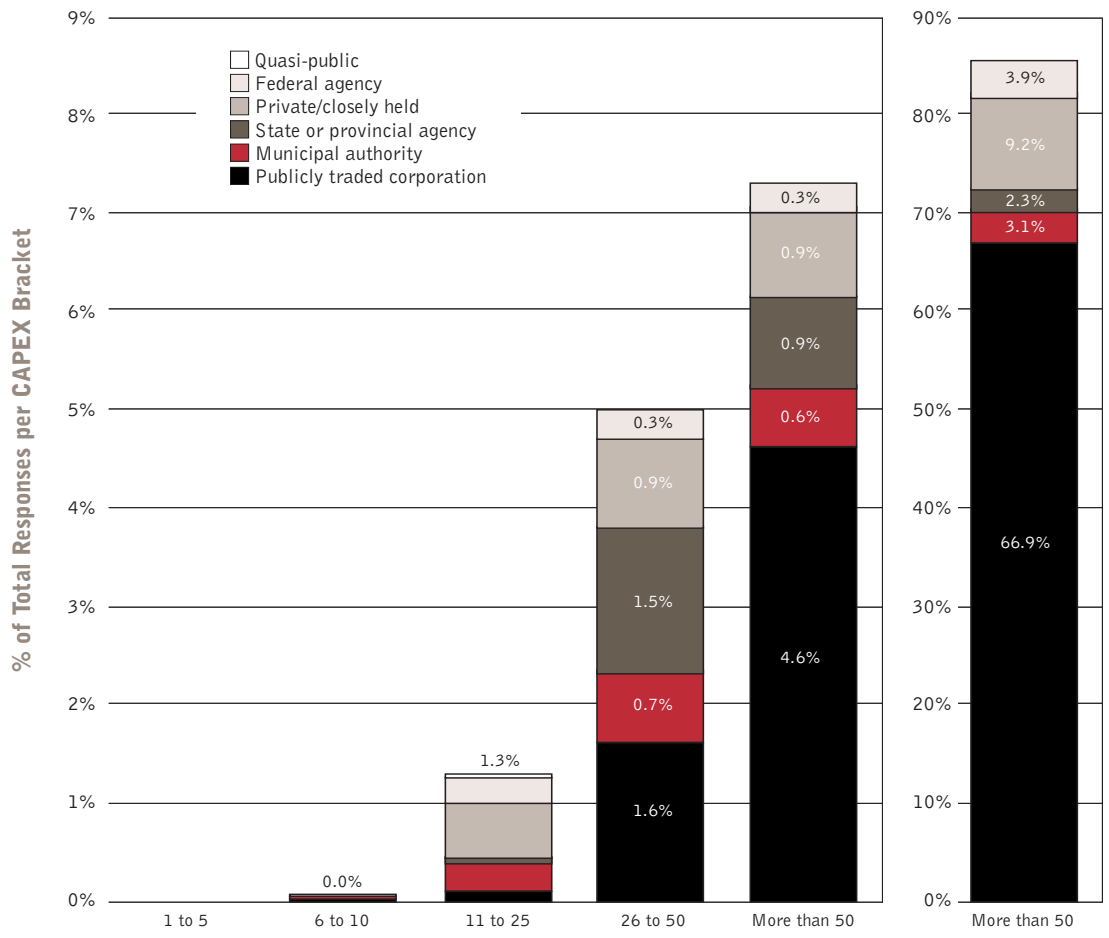
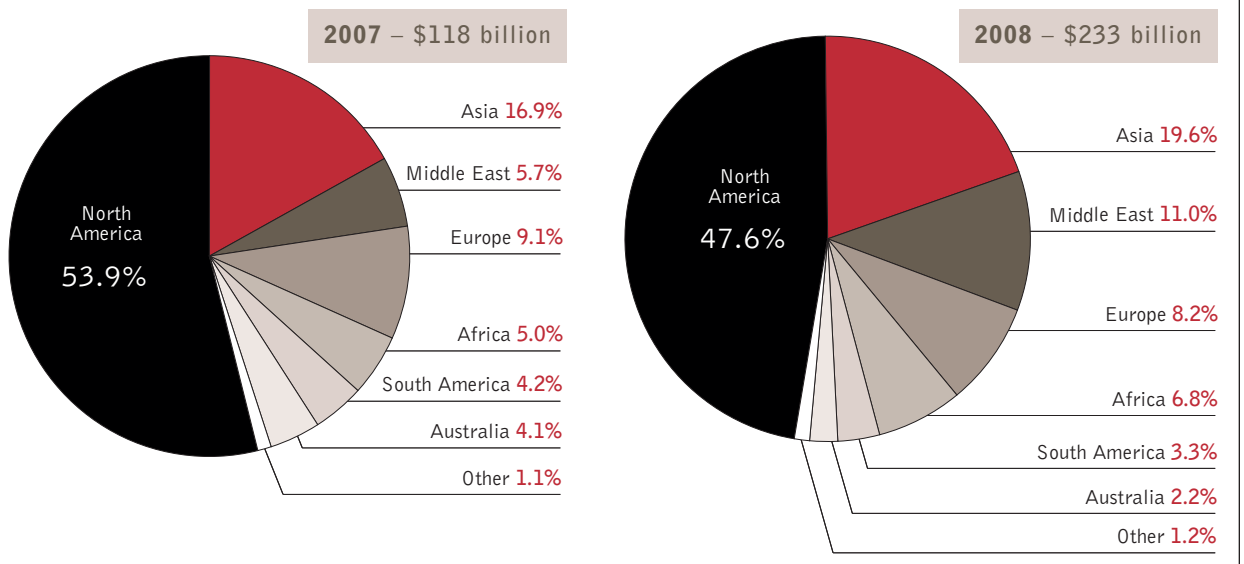


EXHIBIT 20 Annual Capital Spend by Program Size and Owner Type



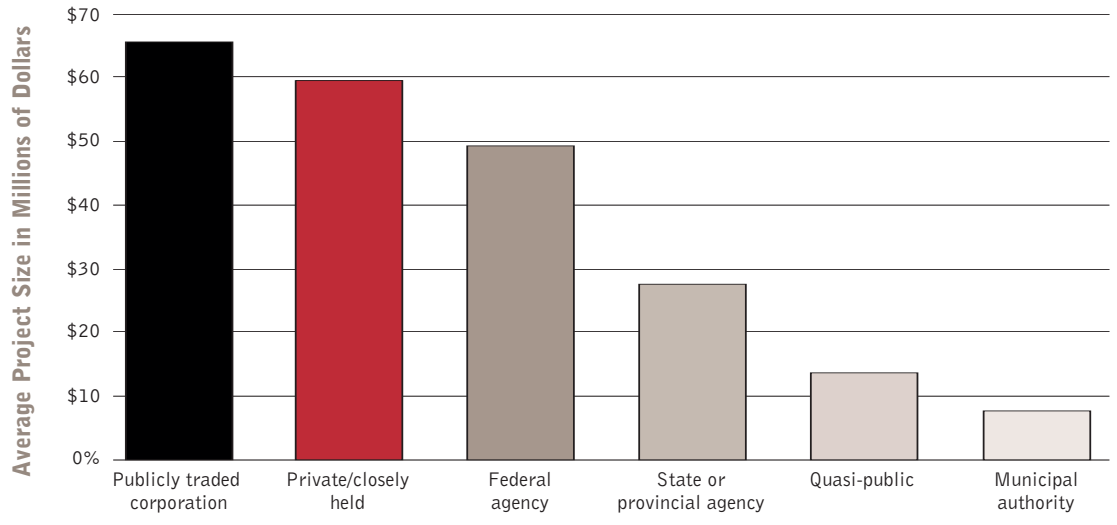
FMI and CMAA asked survey respondents to estimate more specifically the location of their global spending. **Exhibit 21** demonstrates that nearly 48 percent of the $233.9 billion in spending reported by participants is taking place in North America with the remainder spread around the globe. Participants reported the highest figures in the Middle East (11 percent) with Asia (including China) representing nearly 20 percent.

EXHIBIT 21 Capital Construction Spending by Region



There was a near doubling in total capital spending recorded by the survey respondents from 2007 to 2008, even though there was only a 10 percent increase in the number respondents between the two editions of this survey. Average project size for the organization types ranged from $8.3 million to $66 million, as shown in **Exhibit 22**.

EXHIBIT 22 Average Project Size by Organization Type



CONCLUDING THOUGHTS

Innovative owners, progressive corporate boards and highly engaged capital construction teams are injecting risk management discussions routinely into their capital planning. FMI and CMAA believe this type of assertiveness is necessary across the industry and unfortunately too rare. The pace of change, design challenges and financial complexity makes the process of capital construction higher risk and more challenging even for the most sophisticated owners. As reported earlier, 30 of 32 risks presented in this study were rated with multiple "Immense" impacts indicating catastrophic or Black Swan type occurrences. Corporate boards now consider the "worst things" that could happen as a method of being engaged and monitoring the business risks.[10] CMAA and FMI are driving the industry toward this higher level of engagement. Use of a CCM professional, selection of aligned and efficient project delivery systems, and industry training in leadership and management are just three examples of how FMI/CMAA support this transformation.

More can be done and we believe successful owners will move "beyond the bell curve" in risk management of their projects. These efforts will recognize and take into account the following:

- History is less applicable today because complexity is changing the nature of the game
- The most immense and severe impacts to capital construction programs are unpredicted, one-time events
- "Black Swan" type events will take place and recognizing their range of impact is more critical than attempting to predict when they might occur
- Work to specifically avoid underestimating the impact and likelihood of improbable events and understanding the nature of more frequent risks
- Focus on the "forest" as the source of the most devastating risks while managing the "trees" which are easier to see and discuss

As you have suggestions or feedback on how CMAA and FMI might approach future research on risk management strategies, please feel free to reach out at any of the below contact points:

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[10] "Anticipating Corporate Crises: Boards Intensify Efforts to Review Risks and Dodge Disasters," Joann S. Lublin and Cari Tuna, *Wall Street Journal*, September 22, 2008

NOTES

ABOUT FMI

Founded in 1953 by Dr. Emol A. Fails, FMI provides management consulting and investment banking for the worldwide construction industry.

FMI delivers innovative, customized solutions to facility owners; contractors; construction materials producers; manufacturers and suppliers of building materials and construction equipment; property managers and developers; engineers and architects; surety companies; and industry trade associations.

FMI's experienced professionals assist owners with the development of sourcing strategy, assessing design and construction unit performance and support for management skill development. Services provided to other construction industry businesses include strategic planning, leader and organizational development, business development, research, mergers and acquisitions, peer groups, private equity placement, project execution, and training.

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