

Enterprise Risk Management in the Engineering and Construction Industry¹

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Introduction

The focus of this paper is to look at enterprise risks and their management in the engineering and construction (E&C) industry. The E&C industry has lagged many other sectors in the adoption of strong enterprise risk management systems and processes and many of those that have been put in place fail to recognize the features which make this industry unique. The industry's approach to date has in many ways been superficial (especially true for many of the publicly traded firms) that seem to be going through the motions to satisfy public markets.

The uniqueness of the engineering and construction industry challenge arises from the project nature of the industry and the firms operating in it. It is fundamental to the Enterprise Risk Management challenge that the industry faces. This project nature is contrasted with the continuous operational nature of many of the early adopters of enterprise risk management with a standard suite of projects and services. Engineering and construction faces an ever changing suite of enterprise risks as the characteristics and circumstances change within its portfolio of projects.

What is Enterprise Risk Management (ERM)?

Enterprise risk management encompasses the processes, systems, strategies, and tactics to manage the totality of risks and opportunities that a business faces across the entirety of the organization and its portfolio. ERM is focused on assuring that the enterprise can achieve the strategic business outcomes² it has set for itself within its selected risk appetite.

This portfolio view is important in distinguishing ERM from risk management within key functional and organizational elements. In essence it subsumes all lower tier risk management strategies into a broader, all-encompassing one at the highest enterprise level. Management, often including the board of directors, utilize the ERM process for

¹ How to cite this paper: Prieto, R. (2022). Enterprise Risk Management in the Engineering and Construction Industry, *PM World Journal*, Vol. XI, Issue V, May.

“identifying, analyzing, responding to, and monitoring risks and opportunities, within the internal and external environment facing the enterprise”³.

Top level enterprise risk strategies are developed within the bounds of the risk appetite that has been established for the organization and often consider several potential scenarios as part of the development of enterprise risk management and mitigation strategies.

Risk Appetite

The types and amount of risk, on a broad level, an organization is willing to accept in pursuit of value.

- COSO - Committee of Sponsoring Organizations of the Treadway Commission

Why is ERM important?

ERM’s primary focus is to support the organization in its achievement of the strategic business outcomes it has established. Increasingly, enterprise risk management has become a focus area for investors and financial regulators, with the risk scope of interest expanding. This financial and regulatory focus is not limited to publicly traded corporations with larger private companies increasingly being required to meet comparable standards and disclosure requirements.

The importance of ERM to the E&C industry is exemplified by recent losses suffered by major contractors and their subsequent withdrawal from “risk work”. Many have suffered project losses that have put their entire enterprise at risk.

Current State of ERM in the E&C industry

ERM in the E&C industry has lagged other industries due to several factors including the small fraction of work carried out by publicly traded firms; the bespoke nature of commercial arrangements and supply chain; and unique risk factors that are not present in other industries.

ERM is a board level focus in more of the sector with each passing day but suffers from an inadequate understanding of the industry and its risks by traditional audit firms which are often the drivers for greater risk disclosures in financial statements. There are positive

³ Wikipedia, Enterprise Risk Management

signs that a shift is underway from treating ERM as an isolated function to a more integrated management tool.

Later in this paper we highlight one particular weakness in industry enterprise risk assessments with respect to the aggregation, modeling, and mitigation of project level risks.

Classifying enterprise risk

One of the first steps in classifying enterprise risks is to put in place a common risk language. This must reflect industry norms as well as those aspects of the business which are unique to the enterprise or the subsector in which it operates. There are many lists of enterprise risks available but for purposes of this paper we will define them as including:

- Culture, control, and integrity risks
- Strategy risks
- Human resource risks
- Operating risks
- Supply chain risks
- Environmental, social and governance (ESG) risks
- Information security

Culture, control, and integrity risks

All engineering and construction companies strive to develop well defined and recognized corporate cultures, built on a definable vision and documented in a mission statement. These cultures act to define who the corporation is, what it is trying to achieve and how it conducts its business. Culture speaks to shared values within the organization and provides a foundation that facilitates the management of all risks faced by the company and the development of organizational trust⁴. The sustenance and strength of a company's culture is essential, and the monitoring of culture includes measuring understanding, alignment, and employee perceptions and sentiment around culture. Understanding changes to culture or its perception are important to overall enterprise risk management, and all too often are lost as sub elements of human resource risks.

Management effectiveness measures the degree of control the organization is exhibiting in the achievement of its strategic business outcomes and the delivery of current period performance. While many measures track operational results, control risks speak to conformance with established processes and procedures especially those related to the risk management system. Failing to comply is a missed opportunity. Are all required

⁴ Prieto, R. (2022). The Role of Trust in Projects. *PM World Journal*, Vol. XI, Issue I, January.

<https://pmworldlibrary.net/wp-content/uploads/2022/01/pmwj113-Jan2022-Prieto-Role-of-trust-in-projects.pdf>

approvals being obtained in a timely manner? Has the overall risk portfolio been considered as we pursue and capture new opportunities or are we overly concentrating risks (client, market, geography, contract type). Are all risk management processes being conformed to and appropriately documented? Are the root causes of risks encountered understood and any enterprise level risk impacts considered? Have we reassessed the effectiveness of any risk mitigation strategies we put in place to address the risk?

Integrity risks in many ways speak to culture but also explicitly as to whether the organization can be trusted. Does the enterprise conduct its business in a lawful and socially responsible manner? Social responsibility is discussed with respect to ESG risks later in this paper. Legal risks include a wide range of traditional corporate legal requirements and norms and are not repeated here. The engineering and construction industry, however, suffers from a serious corruption⁵ challenge and the enterprise risk management system must be diligent to prevent materialization of these risks and at an enterprise level track potential red flag behaviors. Potential red flag behaviors to be considered in the aggregate at an enterprise level are shown in Table 1.

Table 1
Red Flags - Potential signs of corruption in construction
Goods or services in excess of project requirements or not required by the project.
Poor quality goods or services compensated at normal rates for industry standard.
Suspicious invoices including duplicate, backdated, or unwarranted (no goods or services provided) invoices.
Degraded quality or ethics focus. <ul style="list-style-type: none"> a. Resistance to take required training. b. Compliance activities deliberately reduced or resisted.
Bias in procurement practices and unsupportable outcomes.
Preference to deal only with one individual.
Resistance to training backup for fear of exposing unethical actions.
Reluctance to take annual leave, especially during “high value” periods.
History of corruption.
Checks and balances being regularly bypassed in the interest of expediency.
Contemporaneous written records nonexistent ⁶

⁵ Prieto, R. (2022). Addressing Corruption Risks in the Construction Industry and its Projects, *PM World Journal*, Vol. XI, Issue II, February. <https://pmworldlibrary.net/wp-content/uploads/2022/02/pnwj114-Feb2022-Prieto-Addressing-Corruption-Risks-in-the-Construction-Industry-featured-paper.pdf>

⁶ A general disregard for policy could be signs of problems and creates an environment for corruption.

Strategy risks

Risks that affect or are created by an organization’s business strategy and strategic objectives cause a reexamination of the continuing validity of strategic business objectives in light of the strategic outcomes we have chosen for the business (purpose). For example, has the market grown at the rates we had predicted? Is our market share increasing or have competitor strategies proven to be more effective or are our strategies less differentiating than we believed? Does our preferred approach to growth (M&A, organic) and contracting remain relevant and what implications does a change have to overall enterprise risk? Importantly, have we documented our informed risk decisions?

Strategy risks also consider the enterprise’s success in implementing its selected strategy at the pace we set out for ourselves. Are we meeting the milestones established and are the actions we take producing the results we targeted?

Finally, our assessment of potential risks to our strategy must consider how our assessment of major industry driving risks compare to broader perceptions. The dynamic nature of these broader risks can be seen in changes to the World Economic Forums top risks over the years as shown in Table 2. We need to consider whether there are Black Elephant^{7, 8} risks that can suddenly become impactful as these global risks emerge.

Table 2 Top 5 Global Risks in Terms of Impact									
2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Financial failure	Fiscal crises	Water crises	Climate action failure	Weapon of mass destruction	Weapons of mass destruction	Weapons of mass destruction	Climate action failure	Infectious disease	Climate action failure
Water crises	Climate action failure	Infectious diseases	Weapons of mass destruction	Extreme weather	Extreme weather	Climate action failure	Weapons of mass destruction	Climate action failure	Extreme weather
Fiscal imbalance	Water crises	Weapons of mass destruction	Water crises	Water crises	Natural disasters	Extreme weather	Biodiversity loss	Weapons of mass destruction	Biodiversity loss
Weapons of mass destruction	Unemployment	Interstate conflict	Involuntary migration	Natural disasters	Climate action failure	Water crises	Extreme weather	Biodiversity loss	Social cohesion erosion
Climate action failure	Infrastructure breakdown	Climate action failure	Energy price shock	Climate action failure	Water crises	Natural disasters	Water crises	Natural resource crises	Livelihood crises

⁷ Prieto, R. (2020). Black Elephants; *PM World Journal*, Vol. IX, Issue VIII, August. <https://pmworldlibrary.net/wp-content/uploads/2020/07/pmwj96-Aug2020-Prieto-Black-Elephants-featured-paper.pdf>

⁸ Prieto, R. (2020). On the Subject of Black Elephants, Letter to the Editor, *PM World Journal*, Vol. IX, Issue VII, July. <https://pmworldlibrary.net/wp-content/uploads/2020/06/pmwj95-Jun2020-Prieto-Letter-to-Editor-on-black-elephants.pdf>

Human resource risks

People are a firm's greatest asset. They are also one of the greatest risks an enterprise faces. Recruitment of the right individuals, in the right place at the right time is key to management of many of the risks an engineering and construction enterprise faces. This simple challenge has been compounded by the desire for and likely persistence of hybrid working models in a post-COVID world. Enterprise level risks associated with human resources include recruitment, development, engagement and retention where **degraded performance in any of these areas can have broad impacts across the company's portfolio of projects**. Staffing shortages of appropriately skilled individuals can significantly elevate project risks in fairly short order.

Culture⁹ and ethics risks are most evident in the human resource set of risks but are not confined to just this type of risk.

Operating risks

Operating risks in the engineering and construction industry can be broadly defined. For purposes of this paper, we will define them as including:

- **Business development risks** – Inadequate volume of qualified opportunities and below target success rates represent risks to meeting the enterprise's strategy. Shortcomings here may suggest inadequate differentiation or changed competitive environment.
- **Scope¹⁰ completeness and change management** – From an enterprise risk perspective, systemic shortcomings in contracted scope (missed/incomplete items of scope) or the management of owner driven changes to scope (late notices; denied changes) are important risks to manage.
- **Cost estimating, subcontractor buyouts and project level cost control** – Systemic shortcomings in cost estimates as a result of either internal (misestimates; inadequate quantity takeoffs; dated cost data) or external (misestimate of market price trends including escalation¹¹ in materials and energy costs) factors; achievement of subcontractor buyout cost savings targets; and weak project level cost control contributing to margin erosion represent significant enterprise level risks.

⁹ Among the most commonly cited reasons for engineers leaving a company are corporate culture and poor quality management.

¹⁰ Prieto, R. (2019). The Primacy of the Scope Baseline in Engineering & Construction Projects; *PM World Journal*, Vol. VIII, Issue IX, October. <https://pmworldlibrary.net/wp-content/uploads/2019/10/pmwj86-Oct2019-Prieto-primacy-of-scope-baseline.pdf>

¹¹ National Academy of Construction Executive Insight - Escalation

- **Schedule performance** – Portfolio performance against schedule is an enterprise level risk likely to manifest in increased labor costs (overtime); late project finishes (impacts client satisfaction, reputation and repeat work opportunities); potential late start on subsequent work.
- **Quality¹² performance** – Rework¹³ is indicative of broader management, training, and staffing risks. Adequacy of QA/QC programs for the required work profile and environment must be assessed. Are adequate numbers of quality audits happening? Have deliverables gone through required quality reviews before being released? Are the targeted number of QA training sessions and audits being performed? Quality problems can spread across a firm's portfolio of projects very fast and may manifest before the cost and schedule impacts become evident.
- **Risk management systems and processes** – The establishment of a robust risk management process and system is a good first step. However, it must be complemented by rigorous implementation. Operational risk in this area can be assessed by observing the placement of the risk management function within the firm (independent part of corporate leadership or embedded in growth focus business lines); monitoring staffing and training in the risk area; extent and level of training delivered; timeliness of required risk reviews and coverage of projects; assessment of risk mitigation measures performance and inputs to inform the broader enterprise risk management system. This last point on assessing the effectiveness of risk management actions should be underscored as a simple technique to better inform future risk analysis.
- **Project execution tools** – Do we have in place the right levels and capacities of tools to undertake the work in our project portfolio? Do we have strategies to close any gaps, and have we defined the actions and investments necessary to do so? Are we making capital investments faster than assets are depreciating? Is technology innovation¹⁴ creating added risks or new opportunities?
- **Contract, legal and regulatory** – Enterprise risks may arise from systemic weaknesses in contract negotiating strategies; failure to comply with various legal requirements including obtaining necessary licenses, permits and approvals; failure to adequately address various ESG requirements incorporated in the

¹² National Academy of Construction Executive Insight – Quality Transformation

¹³ Prieto, R. (2021). Rework in Engineering and Construction Projects, *PM World Journal*, Vol. X, Issue IV, April. <https://pmworldlibrary.net/wp-content/uploads/2021/04/pmwj104-Apr2021-Prieto-Rework-in-Engineering-and-Construction-Projects.pdf>

¹⁴ National Academy of Construction Executive Insights – Innovation and Technology Convergence

contract; and changes in regulation or failure to comply. These risks are typically highlighted on an occurrence basis.

Exposure to and materialization of risks associated with terms and conditions found across many of the company's portfolio of projects warrant special attention and act to inform the actions necessary to support the company's risk appetite (avoid, transfer, mitigate, accept).

Claims management^{15 16} and liquidated damages that become significant in the aggregate are considered above threshold levels.

- **Project management and project oversight** – Project managers are the line managers in engineering and construction organizations. Revenue is only realized in a project context. The enterprise's risk level is elevated when there are an inadequate number of trained individuals. Inadequate management oversight of projects¹⁷ results in inadequate challenge to project managers and can be a primary contributor to margin erosion. The frequency, coverage and adequacy of project reviews is important in managing enterprise level risks associated with projects.
- **Aggregation of project risks at the enterprise level** – This is a unique pool of enterprise risk in the engineering and construction industry which will be discussed later in this paper. The risk pool includes singular performance risks as well as combined risks across projects.
- **Overhead** – Overhead is part investment in the future and part tax on the present. Enterprise risk is related to the levels of each type of spend.
- **Business continuity** – Have we put in place the right types and levels of resources to respond to a wide range of crises and recover within targeted time frames. Periodic assessments help inform overall enterprise risk levels and improve our ability to respond to any Black Swan¹⁸ events that may occur.

Supply chain risks

An engineering and construction company's ability to achieve the corporation's strategic business objectives depends significantly on the governance of third-party relationships. The enterprise's ability to manage uncertainty and risk requires that risk be managed in third-party relationships. The integrity and ability of the organization to comply with

¹⁵ National Academy of Construction Executive Insight - Claims Avoidance from an Owner's Perspective

¹⁶ National Academy of Construction Executive Insights – Disputes & Claims

¹⁷ National Academy of Construction Executive Insights – Effective Project Review Meetings

¹⁸ National Academy of Construction Executive Insights – “Black Swan” Risks

regulations, commitments and values are measured by the integrity of its relationships. Risk management does not stop at the execution of a contract. Continuous attention facilitates risk mitigation and exposes opportunities.

Enterprise risk management must aggregate all third-party risks paying attention to concentration risk or over dependence on one supplier; single points of failure in the supply chain including the associated logistical chain; and common risk drivers that may have broad enterprise level (sanctions, industry-wide labor shortages, technology failure) versus singular project level impacts. Emerging artificial intelligence (AI) tools may assist in identifying coupling through common risk drivers.

Supply chain resilience

On one multi-billion-dollar infrastructure program, one structural steel supplier was dominant but relied on a single facility likely operating at a strained capacity. In assessing steel procurement risks at the project level an enterprise perspective was sought. As a result of that perspective a larger, multi-facility supplier was solicited to provide steel. They matched the lowest price of the traditional provider in the market but with a shorter schedule.

Later, when a fire at the facility making the project's steel damaged the project materials, the new steel provider was still able to deliver required steel from other facilities on the contracted schedule.

ESG risks

Environmental, social and governance (ESG) risks represent a growing set of enterprise level risks. These risks arise from a combination of reputational and compliance factors and are increasingly subject to disclosure and compliance requirements. These disclosure and compliance requirements are not limited to public companies but are being increasingly applied to large private entities through procurement and audit channels.

ESG risks include those related to climate change impacts, mitigation and adaptation; environmental management practices and duty of care; working and safety conditions; respect for human rights; anti-bribery and corruption practices; and compliance to relevant laws and regulations. ESG risks share common elements related to culture, control and integrity while including factors related to health, safety and environmental (HSE) which feature prominently across the engineering and construction industry.

A major focus of ESG risks today deals with identifying and reporting so-called Scope 1 and Scope 2 emissions. "Scope 1 emissions are direct greenhouse (GHG) emissions that

occur from sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization's GHG inventory because they are a result of the organization's energy use."¹⁹

Increasingly the engineering and construction industry will be tasked with providing Scope 3 emissions data to major, forward-leaning clients. "Scope 3 emissions include all sources not within an organization's scope 1 and 2 boundary. The scope 3 emissions for one organization are the scope 1 and 2 emissions of another organization. Scope 3 emissions, also referred to as value chain emissions, often represent the majority of an organization's total GHG emissions."²⁰

Other enterprise level ESG risks include:

- Governmental actions including changes in law and regulation
- Relationships with employees, suppliers, partners, shareholders and the overall community and stakeholders
- Wage and labor issues
- Health care costs
- Modern day slavery
- Diversity, equity, and inclusion
- Board practices
- Transparency in shareholder communications
- Data privacy
- Philanthropy (an opportunity area)

Information security

Without a comprehensive ERM program, organizations have no way to identify and assess the relationship between cyber risk and its impact on the business.

Cybersecurity²¹ is a problem that will never be solved. Instead, it is a risk to be managed. It is an issue for the entire business, not just the IT department. Cyber risk management must go beyond compliance reporting, client requirements and regulations. Cyber risk management must support the organization achieving its strategic business objectives while simultaneously providing necessary levels of protection.

¹⁹ Environmental Protection Agency Scope 1 and Scope 2 Inventory Guidance;
<https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance>

²⁰ Environmental Protection Agency Scope 1 and Scope 2 Inventory Guidance;
<https://www.epa.gov/climateleadership/scope-3-inventory-guidance>

²¹ National Academy of Construction Executive Insights – Cybersecurity in Engineering and Construction

Enterprise level consideration of cyber risk includes business continuity, disaster recovery, and data protection. Assessment of the level of exposure to cyber risks should be continuous including monitoring numbers of external users or third-party data providers; currency of the installed software fleet from a virus and malware protection perspective; results of stress testing of system security; and outstanding corrective actions to address identified weaknesses.

Enterprise level risk monitoring in this area benefits from benchmarking against vulnerabilities exposed in comparable industry organizations.

Related considerations include network resiliency, data, and intellectual property protection.

Project risk as a component of enterprise risk

In considering a range of operational risks that feed into enterprise level risk assessment and management, the portfolio of project risks is an engineering and construction industry unique feature. Yet many ERM programs in the industry do not incorporate this risk at the enterprise level, essentially considering risk on a project-by-project basis. But with projects as an E&C organization's only products, it is important to consider how project failures jeopardize the overall enterprise.

These project level risks have a range of common characteristics as well as common risks and risk mitigation strategies. Many of these risks are coupled and the effectiveness of various risk mitigation strategies may shape an enterprise level view of retained or unmitigated risk. This is where a common risk vocabulary becomes very important.

Table 3 provides a summary of some project level risks engineering and construction firms may encounter. Project risk lists would contain significantly more granularity. The list is not all inclusive and bespoke risks may exist in one-of-a-kind projects. Looking across the enterprise's portfolio of projects we recognize that these discrete risks can be associated with several project features including:

- Client
- Project type
- Project size
- Business line or organization
- Geographic region
- Office
- Contract type
- Project phase
- Joint venture partner
- Major subcontractors or suppliers

These provide us with insights into the history of risk materialization, frequency, and risk cost.

Enterprise level risk assessments can consider not only overall unmitigated and mitigated risk exposure but also risks and attendant reserves associated with each type. This opens the aperture for more effective enterprise risk management through tracking of risk drivers, changes in risk likelihood and impacts, and assessment of the effectiveness of risk mitigation strategies facilitating any required adjustments. This may result in risk mitigation at a portfolio level, versus on a project-by-project basis, where additional risk mitigation strategies may be available including risk retention (with self-insurance) and risk transfer through a portfolio based financial hedge.

Table 3 Top Level Project Risk Categories	
Top Level Category	Select Components
External	Economic, including capital availability and competitive environment
	Social, including stakeholders and socio-economic
	Political, including legal and regulatory
	Cultural, including risks related to corruption
Client	Accessibility to real decision makers; client interference; change order process and timeliness; accounts payable risks and retainage
Management	Brand and reputation risks
	Joint venture ²² partner risks
	Decision support, including ability of corporate decision and approval processes to support project schedule
	Resource availability to support project
	Adequacy of corporate backbone systems, including health, safety & environmental; human resources including recruitment, on-boarding, and

²² Prieto, R. (2013) A Look at Joint Ventures; *PM World Journal*, Vol. II, Issue III. March. https://www.researchgate.net/publication/264943051_A_Look_at_Joint_Ventures

Table 3 Top Level Project Risk Categories	
	training; legal (contracts and claims); IT including ability to support project start-up
	Management oversight of projects
	Financial support, including adequate working capital; available bonding capacity; pension payments; effective payroll systems; financial audit and fraud detection
Operational	Contract specific risks related to specific contract provisions including those related to client scope changes or schedule delays; timely receipt of information or client furnished materials or equipment ²³ ; responsibility for third party delays; consequential damages; force majeure coverage; and liquidated damages
	Estimating and cost risks, including labor costs and provisions for adjustments for general wage or benefit changes; escalation costs and provisions for indexing or adjustment; labor productivity ²⁴ ; adequacy and completeness of cost risk analysis and associated contingency ^{25 26} ; and schedule related assumptions related to availability of site, timely permit approval, workdays, and work hours.
	Design related risks, including availability of staff; number of client required hold and approval points and ability to support overall design schedule; technical challenges and uncertainties related to ground conditions; deployment of new

²³ National Academy of Construction Executive Insight – Owner Furnished Contractor Installed

²⁴ National Academy of Construction Executive Insight – Construction Productivity

²⁵ National Academy of Construction Executive Insight - Contingency

²⁶ National Academy of Construction Executive Insight – Event Contingency

Table 3 Top Level Project Risk Categories	
	technologies in the project; and adequacy of QA/QC support
	Availability of construction labor, including skilled labor, in right quantities and time frames; state of labor relations; and competition for resources from other projects
	Ability of permitting agencies to support project schedule; ability of third-party utility relocations to support project schedule.
	Procurement ²⁷ related risks, including market capacity; lead times for equipment and materials; bonding capacity; ability to meet mandatory flow down requirements including those related to ESG; expected quality and level of rework anticipated; and pricing risk and associated contingency reflected in estimates.
	Logistical ²⁸ risks, including access, constrained transport (load limits; restricted hours) for final site and any offsite module or pre-fabrication areas

Tracking enterprise risk

Enterprise risk is dynamic. The portfolio of underlying risks is constantly changing in composition and relative levels as new projects enter the business and others are completed. Similarly, risks are “retired” as individual projects reach key milestones. Underlying risk drivers are similarly changing with pricing and likelihood continuously evolving.

²⁷ National Academy of Construction Executive Insight - Procurement Management in Large Complex Programs

²⁸ National Academy of Construction Executive Insight - Logistics

While portfolio-based enterprise risk management tends to smooth out many of these changes, more systemic²⁹ changes will play through to the enterprise level.

Effective enterprise risk management, therefore, must not only report on the current levels of enterprise risk but more importantly highlight changes in underlying risk drivers. Selection of risk assessment parameters becomes imperative in designing an effective enterprise risk management system. Risk trends (rising, falling) must go hand in hand with risk levels. Recognition of common risk drivers such as general inflation or major supply chain disruptions (pandemic, sanctions) will affect many of the component risks we track at an enterprise level.

The enterprise risks we track can be broadly grouped into strategic, operational, market and client. In addition, tracking the condition and effectiveness of the risk management system itself is important at an enterprise level.

Strategic risk tracking at the enterprise level seeks to confirm that the adopted strategy is in place and being implemented (implementation milestones are being met) in accordance with the organization's approved risk appetite. It further monitors its effectiveness in achieving target levels and timely achievement of key strategic actions. At an enterprise level we also seek to assess strategy's ability to anticipate and respond to emerging changes in underlying strategy assumptions, market conditions and behaviors, and broader industry trends.

Operational risks at an enterprise level tend to focus on effectiveness of the management systems (performance to targeted levels; compliance and reporting completeness), resource levels to support strategy (human, material, technology and financial), organizational development (training, upskilling, technology deployment) and portfolio risk materialization and changes (aggregation of project level risks). Organizational alignment and "trust" (measurable using a Net Promoter Score for example) are key enterprise level metrics.

Operational risks from the aggregation of project level risks will highlight greatest mitigated and unmitigated risk categories, categories growing at significant rates and profile of risk management strategies being employed (avoid, retain, reduce, transfer). These risks may be further parsed as appropriate to highlight the greatest sources of enterprise risk from projects. An aggregate value of the enterprise risk associated with the portfolio of projects can be developed using appropriate Monte Carlo techniques (not just the sum of all project risks) with appropriate consideration of correlation³⁰.

²⁹ National Academy of Construction Executive Insight – Systemic Risks

³⁰ Prieto, R. (2020). The Impact of Correlation on Risks in Programs and Projects; *PM World Journal*, Vol. IX, Issue XII, December. <https://pmworldlibrary.net/wp-content/uploads/2020/12/pmwj100-Dec2020-Prieto-impact-of-correlation-on-risks-in-programs-and-projects.pdf>

Market risks at an enterprise level monitor changes in overall market volumes, foreign exchange (F/X), absolute performance of client relationship management and business development programs (with an emphasis on performance against strategic opportunities), effectiveness of strategic differentiators and changes in the competitive environment (competitor actions and market share changes; change in contract mix (lump sum vs reimbursable)).

Client risks at the enterprise level tend to focus on top clients by aggregate risk levels, noting profits generated from the assumption of this risk. It is at an enterprise level where a decision to “fire” a client will likely occur. Concentration risk by client, sector and geography will also typically be monitored at the enterprise level and common risk categories highlighted.

Important in the design of an effective enterprise level risk management system is to recognize that significant coupling of risks may exist. As a result of coupling³¹, low probability, low impact events may lead to the realization of low probability, high impact events emerging. Earlier we highlighted the broader impacts from an increase in general inflation as one example of risk coupling.

Operational risk assessment at the enterprise level will also benefit from an aggregate assessment of portfolio schedule^{32 33} performance. That is, on average (weighted by value remaining to be put in place), is the portfolio of projects on (or ahead) of schedule, slightly behind schedule (a few days) or significantly behind schedule (many weeks). Aggregate schedule performance reflects resource availability, productivity, and client related issues to name a few. Importantly, however, time is a “risk aggregator.” Communication of aggregate schedule performance lends itself to further parsing (project type, geography/labor pool) to make the enterprise risk picture clearer.

Importantly, the condition and effectiveness of the risk management system itself must be assessed to provide confidence in what is being seen at the enterprise level. As noted previously, it is important to monitor staffing and training in the risk area; extent and level of training delivered; timeliness of required risk reviews and coverage of projects; and assessment of risk mitigation measures performance.

Identifying and tracking risk management strategies

Organizations put in place both enterprise level risk management strategies as well as a portfolio of risk management strategies available at the project level. Enterprise level strategies build on the agreed to risk appetite and must be tested for conformance with that appetite. It is important to underscore that risk appetite is not synonymous with risk

³¹ National Academy of Construction Executive Insights – Coupling in Large Complex Projects

³² National Academy of Construction Executive Insights – Emergent Risks

³³ National Academy of Construction Executive Insights – Earned Schedule

aversion. Having said that, enterprise level risk strategies may include avoidance of certain risks (contract type, client, geography, service); retention of certain risks with conditions (individual projects) and limitations (project and enterprise-wide); transfer to competent (threshold levels defined) counterparties (subcontract/joint venture, financial hedges).

Portfolio aggregation of project risks allows the enterprise's risk management strategies to be assessed, headroom identified in each risk category or mitigation strategy, and informed evaluation and decision making to occur relative to risk levels and mitigation measures.

Deployed risk management strategies may be aggregated across the enterprise and effectiveness tracked and assessed.

Assessing ERM effectiveness

The effectiveness of an enterprise risk management system is founded on the quality of the overall risk management system and the completeness, accuracy, and timeliness of its information. The timeliness of ERM information is also important. While quarterly snapshots may serve the board of directors and regulators, management needs a much more dynamic picture especially in large, often global enterprises. Today's business management systems can provide a substantial part of the backbone of the system, but true effectiveness will continue to rely on timely management and oversight of the organization. This is especially true of timely updating of risk assessments for individual projects as they move from phase to phase or encounter a significant change. Regular (monthly or more frequent) reviews of projects will keep the status of projects current from a performance perspective in addition to supporting timely interventions.

The bottom line, however, is that an effective ERM supports the achievement of an organization strategic business objectives by supporting effective implementation of its selected strategies. An effective ERM should provide the organization with the ability to respond to negative surprises as well as capitalize on positive ones (opportunities).

ERM Dashboards

The engineering and construction industry has done a good job at constructing project level risk reports and dashboards. At an enterprise level, risk management systems are evolving, and increased reporting often driven by external forces, are improving the efforts. Enterprise level dashboards for engineering and construction firms continue to struggle to reach requisite maturity. In significant part this is driven by a plethora of consultants and exemplars which exist for other industries but do not readily translate to the engineering and construction industry. Industry efforts underway may prove to be promising.

Table 4 describes one potential set of dashboard components and is intended to serve as an exemplar. Each component would be supported by available drill downs. Graphical portrayal of dashboard information is a key feature of effective dashboards, and a range of data presentation options are available but not described here.

Table 4 Engineering & Construction Dashboard Exemplar		
RISK APPETITE		TRUST BAROMETER (<i>Net Promoter Score; Corruption Risk Index</i>)
ENTERPRISE RISKS	PROJECT PORTFOLIO RISKS	RISK MITIGATION STRATEGIES
<ul style="list-style-type: none"> • Top Risks, based on potential impact (<i>Heat map of likelihood vs impact</i>) 	<ul style="list-style-type: none"> • Top Project Risk Categories 	<ul style="list-style-type: none"> • Top Risk Mitigation Strategies (Based on value at risk) (<i>Displaying mitigated and unmitigated risk remaining</i>)
<ul style="list-style-type: none"> • Key Risk Drivers (<i>Current level and trend</i>) 	<ul style="list-style-type: none"> • Project Portfolio Risk “S” Curve (Total and category risk) (<i>Displaying mitigated and unmitigated risk remaining</i>) 	<ul style="list-style-type: none"> • Effectiveness of Risk Mitigation Strategies (Risk mitigated/risk materialized)
<ul style="list-style-type: none"> • Top Risk Metrics (select) (<i>Current level and trend</i>) 		
	PROJECT PORTFOLIO SCHEDULE RISK (<i>Weighted schedule performance against baseline; value of delayed schedule performance</i>)	STATUS OF ERM PROGRAM (<i>various performance metrics</i>)
TOP COUNTERPARTY EXPOSURE (<i>Assessment of counterparty performance and risks weighted by value at risk; mitigated (bond) and unmitigated</i>)		
ENTERPRISE VALUE AT RISK “S” Curve <i>(Mitigated and unmitigated; Excluding and including Project Portfolio Risk³⁴)</i>		

³⁴ Event contingency coverage ratio is one measure

Final caution on risk perspective

Risk and reward are two sides of the same coin. While many view opportunity as “negative risk,” it may be better to consider opportunities through a broader lens. Opportunity analyses³⁵ are often integral in strategic planning exercises but there is much to be gained by conducting structured opportunity analysis at the project level. Aggregation of these potential opportunities into an Enterprise Opportunity Management system and dashboard may pay dividends.

A final caution on risk management systems is warranted. Strong risk management cultures must be protected from become just compliance processes. Checklists are great but only if real consideration of the items on the checklist has occurred.

Conclusion

In this paper we have defined Enterprise Risk Management (ERM) and outlined its importance highlighting the journey still ahead for the engineering and construction industry. A preliminary classification of enterprise risks was outlined, and these top-level risks described. The recognition of the aggregation of project risks as a unique feature of enterprise risk in the industry was called out and top project level risk categories summarized.

The paper recognizes the dynamic nature of risk and the importance of understanding these dynamics at an enterprise level recognized. Similarly, identifying and tracking risk management strategies and their effectiveness was recognized as integral to assessing ERM effectiveness. The work still required to design industry relevant ERM dashboards was recognized and can be informed by this paper.

The paper closes by recognizing risk and reward as two sides of the same coin and suggests that an Enterprise Opportunity Management (EOM) system may be warranted rather than treating opportunities as “negative risk.”

³⁵ Prieto, R. (2010). Opportunity Analysis Under Strategic Program Management, Second Edition, *PM World Journal*, Vol. IX, Issue XII, December, 2020. Originally published in PM World Today, September 2010. <https://pmworldlibrary.net/wp-content/uploads/2020/12/pmwj100-Dec2020-Prieto-opportunity-analysis-under-strategic-program-management2.pdf>

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Bob is an Independent Member of the Shareholder Committee of Mott MacDonald and a member of the board of Dar al Riyadh. He is a member of the ASCE Industry Leaders Council, National Academy of Construction, a Fellow of the Construction Management Association of America, and member of several university departmental and campus advisory boards. Bob served until 2006 as a U.S. presidential appointee to the Asia Pacific Economic Cooperation (APEC) Business Advisory Council (ABAC), working with U.S. and Asia-Pacific business leaders to shape the framework for trade and economic growth. He is a member of the Millennium Challenge Corporation advisory board where he had previously served. He had previously served as both as Chairman of the Engineering and Construction Governors of the World Economic Forum and co-chair of the infrastructure task force formed after September 11th by the New York City Chamber of Commerce. Previously, he served as Chairman at Parsons Brinckerhoff (PB) and a non-executive director of Cardno (ASX).

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