Risk Management from the Inside

Yvonne Castillo  
Victor O. Schinnerer & Company  
Chevy Chase, Maryland

Michael Cronin  
Markel Surety  
Austin, Texas

Stuart Shaw  
Black & Veatch Corporation  
Overland Park, Kansas

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I. Introduction

Anyone who has been involved with a construction project from its inception knows that the amount of careful planning, estimating, vetting, due diligence, and other preliminary work can seem endless. Yet, for all of that planning and advance work, industry participants are still often left with a substantial amount of risk to manage. This isn’t a surprise when one considers the ubiquitous risks involved in the industry, including the coordination of any number of contractors, design professionals, analysts, artisans, laborers, as well as manufacturers and suppliers, mixed in with service contracts, sales contracts, contracts that involve land, permits and a slew of variables like fluctuating cost of materials and other resources, forces of nature/weather events, ground conditions, delays, flawed estimations, and broken relationships. How does anything get built?!

These risks and many others, combined with the failure to manage them successfully, have taken a toll on the industry over the past several decades. EFCG (Environmental Financial Consulting Group, Inc.) is a consulting firm that provides strategic advice to contractors, architects and engineers and holds annual conferences for industry leaders. Of the 41 architect, engineering and construction firms who attended its inaugural CEO conference in 1997, all with revenues originally in excess of $100M, only 12 still exist (as of December 2017) and only half of those entities still have the same ownership structure. A difficult-to-believe 70% of these sizeable firms no longer exist. That is not to say that the disappearance of all of these firms occurred because they failed as a business. To the contrary, some of the companies were sold at the peak of their performance as part of a transaction driven by active succession planning with goals to expand opportunities for the entity’s employees or to reach new clients and markets; however, prior to the end of their existence as independent entities, a significant number of these firms did encounter a period of poor performance resulting from an inability to successfully manage risk.
All companies, regardless of sophistication or size, have to manage risk to stay in business. There are well-established methods employed to manage project and operational risks.

Complementing these traditional risk management techniques is the next evolution of managing risk, Enterprise Risk Management (ERM). The highest and best use of ERM is to focus on strategic risks.

Imagine, if you will, a buggy whip manufacturer at the turn of the 20th century. In managing risk, that company was likely focused on its operational risks, such as securing its leather supply chain, maintaining the quality of its product, and enhancing its distribution network, all important things to focus on. But, narrowly addressing these operational risks while ignoring the emerging existential strategic risk—what happens to a buggy whip manufacturer when all of its customers give up their
horse and buggy for an automobile?—would eventually result in the failure of the business. Below, in the context of traditional risk management techniques and ERM, we discuss operational and project risks prevalent in the construction industry as well as the bigger picture systemic risks that may significantly impact the industry.

II. What is This Thing Called Risk?

One of the most ambiguous terms in corporate speak is “risk management”. The application of the term within an organization can cover a broad array of duties and responsibilities, ranging from evaluating and managing project risks, the procurement of insurance, and managing the risk universe for a company. Before we can sort out what risk management means (let alone Enterprise Risk Management), we should first agree on a definition of “risk”. The relevant definitions of “risk” are fairly utilitarian and prosaic:

- **Merriam-Webster’s Dictionary**: 1: the possibility of loss, injury, disadvantage, or destruction; 2: someone or something that creates or suggests hazard or adverse chance: a dangerous element or factor—often used with qualifiers to indicate the degree or kind of hazard; 3a (1): the chance of a loss or the perils to the subject matter of insurance covered by a contract.

- **IRMI**: (1) Uncertainty arising from the possible occurrence of given events (2) The insured or the property to which an insurance policy relates.

- **ISO**: effect of uncertainty on objectives

- **IIA**: the possibility that an event will occur, which will impact an organization’s achievement of objectives. Risk is measured in terms of impact and likelihood.

As suggested by most of the definitions, when many of us think about risk, it has a negative connotation—a harmful, value-destroying thing that might happen in the future—and risk seems like something that should definitely be avoided. However, risk is not inherently bad or good and often provides as much opportunity for profit as it does for loss. For instance, the entire $4 trillion global insurance market exists for the sole purpose of trading upon risk. In exchange for consideration
(premium), an insurance company is willing to contractually assume an ever-evolving mélange of risks (also referred to as hazards or perils) as defined by the terms of an insurance policy.

In his 2016 report to shareholders, Warren Buffet, Chairman and CEO, refers to insurance as Berkshire Hathaway’s, “most important sector.” The “engine” of growth and success of Berkshire Hathaway over the past decades has been its property and casualty insurance business. Driven by its ubiquitous retail brand, GEICO, and its enormous reinsurance business, Berkshire Hathaway is very quietly one of the largest insurance businesses in the world and has mastered utilization of the “float”, which is a feature inherent to the business of insurance. Float is a reference to the time separating when an insurance company receives premium and pays out claims, which can be years, if not decades. Float is an opportunity for an insurance company to invest a portion of the premium received and make money.

In 2016, the amount of money attributable to insurance business float at Berkshire Hathaway was $91.6 billion (yes, billion with a “b”), and it is this enormous amount of leverage that Berkshire Hathaway takes in through its insurance operations that drives the performance of the company. For Berkshire Hathaway, risk isn’t something to be avoided, it is to be embraced, and it has been uniquely successful in the business world because it trades in risk while managing that risk well.

Now that we have established that risk isn’t inherently bad, we need to settle on a definition of risk. With due respect to University of Chicago professor and economist Frank H. Knight, who notably distinguished the two concepts, for our purposes, in the simplest of terms, risk = uncertainty. Uncertainty, well-managed, provides an opportunity for profit and growth. The goal of traditional risk management and Enterprise Risk Management is to optimize the tenuous balance between risk and reward to best position an organization to meet its strategic goals.
III. Setting the Stage: Construction Industry Risk Universe

A. Project-Based/Operational Risks

Uncertainty on construction projects is never going to be eliminated. As a result, we have learned to anticipate the common risks that are encountered, much like the driver of a car constantly anticipates the hazards on the road, to avoid the pitfalls, or at the very least, preemptively reduce and mitigate the damage when unavoidable risks comes to fruition. Though it’s difficult, perhaps impossible, to identify (let alone discuss) the multitude of risks associated with the industry in this paper, we can start with the very broad risk categories common to construction projects before discussing some of the emerging risks within the industry.

A 2011 risk mitigation study identifying the greatest risks to a successful project is still relevant today. The report was conducted by Dodge Data & Analytics (formerly known as McGraw-Hill Construction), in conjunction with Navigant Consulting, Inc. and Pepper Hamilton, LLP, and the respondents where comprised of project managers through the highest levels of architect/engineering firms, general contracting/construction management firms, and owner groups associated with the infrastructure sector of the industry.\textsuperscript{xi}

The respondents were asked what they saw as the greatest risks to a successful project, and five particular categories were identified by over 10\% of the respondents:

*Source: Dodge Data & Analytics*
As illustrated in the chart above, risks associated with *design /project changes and scope creep* was shared by most as the greatest concern at the project level. This was also by far the most popular answer given by the owner respondents, as over 27% of the owners (over a quarter of their group) placed this risk category at the top of their list. Changes on a project can have far-reaching impacts, creating delays and significant costs impacts at all levels on a project.

Interestingly, the risks associated with *budget and cost overruns* was of significant concern to the owner and design folks, though no contractor respondents listed it as a major concern. The owners’ concerns in this regard need no explanation, and the design groups are likely most concerned with this aspect because negative results from a budget and cost overrun standpoint will typically generate finger-pointing in their direction (whether justified or not) and could negatively impact their ability to secure future work. The contractors’ casual attitude as to overall project cost overruns illustrates the idea that, generally, they feel confident that they can avoid the majority of the liability associated with cost overruns and pass onto the owner, though emerging trends in the industry will likely have an impact on the contractors’ level of concern (with a growing trend to push design responsibilities onto the contractor side, and an increase in Construction Management at Risk and Design-Build delivery systems).

The *approval process* stage concerns mostly the design groups, where they are at risk of seeing a disproportionate amount of their resources dedicated to a bogged down process, or worse yet, wasted on a project that never ever makes it out of the approval process for any number of reasons; whereas the inverse is true as to *safety concerns*, where none of the architects/engineers expressed concern, but the owners and contractors each had close to 20% of their respective respondents consider safety concerns near the top of their list. Issues with safety on a construction project not only comes with the obvious concern for the well-being of the people involved, but lapses
in safety processes can result in reputation-damaging accidents and costly litigation, as well as the impacts of potential breakdowns in adherence to the government’s strict safety regulations.\textsuperscript{xvi}

Considering the fact that owners face a not-insignificant risk for differing site conditions, it’s a bit surprising that none of the owners expressed concern as to this category, while the design and contractors groups both listed it among their own concerns. The study noted that, though owners do have risk in this area, they also have the most control over how much risk to take-on as the project is developed, whereas the architects/engineers and contractors are not typically in the position to perform extensive site reviews before they must decide whether not to take on the work.\textsuperscript{xvii}

The five major risk concerns listed by the respondents reveal as much about how industry players view risk as it does about which risks concern them the most. The bulk of the listed risk categories lie within the respondents’ control\textsuperscript{xviii} (not risks associated with weather, forces of nature, market impacts, etc.), suggesting a healthy and pragmatic approach to project risks. Evoking generations of maternal wisdom . . . concern yourself more with things within your control and spend less time worrying about the things that you have no control over.

\textbf{B. Emerging Systemic Construction Industry Risks}

Technology is driving industry transformation in positive ways but the transformation isn't without risk. Recently developed technology advancements, and those coming around the bend, schizophrenically boost human efficiency and at the same time diminish certain levels of human value, which will undoubtedly impact craft labor but also licensed professional services as well. These super-charged efficiency risks deserve thoughtful consideration.

\textbf{1. The Economics of Efficiency}

Understanding the economic landscape of the recent past is a good start to understanding the risks of efficiency. For starters, from 1998 to 2013 (a 15-year period), the United States population
grew by 40 million people – more than the population in all of Canada. In that same time period, there was no new demand for labor, a staggering statistic given the fact that no decade since the Great Depression has ever dipped below a 20% increase in the number of available jobs.

According to The Brookings Institution, a review of data from 2010 to 2016 shows that while output in manufacturing increased by 10-20%, there was only a meager 2-5% increase in jobs. The 1970s brought a decoupling of productivity and wages—where productivity increases no longer led to proportionate increases in wages. For example, according to Martin Ford’s *Rise of the Robots*, a typical production worker in 2013 earned 13% less than he/she did in 1973 (adjusting for inflation) even as productivity rose in that same time period (1973 to 2013) by 107%. This, while cost of living continues to rise, results in diminishing purchasing power. According to the Pew Research Center, a review of five decades’ worth of government wage data reveals that the average hourly wage in 2014 has the same purchasing power as it did 35 years ago (adjusted for inflation). These economic trends can be attributed to a number of factors, including public policy choices and, to a certain extent, globalization; technology, however, is a particularly important driver.

2. **Technology Drivers**

In most instances, technology makes us more efficient and more productive in the workplace. This is a good thing. Getting things done faster and better with the help of technology in the design and construction industry is welcome change. Robots (including drones), for example, and 3D printing are enabling efficiencies of manufacturing and construction, which, in turn, are paving the way for “robotic building sites.” Drones are (and will increasingly continue to be) deployed on construction sites for many tasks ranging from inspections to surveys to construction management and, even, to guide autonomous bulldozers. The same goes for 3D printers. Giant (33’ x 22’) 3D printers with fast-drying concrete for ‘ink’ and mounted on rails on the construction site are being deployed to produce commercial level building components. These ‘printed’ structures can be
embedded with structural, mechanical and plumbing systems. Whole homes (2500 square feet) can be constructed within hours. This level of efficiency is astounding. As this technology becomes more prevalent and scaled for use in the commercial and institutional space, not only will craft labor demand be impacted, but demand for licensed professionals will undoubtedly begin to see the implications as well. And while design professional services will, of course, remain a necessary and important role in the process, when building and home construction can be standardized at this level of efficiency, it isn't hard to see that demand for human intelligence will be severely weakened, which in turn will likely create a new paradigm: humans (fewer of them) serving as mass machine managers at all stages of planning, design, construction, maintenance and operations.

Beyond 3D printing in construction, many design professionals use advanced technologies during the design phase to gain efficiencies. 3D Building Information Modeling (BIM), for example, helps design professionals catch clashes when integrating their architectural and engineering designs before construction commences. This 3D pre-construction use of technology helps design professionals reduce costs and aids in a smoother, faster project delivery. And, while not all design professionals have begun to optimize the use of 3D technology, most have already embraced Computer-Aided Design and Drafting (CADD). The introduction of this technology undoubtedly helped design professionals streamline old manual approaches, enabling the provision of more design detail, quicker turnaround on modifications, and a capacity for sharing and re-using – efficiencies all around.

Similarly, computational design systems, including parametric design, have given design professionals the ability to boost services for clients without necessarily more human capital. Through the use of a number of adjustable parameters in computational design, design professionals can generate multiple models for the client to consider by simply tweaking parameters within the design. This algorithmic-enabled design process offers design professionals a value-add with their
clients who want choices and want to be more engaged in the process and at a level of efficiency that could not be realized without supportive technology.

Virtual reality is another technology that enables design professionals to go a step further by giving the client the ultimate virtual experience of "occupying" the project as designed well before construction. A client experiencing the space being designed during the design process aids the designer by reducing the need to re-design. Similarly, computer-aided engineering has transformed the work of structural engineers by arming them with computer simulations that can be rigorously tested and manipulated at increasingly complex levels, not only opening up the possibilities for never-imagined-possible designs but also enabling a higher level of efficiency in production.

By utilizing these technologies, however, design professionals are and will be forever raising the bar in their delivery of services, just as every other professional is doing in their own practice when investing in technology. Is there a payback on investment? Arguably yes, because early adopters can provide an expanded portfolio of design and construction services to existing and potential clients with efficiency once the technology is mastered; that is, until the competition invests and the bar is raised yet again for more services at less cost and more efficiency. Fortunately for procrastinators in the industry, integrating new technologies into practice tends to be gradual because of upfront costs and the steep learning curve. Early adopters, however, will eventually have a significant advantage over firms that wait. Put simply by Gordon Moore, the “Moore” behind Moore’s Law, “whatever has been done, can be outdone,” so the arms race is on — like it or not; those who choose to engage now are less at risk of being displaced by other technology-using firms.

Equally important to consider are the implications that design technology offers non-design professionals and the possibility that, depending on the jurisdictional legal requirements for having a licensed professional, design professionals can be skipped altogether on certain kinds of projects no
matter the technical expertise. CADD systems such as SketchUp, Chief Architect and Matter Machine enable anyone the ability to design at sophisticated parametric levels. Competition and online community platforms for professional design services such as arcbazar, wikihouse, and paperhouses enable consumers the power to procure free design services for their projects by proposing a project that can be crowd-sourced for funding and design services that are procured through competition. Use of technology in these latter instances, while altruistic and important for addressing societal issues such as affordable housing and sustainability, may hasten an already existent political trend in professional services markets toward liberalization (i.e. de-licensure initiatives, see p. 26).

Design professionals aren’t alone by any means; all professional services are at risk of being replaced by advanced systems (i.e. machines) through artificial intelligence. Professional service firm owners, who are trying to compete with increasingly narrow profit margins, see the value of investing in a machine that can do the job without, for example, needing time off for vacation and that can also work 24/7. With the ever-increasing costs of healthcare, it’s easy to see why employers might reduce their cost structure by ‘employing’ machines over humans. Law firms, for example, are deploying AI technologies powered by IBM Watson to conduct legal research and analysis. While these technologies may not be perfect yet, the efficiencies are staggering with reports that a machine can read and process over a million legal pages in seconds. And, again, while replacement of lawyers may not happen overnight, a recent study showed that almost 25% of an attorney’s job can be replaced with robots. These estimates appear to be conservative. The study is interactive and enables readers to plug in other job titles such as architects and engineers. The output concludes for “architectural and civil drafters,” for example, that robots can’t do certain tasks that in this author’s view point are already being done by machines with limited human intervention. Blockchain is yet another technology and will be discussed in depth later in this paper.
IV. Traditional Risk Management & Enterprise Risk Management

A. Traditional risk management techniques

It is with this backdrop on construction industry risk that we discuss the management of risk in the business world. All businesses manage risk of varying degrees and complexity every day, otherwise, they wouldn’t be in business. In this section, we discuss traditional risk management techniques in the context of operational and project risk. The following traditional techniques of managing risk have developed over time and are widely recognized:

1. Avoidance
2. Contractual allocation
3. Contractual risk transfer
4. Mitigation – loss prevention
5. Mitigation – loss reduction
6. Risk dilution/diversification
7. Risk retention (self-insure)
8. Risk transfer (insurance)
9. Accept residual risk

1. Avoidance

The threshold technique of managing risk is determining whether to accept a risk or avoid it. Companies in the construction industry make strategic decisions in a number of areas. What product or service offerings will the company focus on? Will it try to be all things to all customers or narrowly focus in a niche market? In what geographies will it conduct business? Will it be a local or regional player or work in global markets? What size of projects will it work on? Smaller, high volume projects, or larger, low volume projects? Will the company take on only cost reimbursable work or will it accept lump sum, fixed-price terms? The portfolio of work a company takes on should be consistent with its risk appetite and include the type and quantity of risk that it thinks it can
successfully manage. Of course, being too conservative in taking on risk is a risk itself, and if a company isn’t willing to accept some level of risk, then it won’t stay in business.

2. **Contractual allocation**

Once a construction industry company decides what risk it is willing to take in terms of a project, the next step is to allocate the project risk among the parties involved. While it doesn’t happen all or even most of the time, ideally, allocation places the risk with the party who is best positioned to manage it. In addition to establishing key terms such as price and scope, the contract serves as the primary vehicle for allocating risk between the parties on a construction project. Some typical areas of project risks that are allocated in the contract include: (1) labor conditions, including availability and productivity, (2) fluctuating cost of materials, (3) extreme weather conditions, (4) unforeseen ground conditions, (5) performance of project equipment, (6) time, including responsibility for delays, often framed as liquidated damages (LDs), (7) care, custody and control of project equipment in transit and at the job site, (8) damage to property and injury to people, and many others. Some of these risks are retained by the parties to the prime contract, but once allocated, some risks can be passed downstream to others through contractual risk transfer.

3. **Contractual risk transfer**

Once risk is allocated between the owner and the contractor, the contractor has the ability to transfer a portion of the risk to its subcontractors, vendors and suppliers. As with contractual allocation, a guiding principle should be to place risk with the party who is in the best position to control it. Even when some risk can be transferred to others, the top line contractor is ultimately responsible for the performance of its subordinates, and it is a rare occasion when a subordinate’s failings are fully addressed by the subordinate without impact to the top line contractor. As an example, on industrial projects where performance guarantees are given, there is almost always a gap
between the top line contractor’s LD cap and overall limitation of liability with the owner and the combined limits of subordinate contracts. This is because the liability caps are typically based on a percentage of the contract value, and on a $500 million contract, the top line contractor may be exposed to delay LDs of $50 million while a large subcontractor or vendor may have liability capped at only $10 million. This “cap gap” exposes the top line contractor to liability even if the issue arises solely from the performance of the subcontractor or supplier.

4. **Mitigation – loss prevention**

Companies spend a lot of time focused on reducing the probability of the risk occurring. This risk mitigation strategy is often referred to as loss prevention. By analogy, consider the risk of fire occurring at a hotel. There are a number of things that can be done to reduce the likelihood of a fire happening. For instance, the selection of building material for the hotel—brick and mortar, glass and steel, or wood—can have a substantial impact on whether a fire occurs. The selection of materials and furnishing in the rooms is of equal importance with flame resistant selections reducing the chance of a fire occurring. The hotel could also ban smoking in its rooms and display reminders to guests so that they are more mindful of avoiding fires. All of these choices would contribute to avoiding fire risk. Similarly, companies in the construction industry develop project execution plans and utilize a host of controls to decrease the likelihood of risk resulting in an issue that will impact the project.

5. **Mitigation – loss reduction**

If the efforts of loss prevention ultimately fail, then there are steps that can be taken to minimize the impact of the loss should it occur. Continuing with our hotel fire risk example, there are a number of features that can be incorporated into the building structure or operations that offer help reduce the impact of a fire: (1) a sprinkler system installed throughout the facility, (2) smoke and fire sensing alarms, (3) readily accessible manual fire alarms, (4) firefighting equipment such as
hoses, axes and extinguishers located in common areas, (5) a fire escape plan posted on the door of each hotel room, and (6) clearly marked exits and fire safety signage on elevators. In some parts of the world, each room might also be provided with a (7) a gas mask, and (8) nightstand flashlight. None of these features will reduce the risk of a fire starting, but if it does occur, each may contribute to reduce the impact to property and hotel guests and employees. Similarly, a well-managed construction project will include a host of features intended to reduce the impact of risk. For example, a nurse is often retained and stationed on site to be in a position to immediately address worker injuries and first-aid needs. Plans are developed to respond to worker productivity issues and to access additional resources to make sure the schedule is met. Contingency is included in the project costs to pay for anticipated costs that are difficult to define.

6. **Risk dilution/diversification**

In addition to the strategic decision of whether to accept a particular risk in the first place, risk can be managed by appropriately balancing a business’s portfolio of work. Just like a person saving money for retirement and diversifying one’s investment portfolio among equities, bonds, cash, and other instruments of different degrees of risk and return, a business can strategically determine the right balance of risk in its portfolio. For instance, if a substantial portion of a construction company’s business is cost reimbursable work for clients who pay timely and this work is executed well, then it can probably afford to take on some amount of lump sum, fixed-price work, which often offers a greater level of risk and reward. Not unlike a law firm balancing hourly and contingent fee work, it is prudent for a company to assess its risk appetite and develop a portfolio of work that supports its strategic intent.
7. **Risk retention (self-insure)**

Another means of managing risk is to self-insure it, either through a captive insurance company or by simply budgeting for the anticipated losses. While many companies expend lots of time, energy and money on safety focused on eliminating injuries to its employees, experience suggests that over time, some employee injuries will occur. Instead of trading dollars with an insurance company—premium for claims paid—many companies will accept that some losses are likely to occur and will accept that risk and budget to fund the lower levels of insurance coverage in its program. For large construction or engineering and construction firms, it would not be unusual to maintain large self-insured retention (SIR) on a workers’ compensation program of $250,000 per claim. For professional liability exposures, the same companies could have SIRs of up to $25 million per claim with the very largest firms likely retaining even greater levels of risk. If this self-insured risk is managed well and losses don’t occur, then SIR can provide a significant opportunity for the company’s bottom line.

8. **Risk transfer (Insurance)**

Risk transfer, in the form of insurance, is another means of managing risk. A business’s attitude toward transferring risk is influenced by multiple factors, including the probability of loss, the potential magnitude of the loss, and the business’s ability to absorb the loss. In consideration of these factors, companies that are more averse to the risk of loss are willing to pay to transfer more risk to someone else, and this risk transfer is the business of insurance.

9. **Acceptance of residual risk**

Some risks, no matter how effectively managed, cannot be eliminated. Think of an astronaut sitting on top of a rocket ready to be propelled into space to the International Space Station. Billions
of dollars and countless hours were devoted to loss prevention, but space missions are inherently risky. If the astronaut proceeds with the mission, the residual risk has been accepted along with the potential losses. For a company in the construction industry, all of the above risk management techniques provide the means to contain risk, but some amount of residual uncertainty will always remain. This would apply, in particular, to “mega projects”, which have a collective history of challenged execution and cost overruns.

**B. Risk Management Implementation - Three lines of Defense**

Consistent with best practices, these traditional risk management techniques focused on project and operational risks are often implemented within a business utilizing the three lines of defense. In this model, responsibilities for certain aspects of risk management are clearly delineated with the organization across three separate functional lines.

The first line of defense is the business operations of the company. Managers are expected to be able to recognize risk and apply the various traditional risk management techniques to optimize the business’s approach to risk. The second line of defense is the institutionalized risk management functions within the organization. These functions are often segregated and can include: compliance, safety, information technology, risk management, enterprise risk management, finance and other such
functions responsible for oversight of different aspects of risk. These functions help ensure that the first line of defense is properly designed and is operating as intended. The third line of defense is internal audit, which provides independent assurance that the first two lines of defense are operating appropriately. All three lines of defense should exist in some form at any organization, regardless of size or complexity.

C. Enterprise Risk Management - Framework

If traditional risk management involves the management of uncertainty experienced by a company, then is Enterprise Risk Management (ERM) simply the collective whole of what a company already does to manage risk? No, it is not. ERM is its own separate paradigm, which operates in parallel with a company’s existing traditional risk management efforts. This distinction has been summarized as follows:

ERM differs from a traditional risk management approach, frequently referred to as a “silo” or “stovepipe” approach, where risks are often managed in isolation. In those environments, risks are managed by business unit leaders with minimal oversight or communication of how particular risk management responses might affect other risk aspects of the enterprise, including strategic risk. Instead, ERM seeks to strategically consider the interactive effects of various risk events with the goal of balancing an enterprise’s portfolio of risks to be within the stakeholders’ appetite for risk.

Not surprisingly, in the United States, public companies and financial institutions tend to have the most mature ERM programs because their ERM programs have been created to comply with the requirements of various statutes, regulations and rules that expressly require the management and reporting on risk. For instance, The Sarbanes-Oxley Act of 2002 (Sec. 404) requires publicly traded companies to include in their annual financial statements a report that provides an assessment by management of the effectiveness of the internal control structure and identifies any shortcomings. The New York Stock Exchange Rules place responsibility for risk oversight on the audit committee.
Among other things, the audit committee is expected to discuss a company’s major financial risk exposures and the steps being taken to manage the risk. The Securities and Exchange Commission (SEC) requires companies to disclose the board’s role in risk oversight in proxy statements. In addition, the Dodd-Frank Wall Street Reform and Consumer Protection Act requires large financial institutions to implement a board-level risk committee, and some credit rating agencies evaluate the board’s oversight of risk in their credit rating assessments. Over the past decade, companies subject to these requirements have led the way in developing an approach to risk management that is less focused on controlling acute operational and project risks, as with traditional risk management, and more focused on creating a holistic enterprise-level approach to risk intended to impact strategic decision making and place the companies in a position to reach their strategic objectives.

There are multiple standards that define the elements of a robust ERM program, but the two approaches most widely followed in the United States are:


The 2004 COSO ERM Integrated Framework was published after the adoption of the Sarbanes-Oxley Act of 2002 and expanded upon the Internal Control-Integrated Framework developed by COSO in the 1990s. ISO 31000 followed five years later. As should be evident by the relatively recent development of these frameworks, ERM is still a nascent concept that continues to develop. The 2017 Report on the Current State of Enterprise Risk Oversight (8th Ed., March 2017), published by the ERM Initiative at North Carolina State University, provides several illustrative statistics that
demonstrate ERM’s continuing evolution. Pulled from a survey of over one thousand participants who were members of the Association of International Certified Professional Accountants’ (AICPA) Business and Industry group:

- Only 28% believe their organization has a “complete formal enterprise-risk management process in place,” a finding that has not materially changed over the past five years.

- 25% describe their organization’s level of risk management maturity as “Mature” or “Robust.” Larger companies, public companies, and financial services organizations have more robust processes but still less than 50% are “mature” or “robust”).

- 34% of those surveyed do no formal assessments of emerging strategic, market, or industry risk exposures.

Both COSO and ISO provide basic frameworks to guide companies through the ERM process, but according to a 2017 survey by CEB (now Gartner), 51% of the companies surveyed had independently developed their own internal ERM framework, followed in number by programs based on COSO, and ISO 31000 bringing up the rear. Every company has unique aspects that dramatically shape its approach to managing risk and ERM, including whether the company is public or private, a financial services company, the function and make-up of its board of directors, and management’s commitment to the program. As a result, no two ERM programs are exactly alike.

While the detailed approaches of COSO and ISO do have differences, most ERM frameworks rely upon well-accepted principles to guide the management of risk through a multi-phased process:
1. **Risk Identification**

While every ERM program is unique, most will have some formal means of risk identification. An effective means of identifying risks includes a “bottom up” and a “top down” approach. The bottom up approach will typically take the form of a periodic survey sent out to a broad group of employees who are on the front line of risks. The survey will usually identify risk topics and also include input on the perceived likelihood (velocity) and the severity (impact) of the risk if the uncertainty develops into a real issue for the company. The top down approach would include interviews of the company’s top management and board to get their perception of company and industry risks. The risk universe for many companies can be measured in hundreds of items across such categories as: projects, operations, strategy, financial. The risk identification surveys and interviews will typically focus on a subset of a dozen to several dozen of the top risks. As a benchmark, there are a number of executive surveys available by subscription or publicly to help identify emerging risks.

2. **Risk Assessment**

Once the bottom up and top down risks are identified, along with the likelihood and potential severity of the impact of the risk, then the risks need to be assessed and prioritized into a listing of the company’s top risks. Risk workshops with different constituent groups are often held to interpret the data, make connections across business lines and ultimately rank the risks in order of importance. This can be a complex and challenging exercise given the nature of some of the risks. For instance in defining “talent risk”, a company may face very different challenges with the development, retention and distribution of talent depending on the line of business involved (some markets may be hot requiring greater resources while other parts of the business are over-staffed) and the various geographies in which it operates. Through the risk assessment process, a company will typically identify a half dozen to dozen risks that it chooses to focus on as part of the ERM framework.
3. **Risk Response & Mitigation**

The next step in the process is to determine how best to respond to the risks. As noted above, ERM is part of the “second line of defense”, and so it is not the role of ERM to identify and directly mitigate risk. Rather, it is the role of ERM to facilitate discussions across business lines and geographies about how the company is responding and mitigating risks and in that process, identifying what gaps might exist. One of the tools used in this process is called a “bowtie analysis”, so called because of the shape of the analysis on a page or screen.

![Bowtie Analysis](image)

In the middle (the knot of the bow tie), the risk is summarized. To the left side of the risk statement, the various causes of the risk are documented with a focus on identifying the root causes. On the other side of the knot, the possible impacts of not sufficiently managing the risk are documented. From this analysis, a mature ERM process will also develop Key Risk Indicators (KRIs) that the company should be tracking; KRIs are metrics used to provide early notice of a measurable movement in a risk exposure. It is then incumbent on the “risk owners” on the “first line of defense” to establish and implement the mitigation plans and to periodically monitor and report on the risks.
4. **Risk Monitoring**

Often easier said than done, KRI's from which to monitor risks are ideally derived from the root causes of risk that are identified as part of the bowtie analysis. Data points are sought that link the risk to the root causes and that can be tracked over time. This effort requires the input of subject matter experts who are knowledgeable about the risks. There should be one or more KRI's that are not merely numbers, as some KRI's are effective predictors but not easily measured by numbers. Thresholds need to be set for each KRI and parameters set for acceptable and unacceptable levels of risk.

5. **Risk Reporting**

The reports on risks as part of an ERM process are typically not broadly disseminated but are limited to the higher levels of the company, such as the board of directors, executive committee and perhaps a risk committee comprised of representatives throughout the company. Depending on the audience, reports on risks can be made monthly, quarterly, or in the case of a board of directors, more likely, annually or biannually. Reports can take many different forms, and dashboards showing the status of the KRI as green, yellow and red are popular, similar to the “check engine” light on a car. Green would indicate that the risk is under control and does not pose a significant threat. Yellow would indicate that there are some areas of concern. Red would indicate that there is a heightened level of concern and that the risk could pose a substantial threat.
Heat maps are also frequently used to summarize the risk profile of a company in a single graphic. On the $Y$ (vertical) axis is likelihood of the risk impacting the company and on the $X$ (horizontal) axis is an estimate of the magnitude of the impact. With the heat maps, the less likely and lowest impact risks fill the bottom left corner and the most likely and most consequential risks populate the upper right quadrant.

![Reading Heat Maps](image)

Source: CEB (now Gartner)

Another type of graphic used to summarize risk is a velocity map, envisioning certain risks as meteorites hurling towards Earth. The larger the meteorite, the bigger the impact if it strikes, and the closer the meteorite to the Earth, the greater the likelihood of a strike happening. These depictions are often used to summarize external and emerging risks that could have a major impact on the company.
ERM is a still evolving discipline, and one of the key components required for it to thrive is the existence of a risk aware culture. This starts with the board of directors and executive management of a company making a commitment to advance the management of risk in a more holistic approach. Organizations just starting out with ERM would be fortunate to identify, assess, manage, monitor and report on risks that are known to exist. Ultimately, the holy grail of a mature ERM program is to develop a process that connects the dots between risks and risk management efforts, enabling one to identify and then successfully manage risks that are unknown, but through the ERM process, are knowable.

V. Application of Traditional Risk Management and ERM to Current and Emerging Risks

A. Current trends as manifested in surety world and recognized in construction industry

The post-recession world has seen the construction industry work to rebound, and succeed to a large extent, but with the passage of time and an ever-changing world, the industry finds itself faced with operational risks in a new context.
1. Labor Shortages - Mitigation

When I grow up, I want to work in one of the most dangerous professions in the world. I want to work outside, rain, cold, or blazing hot! I want to be constantly dirty and uncomfortable, and under pressure the entire time that I am working. I want to wear heavy boots, an ugly helmet, and have lots of uncomfortable tools hanging from my belt. I really want to make fairly low wages for performing lots of physically taxing demands so that it becomes harder to perform as I get older. Most of all, I want a job where I have poor benefits and little respect from everyone else!

-Nobody, ever

The industry’s labor shortage continues to grow, and though this has long been an obvious area of risk for the construction industry, the reality is that the situation is generally regarded as nearing a crisis level today. The industry finds itself victim to a combination of several underlying factors all coming to a head at the same time, creating a very real problematic risk to the life-blood of construction; that is, of course, the people.

The great fluctuation in the industry, and the economy as a whole, seen prior to, during, and after the Great Recession, is one source of the increased risks associated with the labor pool. Though the construction industry is one of the highest performing sectors of the U.S. economy, with plenty of work and healthy backlogs, it continues to struggle to catch-up from a labor standpoint, owing in large part to the fact that it saw 1.5 million workers leave the construction workforce during the Great Recession. While the total number of employed construction workers has risen to roughly 6.8 million in this country, the industry is still well below its peak of 8 million in 2006. The number of jobs is increasing significantly on a monthly basis, with a reported 7,000 new construction jobs added in October 2017, and 187,000 (2.8%) over a 12 month period. Further, the average hourly earnings in construction have increased to $28.90, which is a 2.4% increase from the prior year. Construction work pays almost 10% more on an hourly basis than average private-sector jobs in this country (at an average of $26.36 per hour).
Despite having an annual growth rate that has nearly doubled the hiring levels in the overall economy, better pay that continues to increase, and nothing but opportunities all around, the solution to the labor problem continues to elude the construction industry. A recent industry-wide survey conducted by Autodesk and the Associated General Contractors of America found that seventy percent (70%) of U.S. construction firms reported having a hard time filling hourly craft positions, which represent a significant portion of the construction workforce. Stephen Sandherr, CEO for the Associated General Contractors, noted, "[i]n the short-term, fewer firms will be able to bid on construction projects if they are concerned they will not have enough workers to meet demand, . . . over the long-term, either construction firms will find a way to do more with fewer workers or public officials will take steps to encourage more people to pursue careers in construction."

Construction officials cite the lack of investment in a “once robust vocational education system” at the high school level, leaving most young people with no exposure or idea as to the wealth of opportunity and above-average pay in the construction industry. Sandherr advises that, “Contractors have the ‘help wanted’ signs out and are offering good pay and benefits,” and he urges that our various levels of government must work towards revitalizing and funding education programs that will educate as well as train a new generation of construction workers if the industry is ever going to right the imbalance.

Beyond the industry’s push to increase the young, emerging workforce’s exposure and access to the opportunity and possibilities within the industry (increasing and improving job training and vocational programs), insiders have employed traditional risk management techniques in attempting to address the issue and minimize its impact. Construction companies, at both the general contractor and subcontractor level, find that the premium costs associated with obtaining performance and payment bond coverage is well worth the cost considering the current state of the construction labor pool (risk transfer). They have also found that teaming up with manufacturers is an effective way to
manage the labor problem in many instances, where a manufacturer bundles their expert installation team along with the purchased products, whereby the contractor can significantly reduce their risk associated with lack of skilled laborers (mitigation – loss prevention). Companies are being more selective when they do hire key players in their labor teams, ensuring that they are hiring knowledgeable, driven folks that want a home in the industry (mitigation – loss prevention). Increases in pay and improving benefit packages are intended to both attract and retain quality labor (mitigation – loss prevention).

2. Subcontractor Default – Risk Transfer and Retention

As discussed throughout this section, the rebound in the industry has been a blessing and a curse, and no level of construction is more illustrative of this than subcontractors. The increased opportunities for work have not slowed down, and the backlog for contractors increased by 33% (measured in average number of months) between 2009 and 2015. With the labor pool spread thin, not to mention the ever increasing cost of labor and other resources (construction labor costs increase every year, regardless of the construction cycle), along with the fact that they are often undercapitalized, it’s no wonder that subcontractors are struggling to complete their work. With an abundance of work opportunities, a competitive market, and the resulting thin margins that leave little to no room for error, contractors are upping the ante, so to speak, by carrying so much work and continually increasing their risk exposure.

The recession’s impact on subcontractors who were struggling to make it through the downturn was that, for many in the industry, accepting tighter margins at the bidding level and higher costs when completing the work became the norm. With the resulting reduction in working capital post-recession, the newly acquired backlogs are essentially unmanageable for many subcontractors. Mike Bond, head of Zurich North America noted that, “... many subcontractors have not adjusted
their business models to the new margins and are carrying too much overhead to maintain their operations. Juggling tighter cash flows and labor pools in the ‘new normal’ is pushing even large subcontractors out of business.”

One of the ironic curiosities noted in the FMI/AGC joint survey examining the greatest and emerging risks faced by the industry today is that the contractors that were able to survive the extreme downturn are now facing their demise as the industry recovers... and oddly enough, as a result of the impressive recovery. As Hugh Rice, senior chairman of FMI Capital Advisors put it, “contractors don’t starve to death; they die from gluttony. They get too much work, too fast, with inadequate resources, and they get into financial trouble and run out of cash.”

Owners and general contractors have used surety-issued contract payment and performance bonds to help control the risk associated with subcontractors’ deficiencies and potential for overreaching, mismanaging debt, and potential that any one poorly estimated or managed project (with little to no margin) can put the subcontractor out of business and create a big looming hole in a particular project. Besides the direct benefit of payment claims coverage, relieving a general contractor (or owner, in the event of a prime contract) and the project from having downstream debt tie everything up, and the guarantee of performance in the event of default, a subcontractor – surety relationship helps manage risk in other ways. A surety will extend surety credit to a contractor only after a thorough review of the contractor’s financials, references and history, and after establishing the Three C’s (Character, Capacity, and Capital). With its own risk for exposure on the line when it issues bonds, a surety will often engage an accountant to ensure that the contractor has established good internal controls, that it is hiring good people, reporting job profitability and work-in-progress on a timely basis, and making good decisions as to which jobs make good sense to submit bids. At the end of the day, a surety can always decline to issue a final bond if the contractor and the surety
can’t see eye-to-eye. All of the above helps by acting as another mechanism to help balance and mitigate overall risk in the industry.

Subcontractor Default Insurance (“SDI”) is another tool that has emerged as an alternative to performance bonds. Cost increases in the bond market along with frustration with the surety review and investigation process that can be perceived as time-consuming and burdensome, have led some general contractors to use SDI to manage subcontractor risk on projects. The contractors using SDI tend to be very large due to high deductibles/self-insured retention, which makes it cost prohibitive for smaller contractors, despite the lower premium costs. SDI policies essentially insure the general contractor against the risk of subcontractor defaults, and reimburse the general contractor for losses resulting from a subcontractor default. In this arrangement, the general contractor has the task of prequalifying the subcontractor that will be placed under the policy (rather than having a surety prequalify subcontractors that it bonds). Larger general contractors that choose SDI like that they can expeditiously remedy the default, rather than waiting for the surety to do so. The large deductibles/SIR also provide an opportunity for profit if the selection and performance of the subcontractors is well-managed.

3. **Risk Allocation and Contractual Risk Transfer**

Another emerging source of risk in the industry can be seen where owners have continued to push the risk downstream to contractors. Contractors must now contend with risk-shifting contractual clauses that have emerged, such as “No Damage for Delay” clauses (“NDFD”), and “Differing Site Condition” clauses, both which seek to place the risk often encountered in executing a construction contract, and the resulting damages that affect the bottom line, on the contractor.

In an effort to subvert the general rule that a contractor is entitled to recover damages for losses due to delay upstream, owners began inserting NDFD clauses wherein the contractor waived
its right to recover damages from the owner for such delay. Jurisdictions are split, but the majority of courts enforce these exculpatory clauses, though many recognize exceptions. The Texas Supreme Court, for example, identified that NDFD clauses will be enforced unless any of five exceptions applied, and the battle with regard to who will ultimately bear the risk is typically fought in the contract drafting process to help reduce the likelihood of creating an exception by poor drafting language. Generally speaking, so long as the language is clear and unambiguous, the courts will enforce these risk shifting clauses.

Similarly, “Differing Site Condition” clauses are fairly standard clauses found in construction contracts and an area that owners have used to their advantage in shifting risk to contractor. The risk of encountering differing site conditions in the field (subsequent to execution of the contract) is nearly certain, at least to some degree, and largely unavoidable (nature of the beast); so the real issue is, who bears the liability for resulting additional costs.

One of the older clauses found in construction contracts, the clause was first used in the 1920’s by the US Federal government as a way to shift the risk of latent site conditions from the contractor to the owner, with the ultimate goal of encouraging bidding contractors to reduce the additional costs being included in their bids as contingency to account for concerns such as differing site conditions encountered during execution of the work. The clause was meant to allow for compensating a contractor for additional time and cost if/when that contractor encountered a, “materially different condition,” while performing the work. The irony of this clause is that over the course of time, and through a series of court decisions, the clause has actually increased contractors’ allocation of the risk as it relates to differing site conditions. Owners’ use of disclaimers (“we have provided a geotech report, though we make no representations and deny responsibility for its accuracy”), site investigation clauses, and notice of non-incorporation of drawings, site reports, etc.
(not part of the contract) among other drafting tools, have worked in conjunction with years of case law interpretation to gradually narrow the coverage of the clause as a benefit to the contractor.

In managing this type of risk, contractors must be prepared to recognize onerous differing site condition clauses and, if unable to negotiate the clause to a mutually beneficial clause, the contractors must be diligent in knowing and documenting the conditions (as well as an accounting of all impacts and additional work) and adhering to the strict claims processes often used by owners, so as not to waive their rights to recovery for additional compensation (mitigation – loss prevention and mitigation – loss reduction). Diligent contractors also conduct reasonable site inspections prior to bidding a project, to the extent they are able, and document well. If the risk associated with the site conditions can’t be fully vetted and managed, in some cases, the contractor will be much better off to avoid the project altogether (avoidance) instead of assuming risk that can evolve into a nearly bottomless pit in need of remediation.

4. **Implied Warranty**

One hot topic in the industry as it relates to owner risk shifting is the issue of who bears the risk and ultimate liability for defective design on a construction project. The answer has obvious implications for those assessing the risks on construction projects. The majority rule was established long ago, in 1918, when the US Supreme Court ruled in *U.S. vs. Spearin* the owner bears such risk, which makes good sense when you consider that a contractor may not design or engineer a project without a license to do so, and the owner generally retains the design team on a project. There are certain jurisdictions, though, where this rule does not carry the day, as well as other nuanced, emerging exceptions.

One example where Spearin does not apply is in the State of Texas, where the Texas Supreme Court’s ruling in *Lonergan v. San Antonio Loan & Trust Co.* and later clarified the same rule in
2012 in *El Paso Field Servs. L.P. v. MasTec N. Am.*\(^{lviii}\), that the contractor, in fact, bears the risk of defective design where the contract remains silent on the issue.\(^{lix}\) Texas Law is now inconsistent with the majority rule, creating a fairly common misconception in the state’s construction industry that a contractor is not liable for design issues, absent contractual guarantees by the owner . . . thus creating a bit of a trap for unwary contractors.\(^{lx}\)

The obvious lesson in the minority jurisdictions’ decisions is that contract review and drafting is paramount to properly allocating the risk. Contractors must avoid assumption of risk language of any kind, and clearly provide for an implication, if not stronger language, that the owner guaranties sufficiency of specifications. Best practices dictate as thorough a review of the contract to negotiate out clauses that might bar claims for insufficient specifications and plans for items such as subsurface conditions, as well as clauses such as site investigation requirements that can be construed as an acknowledgment of insufficient plans (contractual allocation). Also, best practices of documentation during all phases of a project where owner, architect, or engineer involvement (or better yet, interference) exists can aid a contractor in arguing against ownership of liability associated with insufficient plans.

5. **Design-Build and Construction Management at Risk**

Settling back into the majority-world, where *Spearin* is the rule, emerging project delivery methods like design-build and Construction Management at Risk (“CMR”) are often an exception, much to the comfort of project owners. A carefully drafted contract that that includes only a performance specification will typically be construed as a situation where the design liabilities rest with the design-builder.\(^{lxi}\) Additionally, disclaimers that are specific and narrowly-tailored will excuse the owner from the design liability, such as a contract that contains a waiver that expressly states that the contractor has no claim if it encounters site conditions that are different from the RFP.
Also, courts have been unwilling to enforce the Spearin doctrine where specifications are incomplete or unclear, which in a design-build or CMR scenario would seem to indicate the contractor discretion that lends itself towards the contractor assuming the risk for design. Conversely, owners, try as they may to shift the risk, can also “cut off their nose to spite their face” when they get too involved after a design-builder has taken control of the project. A hands-on owner will cause the pendulum to swing back, placing the risk of design on its side of contract.

Like the other contractual allocation of risk concerns discussed above, contractors must be diligent in contract review and drafting to reduce the risk associated with design, though it’s more difficult to avoid in the design-build/CMR context where the contractor has assumed more of this risk by the very nature of the system.

B. Enterprise-Level Strategic Risk: The Next Wave of Efficiency — Blockchain

Much of what businesses do to manage risk is focused on operational risks. This is validated by the 2014 analysis of Corporate Executive Board (CEB, now Gartner), indicating that 42% of executive time spent on managing risk relates to operational issues.
CEB’s study also indicates that the time devoted to managing operational risk may not be the best use of time, as operational risk only accounted for a 9% impact on the value of the companies studied. Contrast that to strategic business risk, which accounted for 86% of the market declines in value, while executive management only devoted 6% of its time focusing on strategic business risk. Again, query whether a turn of the 20th century buggy whip manufacturer would have been better off spending time focused on its operational risks (supply chain, quality, and markets) or on strategy (how it would respond to the invention of the automobile and the virtual elimination of its market).

We discussed technology advancements earlier in this paper and the risks that super-charged efficiencies could pose from these advancements. A technological advancement that deserves deeper consideration and strategic analysis because of its expansive risk implications on markets is called blockchain. It has an enormous potential to disrupt the foundation of the global economy because it enables secured, un-hackable transactions. In fact, many experts say that blockchain technology can be compared to "what the internet was in the 1990's"; it is still in a nascent development stage but is a very important development for businesses to watch. In a CEB Q3 2017 emerging risk survey, blockchain was identified as the second highest-velocity emerging risk, though its impact is still difficult to estimate.
Consider this: among the 7 billion occupants on Earth, we collectively make $100 trillion in transactions a year and we do so through ‘manufactured’ trust with the help of middlemen such as banks, credit reporting agencies, lawyers, title companies, brokers, etc. who assist in verifying transactions for us over the internet. Blockchain ledgers could evolve to be an epic upgrade to this current way of doing things.

1. **Understanding the Technology**

On a blockchain, every record of a transaction has a unique cryptographic key and every record is time stamped. All subsequent records related to the asset in the original transaction include everything from the first record, including the cryptographic keys and timestamping. The same thing happens for the 3rd transaction related to that asset, the first and second record and cryptographic keys are included, *ad infinitum*. All of the records are chained together, hence the name blockchain. The
architecture of this technology has built-in trust and underpins the capacity for peer to peer
transactions without the need for institutional intermediaries. It is also the most secure architecture
for online transactions to date that has yet to be hacked, despite being in existence since 2009. (Please
note, this is not to be confused with a number of hacking incidents impacting cyber currency
exchanges.)

Think of blockchain as a global, time-stamped ledger for all transactions for anything of value
(goods/services/information). It might be helpful to imagine blockchain as a train track between
parties who wish to transact or share information. On the train track is a car that represents a digital
token, which could be a cyber currency such as Bitcoin or ether, or any number of digital tokens in
existence. Attached to the car (digital token) is money or the asset being transacted. When the car
moves across the track and the transaction is complete, it is processed and validated using algorithms
through a decentralized network of participants, rather than being validated or processed by an
intermediary, such as a bank. Once the transaction is validated, it’s locked and stored as a block on a
decentralized network of participant-nodes that are timestamped every 10 minutes and cannot be
altered because they are not stored in one place and are linked to other related blocks of transactions.
Every participant to the transaction maintains a copy of the transaction on a shared ledger so it’s
stored in all participant-nodes across the network (i.e. decentralized servers). Anyone who tries to
tamper with blocks of information that have been time-stamped, and linked in the chain will be
recognized by consensus of the participant nodes as inconsistent and rejected.

To understand further how secure this architecture is, imagine the scenario of a burglar trying
to break into a home where the security system and keys for the home are tied to the entire
neighborhood. A burglar trying to break into a home must overcome a security system that’s tied to
the entire neighborhood, making it much more difficult to do. In the simplest terms, blockchain is
about taking a centralized paradigm of siloed data--that is currently being secured through expensive
firewalls--and turning that paradigm on its head with blockchain, which breaks the silo down so that
the information/data lives in many different servers across a network. Hackers who might try to
break into one server won’t get very far because the system is secured in multiple time-stamped
blocks on the blockchain.

2. Blockchain Use Cases

i. Legal/Accounting/Insurance

One interesting use-case of blockchain technology is the smart contract, a self-enforcing
contract where terms of the contract are automated and triggered by agreed-upon events. Because the
contract is stored on the blockchain, it’s fully auditable with time stamps for future reference. The
architecture of blockchain would prevent any parties to the contract from changing terms without
everyone being advised and agreeing to proposed changes. The impact these contracts will have on
the legal profession and other 3rd party intermediaries, such as banks, insurance companies, and
accountants, are still unknown but it's not hard to imagine that the utilization of smart contracts could
significantly reduce disputes and, therefore, lessen the need for litigation. Lawyers, on the other
hand, who understand coding could expect to have a significant lift in business.

ii. Healthcare

Another interesting use-case for blockchain is what the healthcare industry would call
“longitudinal health records.” Currently, health recordation is a siloed process and most of us have
suffered from the inefficiencies. Every time a patient is treated, the patient must fill out paperwork
before being seen by the doctor. That paperwork becomes a record that ‘lives’ in the computer
system of the physical facility where the patient is treated. It’s siloed not only from other treatment
providers in the same physical facility, but also from treatment providers in other treatment facilities
– everyone has a different system and the only way a patient can access and share that information
with other treatment providers is through an arduous process of contacting the provider, granting
permission, and oftentimes manually sharing hard copies of records; integration of records does not occur.

These inefficiencies will change with blockchain and is referred to as the ‘womb to tomb’ recordkeeping solution. From the moment a baby is born, the birth is recorded on the blockchain. Any and all treatment the baby has for life will be recorded in the same place in the patient's digital record with the patient authorizing access to 'the record' by treatment providers through cryptographic keys. In other words, the patient, in this example, has full control and ownership over his/her record and will always have one place to store all treatment for life. It is easy to see that the benefits for holistic care could be enormous. And, gone may be the days where a patient is forced to fill out medical history paperwork and doctors have to rely on inaccurate memories to treat patients holistically. This same secure and immutable record-keeping could exist for capital assets (see discussion below).

iii. Energy

Blockchain, coupled with renewable energy, is providing yet another informative use-case. As an important backdrop, it is important to appreciate the energy transformation trend separate and apart from blockchain, that is, the movement away from a centralized paradigm of energy generation coming from large, far-off power plants to one where generation comes from decentralized consumer-based 'power nodes' all over of the grid in cities and neighborhoods through roof-top solar. With this shift, an interesting challenge has arisen. What happens when there's excess production and no use for it by the consumer who produces it? Blockchain technology is providing consumers the ability to share the excess energy with neighbors directly, without any intermediaries such as a utility, and monetize that value. The blockchain serves, in this instance, as a platform that enables real-time analysis of supply and demand across a microgrid. By doing this, peer-to-peer transactions can
happen seamlessly – one neighbor can sell excess energy to another neighbor. While energy storage will increasingly become part of the solution, blockchain technology is being deployed now and is enabling a brand new democratized and decentralized paradigm in the energy service sector. A great example of this use-case is being tested in the Brooklyn Microgrid Project where members of the community are now buying and selling energy through a blockchain platform. This shift begs the question: how will society (individual, private companies and public entities) react to the value-add notion that when purchasing a home, building or structure, they are also purchasing the energy production capacity as well? In other words, why would I buy a home or building that doesn’t monetize its energy production? And what are the implications for design and construction professionals moving forward? As this model evolves and grows, the knowledge expectation and ability to deliver will also grow.

iv. Governments

Governments are also seeing the value of blockchain. Many state governments have flagged blockchain as a priority issue and in May 2017 issued a report calling it the “next big transformational technology in government.” Tracking records (corporate, health, land, voting, or licenses for example), filings, procurement procedures, to name a few, are the types of use-cases being explored. The National Association of State Chief Information Officers described the blockchain potential as “a new and growing capability for creating, recording, and verifying transactions instantaneously using a decentralized autonomous logic.” Illinois and Delaware appear to be taking the lead in the US with formally launched initiatives. Countries across the globe are also heavily engaged in testing blockchain’s use—Estonia, Georgia, Sweden, Dubai, and China appear to be heavily investing. As governments move forward with their own blockchain initiatives and become more conversant in the technology, it would be no surprise to see the technology being used to streamline procurement of services, including legal and design/construction services. Think of the inefficiencies that exist today
and the siloed processes. All of that could change with technology that enables security, immutability and efficiency.

v. Design and Construction

The design and construction industry is, by all accounts, one of the most disaggregated industries known, due the complexity of its processes, enormous scale of players, and the coordination to complete tasks/responsibilities in order to advance the transaction to each sequential phase. There are numerous stakeholders and participants, layers of procedures at varying phases of delivery, and an abundance of laws and risks related to workers, protecting the environment and protecting the public. Siloed procedures, disconnected work flows, and inconsistent information-sharing offer inefficiencies at every turn.

Blockchain could change all of this in a number of ways, some of which may be forced on the industry from the edges as described above. When exactly will smart contracts begin to be used in construction? As of the writing of this paper, it’s not known but, no doubt, it’s coming. Just as governments began requiring BIM 3D modeling in their procurement contracts a decade ago, governments will progressively gain a better working knowledge of blockchain, and as they do, the design and construction industry will likely see the imposition of its use vis a vis permitting and procurement procedures for starters. Likewise, as blockchain use becomes more accepted in the energy space, owners of homes, buildings and structures will expect a similar competency level from their design and construction professionals.

While external forces may drive the design and construction industry into blockchain integration, innovators from within who want to maximize project management may prompt its use. Recall that blockchain connects systems. Imagine a project where the design and construction technology platform, say BIM 3D, speaks directly to the payment system (accounting software) being
used, and the contract system (the smart contract) that governs the responsibilities and expectations. When all systems live in one place on a project and ‘speak’ to each other, not only are work flows that sequence constructability in one place, but embedded together within this system are automated payments to all parties, including necessary government fees/permits, which could be coded to trigger subsequent work flows as well as self-enforcing contract terms and conditions. It seems implausible at the moment and akin to science fiction, no doubt, but so have we been surprised by many other recent technology adoptions in society today. Everyone in the design and construction industry feels the pain of inefficiency in project delivery. Blockchain *perhaps* has a place in this space.

Another possible use case could be envisioned by recalling the health care use-case above regarding longitudinal healthcare records. Longitudinal facility 'life cycle' records from construction through operations to decommissioning and re-construction could exist on a blockchain, taking the mystery out of historical maintenance records and providing a platform for *more informed* future investments and modifications.

Materials transparency is another area where blockchain may provide the ultimate solution. Imagine this. Companies that develop construction products would have associated QR codes for each product that can be scanned by phone so that purchasers of the product can know where the product originated from the raw material through manufacturing and transport. Every transaction that occurred on the supply chain is recorded on the blockchain. When buyers have a choice of purchasing a product that says it's "sustainable" but there's no documented transaction history, how does the consumer know that it's really sustainable? One has to trust. With blockchain, the consumer will *know*. 
C. ERM Approach: Blockchain

Blockchain is still a nascent risk that could fundamentally change the way business is conducted by many industries. Except for financial services companies where its use is being actively and widely explored, it is unlikely that blockchain would make a list of top 10 risks at a company during the risk identification and assessment exercises discussed above. Blockchain is also an external risk, and its development isn’t going to be materially impacted by the actions of a single company. Many companies will simply ignore this risk and not respond to it unless its development has a tangible and material impact on the organization. But, ERM does offer the framework to take a more proactive approach, which could provide a company with a strategic advantage in responding to the rise of blockchain adoptions earlier than its competitors.

As referenced above, a tool that can assist in better defining, evaluating and monitoring the risk is the bowtie analysis, which looks like this:

![Bowtie Analysis Diagram]

1. Risk Statement

To conduct the bowtie analysis, the first step is to define the risk in a succinct way. Depending on the acuteness and maturity of the risk, the risk statement can get fairly specific. In the case of blockchain, it is still a somewhat diffuse concept but over the long term has the potential to acutely impact business perhaps in ways likely not yet imagined. As a result, the description of the risk statement is better left as a more generalized and broader statement, such as this:
2. **Cause**

Once the risk is defined, the next step is to identify the root causes of the risk with this input placed to the left of the bowtie “knot”. In the case of blockchain, its development is enabled by continued technological advancements, the quick pace of adoptions, the need to transact business via the internet, and consequential need for cybersecurity. To remain competitive, companies have a continuing need to:

- Increase efficiency in processes
- Transact electronically without compromising confidential information
- Maintain control and quality of digital data and digital assets
- Optimize collaborative models through data-sharing
- Maintain transparency for financial reporting/auditing, including materials transparency
- Protect against intellectual property infringement/promote due compensation for using intellectual property
- Enable internet of things to connect
Additionally, through the rise of E-Bay, Amazon and the sharing economy, peer-to-peer transactions are becoming more prevalent at a time when faith in traditional governmental and financial institutions is waning. Cyber security, which would have been on few company’s top ten risks a decade ago, is now the focus of attention in board rooms, which pushes towards a more secure way of conducting business. Putting these concepts in the form of the bowtie analysis looks like this:
3. **Potential Impacts**

At this point in time, the potential impacts of blockchain remain somewhat speculative, but the theme of efficiency runs throughout. If blockchain evolves and eliminates the middlemen on peer-to-peer transactions, fewer resources in the form of human labor will be needed to conduct business but a greater investment in the technology and systems that enables blockchain models will be required. If the promise of blockchain comes to fruition, there will be fewer disputes arising from self-enforcing contracts and transactions that are immutable and secure. Businesses that have not invested in the approach will be less competitive, and there are likely a host of other effects of blockchain’s rise that are as inconceivable decades ago as the societal impact that the world wide web, mobile phones and social media have had.

**Cause**
- Increase efficiency in processes
- Technological developments enable the internet of things
- Need to transact electronically without compromising confidential information
- Optimize collaborative models through data-sharing
- Increasing acceptance of peer to peer transactions
- Maintain transparency for financial reporting/auditing
- Societal changes, including diminishing trust in governmental institutions
- Cyber security threats and security concerns increase the demand for immutable and unhackable transactions

**Effect**
- Business is conducted more efficiently, requiring fewer labor resources and more technological investment
- Fewer resources are required to perform the same amount of work
- Fewer disputes arise by using self-enforcing contracts and more secure transactions
- Businesses who have not invested in technology and processes to adjust to the new blockchain business model are at a competitive disadvantage
- New ways of conducting business emerge, as yet, unimagined, causing significant disruption

**Key Risk Indicators**

**Mitigation Plans**
4. Key Risk Indicators

When will we know if we have reached the tipping point with blockchain? Certainly Key Risk Indicators (KRIs) could play a role in providing advance notice. As a still-emerging risk, there aren’t well established metrics to track blockchain, but there are some metrics that could provide some insight. First, Bitcoin, ether and other crypto currencies are on the front line of the development of blockchain and the most tangible and measurable examples of its use. The value of Bitcoin has been mercurial and has fluctuated wildly in value over the past several years. Continuing to monitor the value of a single cyber currency unit along with the cyber currency market as a whole, and their stability as a currency would be a KRI that targets the success of the blockchain model; this should be a leading indicator of whether its use will expand outside of the financial markets. Government action to regulate crypto currencies will also provide some indication of its acceptance and its ability to exist as a decentralized means of transacting business outside of the reach of traditional governmental and other institutions. One could also monitor the areas of least resistance for future expansion of blockchain to non-finance industries, such as maintenance of medical records. Finally, more specific to the construction industry, blockchain’s rise is likely not going to be driven by construction companies but by project owners, so monitoring its use in public construction projects should be a leading indicator of a more wide-spread adoption.
5. **Mitigation Plans**

Design professionals, construction laborers, construction managers and construction lawyers are all at risk of being displaced in certain degrees by technology adoptions – the efficiency risk is everywhere. What mitigation steps can be taken now to remain resilient with the technological challenges that lie ahead? Plan for worst-case scenarios so that you can stress-test your business model. Assume that technology advancements will continue to streamline work flows, especially in
areas where technology is already making significant headway. Assume that industry sectors such as energy, government and healthcare will move forward with blockchain platforms. A business should analyze technology options and prioritize the investment needed to adopt the most meaningful platforms for optimal service delivery.

Technology adoption waves will peak and plummet at varying degrees and differently within varying industry sectors. A business should focus on which trend will help deliver meaningful value to clients. Research, prioritize, and strategize at the leadership level with diverse generational input to determine which technology platform will deliver the most meaningful value to your clients. After robust deliberation, pick one that makes the biggest impact on your operational costs and service delivery. Plan the deployment with deliberate short-term and long-term goals, and discipline your firm’s leadership to check-in quarterly to assess progress, lessons learned through a robust communication platform for firm-wide discussions (electronically and in person) to institutionalize best practices.

A business should challenge itself to think about technology this way: “As an employee of an organization, if someone else can be trained to do my job, then a machine can also be trained to do my job, so I’m at risk.” Remaining awake to this concept is critical to planning for the future and managing the associated risks. By being aware of these risks and setting aside long-held presumptions that licensure and regulatory environments have had in protecting professional service firms from encroachment from unlicensed populations, firms will be able to take deeper dives into the essence of their services and new expanded ways of delivering value for clients.
You can’t predict the future but you can reasonably expect that the future will look different than today. Knowing this with a high degree of certainty, a company should ask itself: do I want to shape that future or simply be shaped by it? By pioneering the future of your industry beyond its own walls, a company will have the best chance to remain a viable and relevant service provider.
NOTE 1 An effect is a deviation from the expected—positive and/or negative.
NOTE 2 Objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and processes).
NOTE 3 Risk is often characterized by reference to potential events (2.17) and consequences (2.18), or a combination of these.
NOTE 4 Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood (2.19) of occurrence.
NOTE 5 Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood.

Knight asserted for the first time that risk and uncertainty are distinguishable; “risk” is measurable and “uncertainty” is not measurable. Knight’s view has merit, and this concept is a cornerstone of the insurance industry where insurable perils can be measured, priced, and transferred; however, in the practical real-world application of risk management, where a company may routinely face literally hundreds of identifiable bits of uncertainty with limited resources available to quantify and manage them, it is often a distinction without a difference.

Risk Uncertainty and Profit, Frank H. Knight, 2014 reprint of 1921 edition: "Uncertainty must be taken in a sense radically distinct from the familiar notion of Risk, from which it has never been properly separated. The essential fact is that 'risk' means in some cases a quantity susceptible of measurement, while at other times it is something distinctly not of this character; and there are far-reaching and crucial differences in the bearings of the phenomena depending on which of the two is really present and operating....It will appear that a measurable uncertainty, or 'risk' proper, as we shall use the term, is so far different from an unmeasurable one that it is not in effect an uncertainty at all."

xvi *Id.*
xvii *Id.*
xviii *Id.*
xx *Id.* page 10.
xxi *Id.*, Page 11.
xxii *Id.*, referenced as “ignore”
xxiv *Id.*, page 4
xxv *Id.*, page 7
xxvii COSO, ISO 3100, COBIT, ANZ 4360, NIST are all frameworks addressing risk
xxviii CEB (now Gartner), State of the ERM Function: Key Benchmarks and Findings from the 2017 Survey, Page 37
xxix Risk Reporting & Key Risk Indicators: A Case Study Analysis, page 4 (Boyd, Moolman and Nwosu)
xxx *Id.*, page 5
xxxi *Id.*
xxxii *Id.*, page 12
xxxvii Association of General Contractors, Construction Data-Employment, “CONSTRUCTION INDUSTRY ADDS 6,000 JOBS IN JULY AND 191,000 OVER 12 MONTHS; ANNUAL GROWTH RATE IS NEARLY DOUBLE THE HIRING PACE IN OVERALL ECONOMY, August 4, 2017.
xxxviii *Id.*
xxxx Association of General Contractors Survey, “SEVENTY-PERCENT OF CONTRACTORS HAVE A HARD TIME FINDING QUALIFIED CRAFT WORKERS TO HIRE AMID GROWING CONSTRUCTION DEMAND, NATIONAL SURVEY FINDS, August 29, 2017
x *Id.*
xxi Association of General Contractors, Construction Data-Employment, “CONSTRUCTION INDUSTRY ADDS 6,000 JOBS IN JULY AND 191,000 OVER 12 MONTHS; ANNUAL GROWTH RATE IS NEARLY DOUBLE THE HIRING PACE IN OVERALL ECONOMY, August 4, 2017.
FMI Corporation, June, 2016. Managing and Mitigating Subcontractor Default Risks. FMI Quarterly

Id.


Id.


Id.

Id.

Id at 38.

Id.

248 U.S.132 (1918).

104 S.W. 1091 (Tex. 1907).

389 S.W.3d 802 (Tex. 2012).

Id.

Amy K. Wolfshohl, Never Can Say Goodbye: Lonergan Reaffirmed by Texas Supreme Court 100 Years later, 28th Annual Construction Law Conference, 2015.


Id at 9

Id. At 10.

Id

Corporate Executive Board (now Gartner), Q3 2017 Emerging Risks Survey