



WHITE PAPER

Future Pathway for Industrial Mega-Project Delivery

George F. Jergeas
&
Robert Porter Lynch

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Future Pathway for Industrial Mega-Project Delivery

The Case for Collaborative Construction Delivery & The Aligned Construction Enterprise

By George Jergeas¹, Ph.D., P. Eng. and Robert Porter Lynch²
Co-Founders, Can-Am Collaborative Construction Institute

EXECUTIVE SUMMARY

Part I: The Case for Collaborative Construction

Mega industrial projects are massive investment of time and capital, typically experience huge cost and time overruns (50-100% over time and over budget), making investments questionable and very risky.

This has resulted in investments moving to more efficient areas of the world. This paper sets the foundation for the adoption of a more effective project delivery approach and provides a review of current industry challenges and an evaluation of three project delivery models: *adversarial*, *transactional*, and *collaborative*, including the factors needed to influence success, lessons learned, and project execution innovations that can provide a stable, predictable, and profitable project.

In virtually every case, the collaborative industrial model, powered by trust, teamwork, collaborative innovation, and strategic alliances, consistently produces on-time, on budget project delivery.

Part II: The Next Generation – Aligned Construction Enterprise

We propose the "next best practice" – an evolutionary step in Mega project construction. Named the "Aligned Construction Enterprise (ACE)," its aim is to address the current structural and organizational deficiencies in project delivery and to create a highly productive collaborative model for the future.

The proposed solution adds a new dimension to the alliance-based construction model by the creating a "Systems Integrator" function imbedded in the middle of the value network or project alliance. The System Integrator holds unique best-practice core competencies that enable the organizations to function at maximum capacity.

ACE is collaborative, powered by trust, teamwork, collaborative innovation, and strategic alliances that will consistently deliver more effective results when used properly. This paper strongly suggests the need for changing industry mindsets and proposes key ideas and steps for the executives in the Mega project environment to create a collaborative construction initiative.

¹ Professor of Project Management at the University of Calgary

He has facilitated more than 90 partnering projects in Canada. email: Jergeas@ucalgary.ca

² Author, Thought Leader, & Founder of Association of Strategic Alliance Professionals.

He teaches at Universities of Alberta and British Columbia email: RobertLynch@warrenco.com

The Collaborative Construction Advantage

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PART ONE: THE CASE FOR COLLABORATIVE CONSTRUCTION DELIVERY

BACKGROUND ON MEGA PROJECTS

Major industrial development projects are Mega engineering and construction undertakings ranging between \$8-10 billion in capital investment and employing thousands of workers, engineers, suppliers, contractors and support staff. Mega projects are characterized by:

- Magnified cost & High visibility
- Extreme complexity, uncertainty, change orders, and interface management issues
- Increased risks, many of which are outside the control of the project management team
- Environmental, regulatory, community impacts, and labour availability
- Cost over-runs that exceed total project cost or approved budget.

Mega Projects are notorious for running over budget and schedule. Oil Sands projects in Alberta typically experience overruns of 50-100%

Although success is the goal of all project stakeholders, it has been difficult to achieve; 50-100% overruns in budget and time are the norm. Success/effectiveness and the extent of learning from experience are becoming a major challenge in today's Mega project delivery.

SUMMARY ANALYSIS OF PROBLEMS

Literature is flowing with documents and papers about repeated global cost overruns and delay cases. *It is not the intention of this paper to provide/repeat a detailed literature review of the causes*, but the following provides a summary of a host of major challenges and leading causes for cost & schedule overruns (Jergeas 2008),¹ (Ernst & Young 2014)² which are exacerbated by the fast track nature of the Mega project environment.

Ernst & Young examined 205 current oil & gas Mega Projects across the globe, finding that current project estimated completion costs were, on average, 59% above the initial estimate.

Unrealistic or overly optimistic AFE (Authorization for Expenditure) cost estimate and schedules

- under-appreciation of project complexity, interfaces, interdependencies and risks associated with Mega project environment.

If this were a disease, we'd call it a "pandemic"

Incomplete scope definition or inadequate Front End Loading/Planning prior to sanction

- the fast-tracking nature of Mega projects and ongoing changing customer requirements resulting in scope changes throughout the life cycle of the project
- lack of understanding of cumulative impact of scope changes on project cost/schedule
- pushing work to the field early puts construction under unrealistic compressed schedule with increased overtime requirements

Improper or late consideration of project strategies for the Mega environment

- need for much detailed levels of scope definition relating to design, procurement, construction, prefabrication and assembly and commissioning adds to cost overruns
- extreme pressure to fast-track due excessive sunk investment costs prior to attaining ROI
- fluctuating Market Conditions that may adversely impact delayed projects
- extreme Owner Risk which triggers stronger owner participation and control that may actually introduce more problems and complexities
- considerable design, procurement, construction, labour, prefabrication and assembly and commissioning complexities and interdependencies that adds to cost overruns.

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Mismanagement of the construction phase

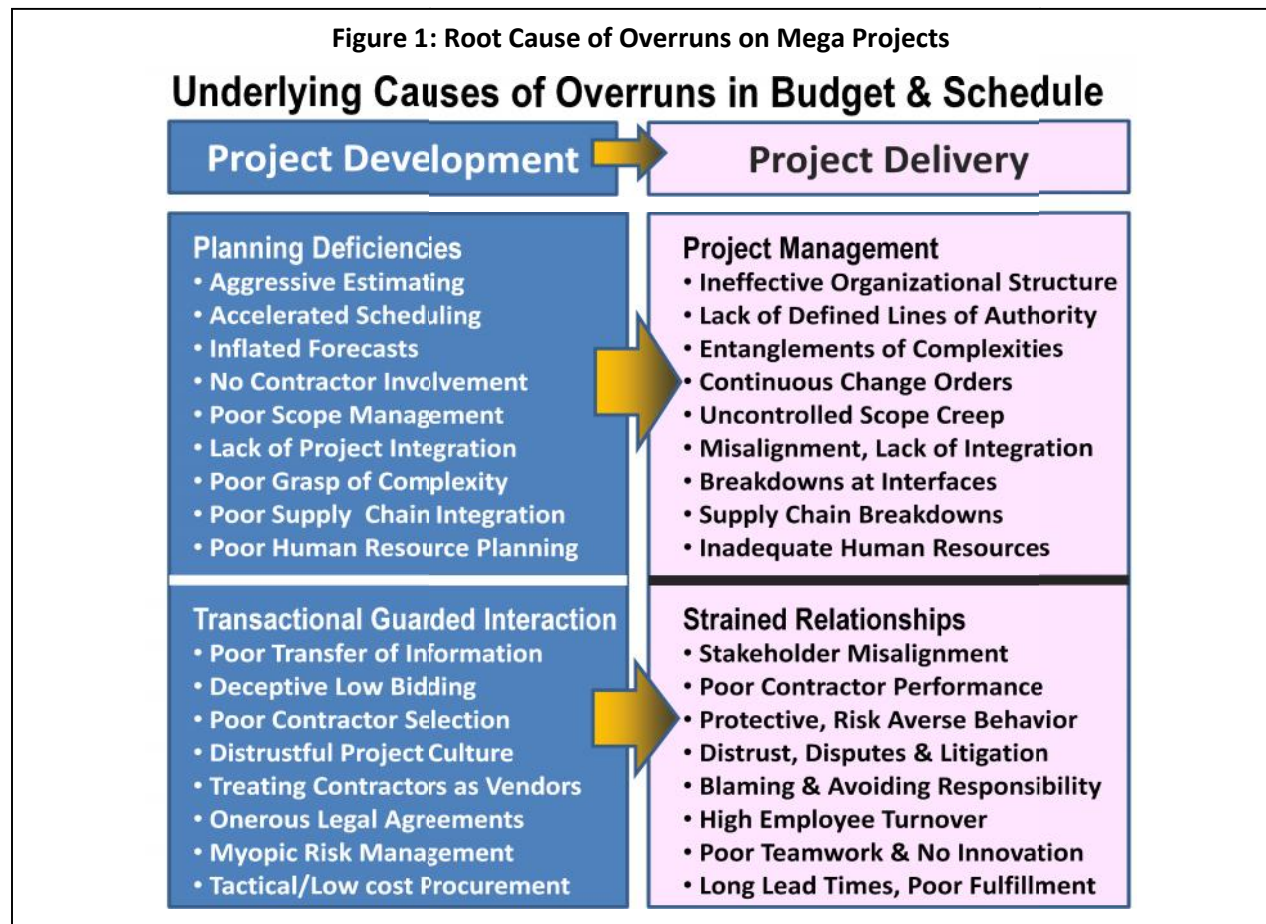
- later than anticipated engineering, vendor data, equipment and material deliveries
- inadequate plan of execution, and poorly defined tasks and division of responsibility
- inexperienced or poorly equipped project management personnel and supervisors, coupled with the inability to understand, plan, adapt, implement project management procedures or systems
- lack of standardization and fit-for-purpose design including inadequate use of shop fabrication, modularization strategy and constructability reviews, and
- poor communication, team work and alignment between the players leading to adversarial relationships and protracted disputes.

A 2011 industry study by Independent Project Analysis (IPA) 2011 found 78% of upstream Mega Projects faced either: cost overruns or delays, a deterioration from 2003, when 50% of the projects were over budget or late.

It's not getting better; it's getting worse.

Numerous other studies have isolated a number of causes of low construction productivity and cost overruns. Figure 1, summarizes the underlying causes and the contributing issues for the poor project results. The authors' analysis of complex projects that ran over the projected time and budget targets, many of the problems occurred in two time spans: (separated by the Approval For Expenditure (AFE) stage gate) Project Development and Project Delivery.

All of the above causes have contributed to cost overruns and lack of predictability resulting in investors shifting their capital to other more efficient/cheaper areas of the world.



CRITICAL ISSUES IN MEGA PROJECT DELIVERY

Risk Management and Trust

Mega projects are high risk, complex ventures. Traditional risk management calls for handling risk by insulating, insuring, shedding, or avoiding risk. This approach is often myopic when assessing the development of a Mega project. Many key factors are often overlooked.

The inherent complexities of a Mega project are severely exacerbated in distrustful environments, and excessive risk aversion can cause severe distrust, which *counter-productively increases risk*. Contracts filled with pages upon pages of excessive legal protections and penalties oftentimes actually backfire, causing people to protect themselves rather than take actions that would advance productivity on the job. Risk premiums added by contractors, and legal/ litigation costs, are two consequences of excessive risk management that can drain profits and executive energy. The authors' conducted in workshops throughout Canada and the U.S. for over 4500 senior managers who evaluated the impact of trust on key operational factors. Universally executives reported a minimum of 30% advantage in each of the factors when evaluating high trust over low trust organizational cultures, demonstrating that trust dramatically improves speed, innovation, forecasting, joint planning, and reduces cost among other factors.³

But Mega projects often craft legal contracts armed like a battleship ready to fight. Once excessive risk management gathers momentum, often it becomes the universal solution to everything, misapplied to any issue of uncertainty, with great impact on contingency planning, trust building, and clarity of roles & responsibilities. Because trust is missing, innovation is overlooked as the best solution. Instead we should be very selective about who gets to play on the project management field, excluding those few who can/should not be trusted.

Systemic-Strategic Obstacles to Improvement

The problem in the industry is not one that can be solved by isolating each individual problem and then fixing the problems piecemeal, one by one. If this were to be true, the problems would have been corrected by now. The difficulty in the construction industry is two-fold.

First, historically the industry has grown up from a "cottage" industry, where top managers today often got their start in the apprentice system beginning as laborers, then as supervisors, then site or project managers. From this perspective they were not trained to see the strategic and systemic issues in their industry. Thus the mindset of the industry is still *oriented to projects*, and their expeditious completion, *not to systems change*.

Second, the industry is deeply structurally fragmented, with divided interests that have little trust in each other, and thus limited collaboration, which is foundational to joint problem solving, fast-track delivery, and innovation. The following description (abridged from Thomsen et al. 2009)⁴, clearly states the structural difficulty:

Construction projects frequently suffer from adversarial relationships, low rates of productivity, high rates of inefficiency and rework, frequent disputes, and lack of innovation, resulting in too many projects that cost too much and/or take too long to build.

Typically, construction projects are organized into three main camps with diverse interests that sometimes converge and other times are opposed; owner, designer and contractor. Project participants come into their camps at various times during the project, with designers coming on early, and general and trade contractors coming on after design is substantially complete. Project communications typically reflect contractual lines, so a trade contractor's issues flow up to the

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general contractor, over to the owner, and if needed, down to the design consultant having the answer.....with each camp organized vertically and separated from each other by contractual walls. This problem practically ensures that:

Design effort is wasted because information about cost, constructability and operability preferences only come to the designers, if at all, at a few milestones, after substantial design effort has occurred, thereby requiring redesign.

Construction costs are higher because contractors will pad their prices with contingencies resulting from the owner's risk allocation strategy and their uncertainty about the meaning/completeness of the design, in which they had little or no involvement.

Engineering safety factors are extreme, as the engineers have no assurance concerning the capability and quality standards of the contractor who might ultimately be the low bidder. To avoid an underperforming system, engineers often overdesign the system's capacity.

Change orders result because the contractor's first chance to point out problems in the drawings occurs after they have provided their final prices. Additionally, trade contractors who know best how to influence the design in order to improve productivity and constructability are excluded from the design process. Change orders may also become the "get even" opportunity for contractors and subcontractors, who were beaten up on price in the original negotiation, to over-charge to make a fair profit.

Relationships are adversarial and disputes more frequent. The contractual structure encourages each party to look to its own interests rather than the interests of the project as a whole. Lack of constructor involvement in the design phase reduces the level of common understanding of the project.....resulting in more mistakes, misunderstandings and blame....long-distance and arms-length relationships among project participants, hindering collaboration and increasing....misunderstanding and mistrust.

Believing that just fixing the problem by attacking the pieces of the problem clearly has not and cannot work. Every attempt at solving the problem piecemeal has failed, because this is a “*strategic systems problem*,” not a “*fix the broken parts problem*.”

Seeking a Robust Systems Design Architecture and Competing Project Delivery Options

What's needed is a “robust systems design architecture” that delivers on-time/budget, *aligning* the delivery of construction services which currently manifest as having “broken parts”.

But this requires we first understand the conundrum: “Why has the construction industry been so impervious to change?” Underlying these difficulties is an interwoven set of three different belief systems and supporting methods that cause fragmentation and misalignment within the construction industry”

adversarial, transactional, and collaborative

each founded on different philosophies, each producing different results, each with different advantages and disadvantages, and a right and wrong time and place for their use. (following) illustrates the three distinctly different models of project delivery and provides further details of its characteristics.

Collaborative Innovation is sourced from the basic principle that the best new ideas come from differences in thinking – people who challenge the status quo, ask difficult questions, and iteratively postulate new possibilities. The interplay of differences fostered in a trusting, honoring environment, yields co-creativity and synergy.

The Collaborative Construction Advantage

	Adversarial	Transactional	Collaborative
Key Beliefs	Business is a "Psychological War Game;" Winning comes from Power	Trading, Bargaining, & Differential Views on Value Produces Economic Exchange	Extreme Value is Generated when people work in teams to Push the Envelope on Performance
Behaviors	Argumentative, Money Rules, Use Age, Experience, Position or Budget to get your way, "dog eat dog"	Squeezing & Positioning enables you to get the best result in Negotiations, throw a bone to sweeten the deal	Co-Creative, Teamwork, Trustworthiness, Highly Ethical & Honest; Maximize what's in the best interests of the whole
Rules of the Game	Pressure others; Winning is a result of Cunning & Craftiness; Hype your importance; Protect your backside; Don't Trust Others or you will get screwed; Everything is Win – Lose	Take advantage of every opportunity, Exploit weaknesses; Timing is critical; Perception is everything; Trust but verify; Use lawyers to ensure protection; Everything is in the "deal"	Create value & competitive advantage by using Teamwork (internally) & Alliances (externally). Close integration between operating units, suppliers & Close attention to customers/client; Strive for Win-Win
View about Risk Management and Creating "Synergy"	Synergy is an impossible dream, (don't even think about it.). Manage Risk with tough contracts & tougher legal team empowered to litigate	Synergy is derived from High Efficiency and elimination of Non-Value Added Work. Risk Management, insurance, and shedding risk will limit losses	Synergy is a result of high levels of trust, teamwork, and alignment of goals & values. Use high trust architecture to reduce risk. The biggest risk is failure to adapt & innovate to emerging risks and opportunities
Value Proposition	Minimum Required to Close a Sale; Squeeze vendors in supply chain	Competitive Price, Acceptable Quality; transact through supply chains	Performance Excellence thru Value-Networks, Good Price, Speed, and Innovation
Framework for Negotiations	Winning is essential for me; I get more if I push, squeeze, and threaten to ensure I leave nothing on the table. I'm stronger if you're weak	What happens to you is your business. Long term relationships are only the product of me getting what I need/want. Switch suppliers to get best deal.	A Win/Win is essential to create productive long-term relationships to mutually thrive. Use our different needs & perspectives as the source of collaborative innovation.
Competitive Advantage	Gained from Size & Money	Gained from Proprietary Information & Bargaining	Gained from Value Co-Creation and Sharing
Information Sharing	Horde Information – It is Power	Contractor responsible for interpretation of information	Share Information to create more new ideas
Trust Level	Distrust, Deception, Aggression, & Manipulation Prevalent	Caveat Emptor (buyer beware) Trust is elusive and unsustainable	Trust is essential to generating a continuous stream of new value

Table 1: Spectrum of Three Competing Models of Project Delivery & Their Characteristics

Each model has very different beliefs, underpinnings, motives, outcomes, and advocates.

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These three themes act as interwoven threads in the fabric of the construction industry. The result is often that a project entraps the participants in a cross-fire, the "muddle" of different philosophies, objectives, and ways of management. The end result is misalignment and fragmentation resulting in missed deadlines, budgets, and objectives. Here's a description:

Adversarial Project Delivery Model

The *adversarial* model's objective is winning at all costs. Based on self-interest, strong-armed bargaining, and strong self-protection, it places barriers between each entity in the value chain. When placed under stress, the lack of trust typically fractures at the interface between organizations, pitting one against the other, with the strong chance of degenerating into hard-nosed adversarial disputes. This battleship model, in the extreme, relies on negotiations driven by win-lose bargaining and an army of lawyers to shift risks to contractors along with onerous contracts that assure the destruction of joint problem solving and trust-building at the outset.

While logical in game theory, win-lose is irrational in the realities of real human interaction, driving those people on the losing end to get even, to form unions, to file grievances, withhold information, to fail to cooperate, and to hunker down in silos, all the while adding layers of non-value added work to the project equation.

In dealing with highly unethical people, an *adversarial* approach may be appropriate, positioning to fight, apply win-lose gaming, and protecting one's territory. But dealing in a prolonged adversarial manner with a critical union or contractor relationship will ultimately end in a "lose-lose" for both parties; producing litigation and being unprofitable for both.

Adversarial relationships generate significant after-shocks which manifest as law suits, high employee turnover, customer churn, and projects that consistently run over-time and over-budget. Productivity is severely jeopardized and innovation grinds to a halt in this model; high concern with self-protection results in defensive, not innovative, behavior. Many attribute this decline to the introduction of layers of "Non-Value Added (NVA)" work from excessive accumulation of *adversarial* and *transactional* and protection mechanisms over the years.

An Owner/Investor typically seeks about a 15% ROI (Return On Investment), which doesn't commence until after the project commences delivery.

On a Mega Project, where the investment is in billions of dollars, it is to the Owner's/Investor's advantage to bring the project in ahead of schedule and under budget.

But adversarial contracts emphasize liquidated damages and litigation, rather than incentivizing all the firms and their employees involved in project delivery to cooperate for the long term benefit of the

Transactional Project Delivery Model

The *transactional* model focuses on bargaining, trading, and price-driven exchange. A business model like eBay or Amazon benefits from an efficient transactional system. But this seldom *creates* value, not being conducive to innovation, which is essential in complex environments.

The *transactional* model is based on economic beliefs that everything is a "deal" and lowest price paid with highest return governs decision choices. Fundamentally, *transactional* thinking has a very narrow objective: increase shareholder value and profits. It treats those who deliver projects as vendors. Vending is a set of beliefs that drives decisions based on cost, not value, choosing the lowest price even though a contractor may be deficient in quality, safety and productivity practices that result in cost overruns and project delays. It's what's "missing" from this thinking that is disconcerting; there is:

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- No regard for ensuring that the entire project delivery system is aligned in terms of goals, measures of success, integration between delivery specialties, or how rewards will be fairly allocated to ensure everyone is acting together.
- No method to ensure the contractors/employees/supply chain of a project, who invest time and commitment, are treated fairly or given any security, such as a favorable rating on the next project, in exchange for their full engagement and successful achievement.
- No support for building high levels of trust, teamwork, or innovation which create the competitive advantage that enables sustained project improvement and delivery success.

Because these safeguards are not built into *transactional* thinking, when difficulties and conflicting objectives arise, too frequently the project begins to breakdown under stress, spinning out of control as it degenerates into an *adversarial* game that sets participants against each other.

The consequence of increased proliferation of *transactional* and *adversarial* models in the construction industry is severe over the last forty years, despite computers, better equipment, and improved materials. According to many analysts, productivity in the construction industry declined, while within the manufacturing & industrial market sectors it has more than doubled.

Collaborative Project Delivery Model

In contrast, the *collaborative* model aims at working together, sharing ideas, aligning interests, fairly apportioning risks, and developing fast innovation. It is best used in long-term projects where the stakes are high, ambiguity or uncertainty is likely to arise during delivery and there are innumerable complex interfaces.

The *collaborative* approach is designed to align the interests of all major contributors, create an environment where trust, teamwork and innovation prevents disputes, foster a cooperative bond to everyone's benefit, and facilitate the successful completion of projects on-time/budget. It typically entails a considerable up-front investment in time and resources to forge a common team identity among participants from different organizations.

The consequence of increased proliferation of transactional and adversarial models in the construction industry is severe: over the last forty years -- despite computers, better equipment, and improved materials -- productivity has decreased (see Figure 2: Productivity Loss in Construction) using the Transactional Project Delivery Model

In the last fifty years, according to many analysts, productivity in the construction industry declined (by contrast, the productivity rate within the manufacturing & industrial market sectors has more than doubled).

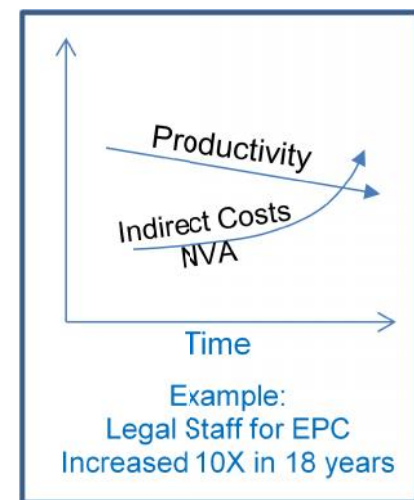


Figure 2: Productivity Loss in Construction

Many attribute this decline to the introduction of layers of Non-Value Added (NVA) work from excessive accumulation of transactional and adversarial protection mechanisms over the years.

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Oil Sands Projects Thrive with Collaborative Construction

Sometimes it takes the exception to prove the rule. In the case of Devon Energy of Alberta, they built three 35,000 barrels/day facilities. The first phase (named “Jackfish 1”) was built based on *transactional* contracting. Jackfish 2 was a “hybrid” using *transactional* and *collaborative* approaches.

By the third edition, Devon had converted to a *collaborative* construction model; the results were very gratifying: ahead of schedule, on budget, and a stellar safety record – the three hallmarks of project excellence. Steve Bass, Supply Chain Director at Devon comments:

Collaboration has been underrated and unfairly ridiculed

– look at the evidence –it produces the best results.

The *collaborative* construction model sees that the purpose of a project is to deliver in a cost effective manner, on-time, on-budget, on-target, competitively, safely, ethically, and sustainably at a fair profit for all. Unlike the *transactional* model that asserts the independent protection of self-interest and seeks a fair *exchange* of value, the *collaborative* strategy *aligns* the interests of the stakeholders, and seeks the *expansion* and *creation* of value through collaborative innovation. Project stakeholders include clients, investors, engineering and construction contractors, subcontractors, employees, and suppliers, and the larger community in which the project resides.

Best-in-Class Collaboration Results

Based on the authors' analysis of 90 Canadian projects, we have assessed success rates of each type of construction model, indicated in Table 2.

MODEL	ADVERSARIAL	TRANSACTIONAL	COLLABORATIVE
% chance of On-Time, On-Budget, On-Target Project Delivery	Under 10%	20-30%	80-100%

Table 2: Typical Success Rates

Under the weight of complexity and risk, *transactional* and *adversarial* systems are far more likely to break down. Our estimates are supported by other research at the Construction Industry Institute at the University of Texas at Austin. Their research team examined those companies that were truly committed to a “partnering” relationship in construction projects. These “best in class” companies had a profound competitive advantage, as evidenced in **Error! Reference source not found..**

Creating Value Starts with Commitment to the Values of Integrity & Fair Play

Gaining competitive advantage through collaborative relationship must start with senior leadership making a powerful commitment to building trust. Devon’s Steve Bass’ perspective:

Our philosophy is a “value delivery model” – it looks at total value with suppliers working together as a team, not just low cost. Productive supplier relationships are essential for value delivery to work.

Our Corporate Values are central to our supply chain; this means having integrity, being open, forthright and honest with our suppliers, and being committed to our mission and purpose – to have passion in improving our business and building trust with our suppliers.

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Table 3 Collaborative Construction - Best-In-Class Results

SUBJECT	AREA	RESULTS
COST	Total Project Cost (TPC)	10% reduction
	Construction Administration	24% reduction
	Marketing	50% reduction
	Engineering	\$10/hr reduction
	Value Engineering	337% increase
	Claims (%TPC)	87% reduction
	Profitability	25% increase
SAFETY	Hours without lost time accident	4 million vs. 48,000 industry standard
	Lost Work Days	0 vs 6.8 industry standard
	Number of Doctor Cases	74% Reduction
	Safety Rating	Top 5% of National Average
SCHEDULE	Overall Project	20% reduction
	Schedule Changes	48% reduction
	Schedule Compliance	Increased from 85% to 100%
CLAIMS	Number of Claims	83% Reduction
	Projects with Claims	68% Reduction
MORALE	Employee Job Satisfaction	30% Increase
QUALITY	Rework	50% Reduction

Gaining competitive advantage through collaborative relationships must start with senior leadership making a powerful commitment to building trust and looking at the total value with suppliers working together as a team, not just low cost. The metrics of value and cost must be analyzed holistically – the total cost of ownership and life cycle costs, not just the procurement price. Productive supplier relationships are essential for value delivery to work. Owners' corporate values must be central to its supply chain; this means having integrity, being open, forthright and honest with its suppliers, and being committed to its mission and purpose to have passion in improving its business and building trust with its suppliers. Old, hard-line attitudes like *squeezing the vendor* and *the lower of three bids* will fail to produce innovation, rapid problem solving, teamwork between the trades, elimination of non-value added work, and fast track results that are the essential ingredients of successful Mega projects.

***Lack of collaboration results in Isolation, which breeds ignorance and arrogance,
--- spawning future failure.***

The more complex the project, the more collaboration required

The Collaborative Construction model is the best form of project delivery and can consistently produce sustainable competitive advantage.

This model is also customer friendly, highly adaptable to change, engages its employees and contractors more successfully, and produces greater wealth for all the stakeholders.

Collaborative Construction must become the future delivery model for Mega Projects if Alberta is to stay competitive in the world marketplace.

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A DECISIVE ADVANTAGE

Based on the preponderance of evidence from the authors' analysis of highly successful construction projects in Canada, the U.S. and Australia, as well as evaluations from numerous other sources, the *collaborative* construction model meets critical criteria:

1. Competitive Advantage

The *collaborative* model produces superior delivery of value to owners compared to current industry practices, because it intentionally *aligns* the interests of all the stakeholders. Simultaneously, this approach builds trustworthy teams and strategic alliances throughout.

2. Innovation/Adaptability

Mega project risks are unpredictable, rapidly changing and fast moving. The idea "innovate or die" is the core of long term corporate sustainability. Innovation is needed at every level of the value creation chain, from inception to completion of the project delivery system. Because of the nature of complexity, integration, which is dependent on collaboration, is essential.

3. Productivity

In a global market, continuous productivity improvement is the foundation of both competitiveness and profitability. *Adversarial* models inject large amounts of "Non-Value Added (NVA)" work that stem from distrust, silo mentality, poor communications, and transactional handoffs. The productive organization focuses not on working harder, but working smarter using the intellectual/creative capital of its employees and alliance partners to streamline output.

4. Profitability

Earning a profit is one hallmark of a successful business. Profitable performance provides maximum flexibility for allocation of the profits to investors, to management, to employees, to contractors or reinvestment back into the business. For long-term sustainability, profitability must come not from quick-fix cost cutting, but from elimination of NVA work, productivity improvements, and innovation, all of which are inherent in *collaborative* strategies.

5. Engagement

Employees that are not fully engaged in their work can be expected to migrate from one job to the next on a regular basis, resulting in poor productivity and high levels of employee turnover. People work harder and smarter in a high-trust, high-teamwork environments where they find meaning and purpose in their work. This is supported by the data indicating much higher level of employee morale in collaborative work places (see Table 3).

6. Conflict Reduction

Collaborative construction reduces the chances of wasteful conflict such as litigation, strikes, lack of proper skills, and failure to deliver which have plagued the industry. It relies on contracting approaches designed to be less litigious, resolve problems at early stages, anticipate difficulties before they turn sour, mediate conflicts before they escalate, build trust among the parties, fairly apportion risks, and align the interests of the parties before project commencement.

In a high risk, high complexity environment, the Collaborative Construction model is the best form of project delivery and can consistently produce sustainable competitive advantage on-time, on-budget, on-target, safely, ethically, and at a fair profit for all.

Devon's Steve Bass' Tips and Insights

- *The legacy model of procurement is highly transactional (although there are times when it is appropriate, especially for commodity, off-the-shelf procurement). The collaborative model requires a lot more strategic work, technical development, building trustworthy relationships, and supplier development.*
- *Creating relationships is not new in the oil patch. It goes back to the beginning, when you'd shake hands on a deal. The difference today is to understand how to do it in the face of complexity and uncertainty and how to yield value from it.*
- *Doing business is more complex now, which requires a foundation of strong relationships built upon trust.*
- *Sharing risk and creating mutual value is a very successful formula for building trust.*
- *Both parties need to be putting something on the table that they wouldn't have done before. Otherwise it's just negotiating or a transaction.*
- *If it's only a success for Devon, we're likely to miss a lot in creating value for the project. Your partners need to succeed too. Without mutual success we just generate issues and claims at the back end.*

***Without trust,
teamwork and alignment is a delusion***

PART TWO: The Next Generation – Aligned Construction Enterprise

EVOLUTION OF COLLABORATIVE CONSTRUCTION

Working cooperatively is not a new phenomenon. A century ago, the construction industry was much more informal and community based. Today senior managers often speak, with some lament, of the days when construction started with a handshake, contracts were short and frequently signed well into the project cycle, and law suits were virtually unheard of.

The evolution of *collaborative* construction has taken two parallel paths: "partnering" and "alliancing" dependent upon the size, risk and complexity of the project or program. Figure 3 clarifies the differences and show when each approach is most appropriate.

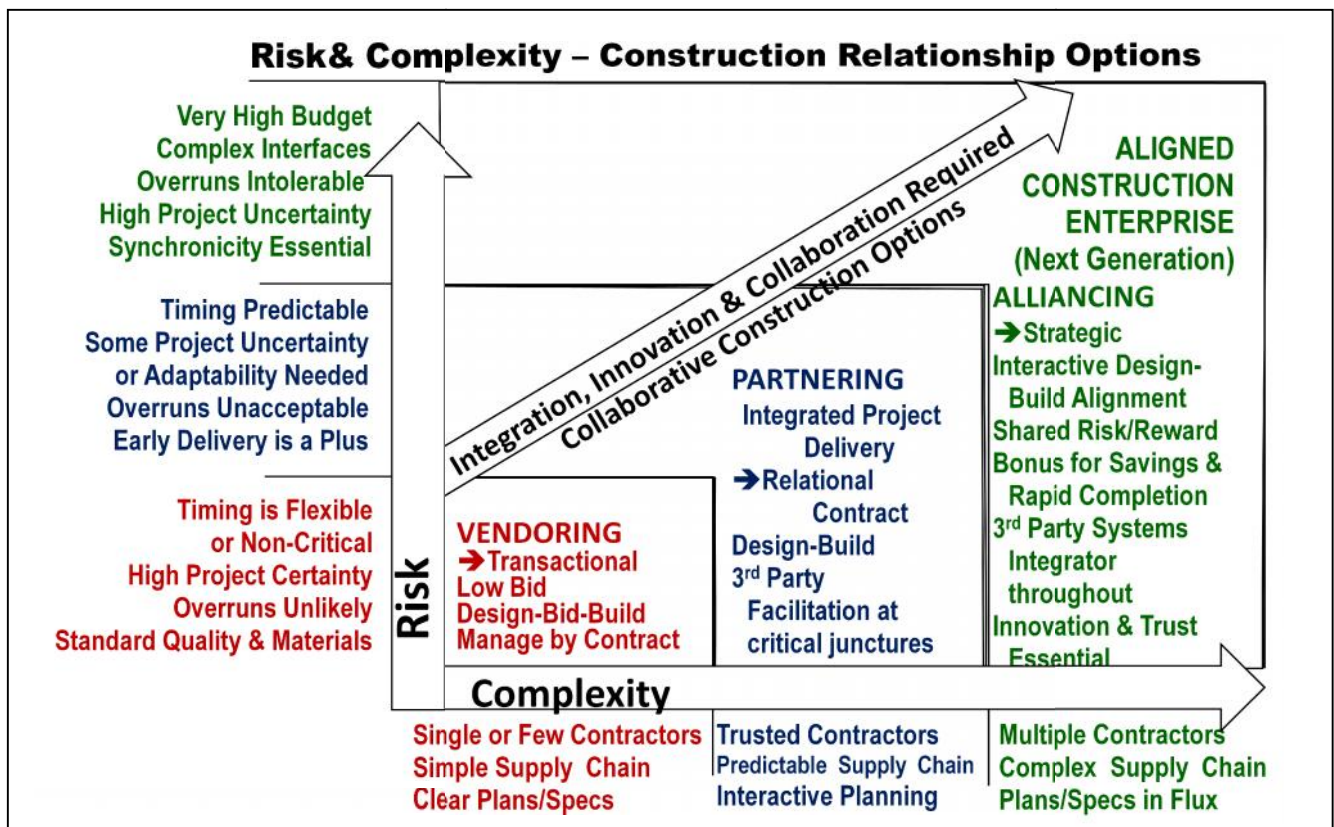


Figure 3: Risk & Complexity

The Canadian partnering model is based on the authors' extensive experience helping in the ninety construction projects which were characterized by the predominance of the *adversarial* and *transactional* interaction.⁵ The authors managed to move them with great success to a more *collaborative* mode resulting in over 90% success rate. The framework was tested in Alberta mainly on construction projects including transportation systems, highway interchanges, airport construction, roads and bridges, high rise buildings, hospitals and Mega oil and gas facilities. For example, many of the City of Calgary Light Rail Train (LRT) and interchanges projects were delivered on time and on budget without litigation using the partnering approach. Alliancing on the other hand, has been used in the U.S., Alberta Oil and Australia. In Australia, the alliance methodology, called "Alliancing," has experienced tremendous success, consistently bringing in hundreds of large scale projects on time and on budget.⁶

The Collaborative Construction Advantage

ALIGNED CONSTRUCTION ENTERPRISE

Need for Alignment & Integration

The authors have evolved the existing "Collaborative Construction Model" with a full-scale set of best-practice methodologies which combines learning, and the most productive practices from the Canadian partnering model and the Australian alliance models to create a hybrid, high performance system: the "Aligned Construction Enterprise (ACE)".

ACE is specifically designed to address the unique difficulties found in industrial Mega projects, which are typically plagued by cost and time over-runs mainly due to misalignment and fragmentation. The roots of misalignment lie in the heart of how major projects are conceived at the beginning and executed at every milestone, resulting in isolation, which breeds ignorance and spawns future failure ultimately resulting in further cost overruns and delays.

Correcting Structural Inadequacy

The systems problems that have plagued the industrial Mega project sector (outlined in Part One) highlight fundamental flaws from fragmentation of the organizational project structure causing poor *alignment* and faulty *integration* of all the stakeholders.

Our approach focuses on addressing large-scale construction projects deficiencies from a "systems" perspective, utilizing a systems integrator to ensure alignment and integration, and to provide critical core competencies that are traditionally missing in any of the key stakeholders. The proposed a new model creates a value network between principal players (see Figure 4).

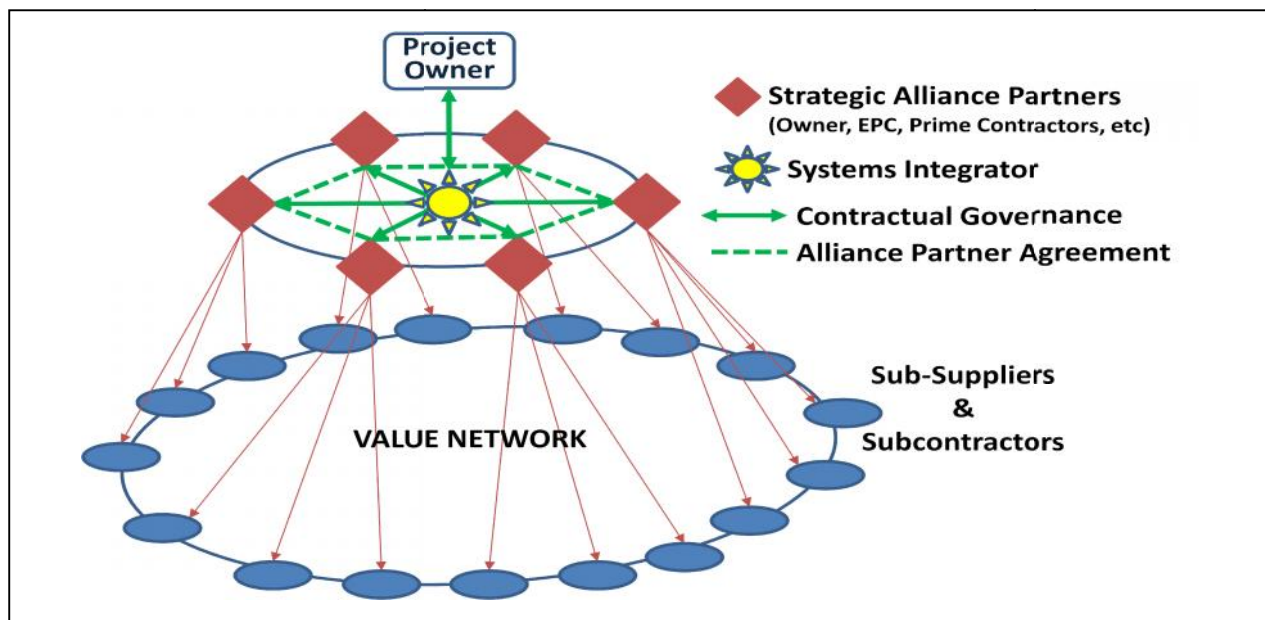


Figure 4: Aligned Construction Enterprise as a "Value Network"

Unless the entire project team is completely aligned with the goals and objectives of the project, and all the players are integrated into a complete team, the problem of poor performance will continue. Attaining this alignment and integration has been a major problem. The roots of misalignment lie in the heart of how major projects are conceived at the beginning and executed at every milestone

Future Pathway for Industrial Mega-Project Delivery

Why a Systems Integration Function?

Mega projects are highly complex systems requiring extraordinary levels of integration and innovation across the entire system. Because the different project components of the entire network are so highly compartmentalized, each, unless aligned, will naturally gravitate to maximize their own interests, not the interests of the project.

In smaller ventures integration can happen by creating an informal collaboration between owner, designer, and contractor(s), such as in IPD (Integrated Project Delivery). But in something as massive and complex as the scale of Mega projects, the alignment, integration, and innovation functions need to be more formalized, managed, and systematically applied.

To use an example: Boeing is one of the largest aircraft manufacturers in the world. But they don't make wings; nor landing gear; nor engines; nor seats; nor avionics. Boeing does not consider itself a "manufacturer;" defining themselves as a "systems integrator;" masters of the design, development, contracting, assembly, testing, and selling.

In other words, the "systems integrator" connects all the elements of a *value network*, making sure all the points of value creation⁷ are maximizing their potential, in-unison and in-synch.

Using another example: The human body is a highly complex, dynamic organism. One of the functions of the brain is to ensure each of the organs and appendages is doing its job in the right sequence and performance level. When one goes running or jogging, the heart and lungs respond by increasing the flow of blood and oxygen intake to meet the needs of running hard. The brain manages the alignments and integration of complex functions.

In the same vein, a highly complex system like a Mega project needs a far more advanced systems integration function than one needed for smaller scale projects.

Alignment Requires Early Engagement

Alignment cannot begin at groundbreaking – by then it's already too late; it starts with *early engagement of key partners*.

Devon's success in Jackfish 3 relied on having key members of the development, supplier and construction teams sharing ideas, concerns, and recommendations from the inception:

It means getting everyone in alignment early – the internal departments such as engineering and the supplier partners and contractors – together doing front end planning together, getting their best people engaged early, providing insights and practical applications while we are defining material requirements.

Early engagement with our key supplier partners gives us a real competitive advantage. We have open discussions about risks and how to address them jointly. We all work together under a common model and problem solving method.

Owner Executives and key decision makers often lack experience in project management and project execution of complex major capital projects, which causes serious project execution issues. For example, a company that assigns a Mega Project to an Executive Vice President who has never managed a project in their career, the inevitable result will be massive and catastrophic. The more experienced people who can be brought in early on, the more likely a successful outcome.

The Collaborative Construction Advantage

Aligned Construction Enterprise (ACE) Management Centre

The ACE solution for Mega projects adds a new dimension to the alliance-based construction model by the creation of a Systems Integrator function imbedded in the middle of the value network to unify project delivery. The project systems integrator will act as a facilitator, alliance manager, and integrator, cooperating and assisting the stakeholders and the owner/investor's organization(s) to provide critical support to the project delivery teams, especially in areas that are not traditionally embraced in the core competence of any of the delivery members.

These operational functions enable maximum performance and are centrally coordinated through the "Management Centre." (see Figure 3).

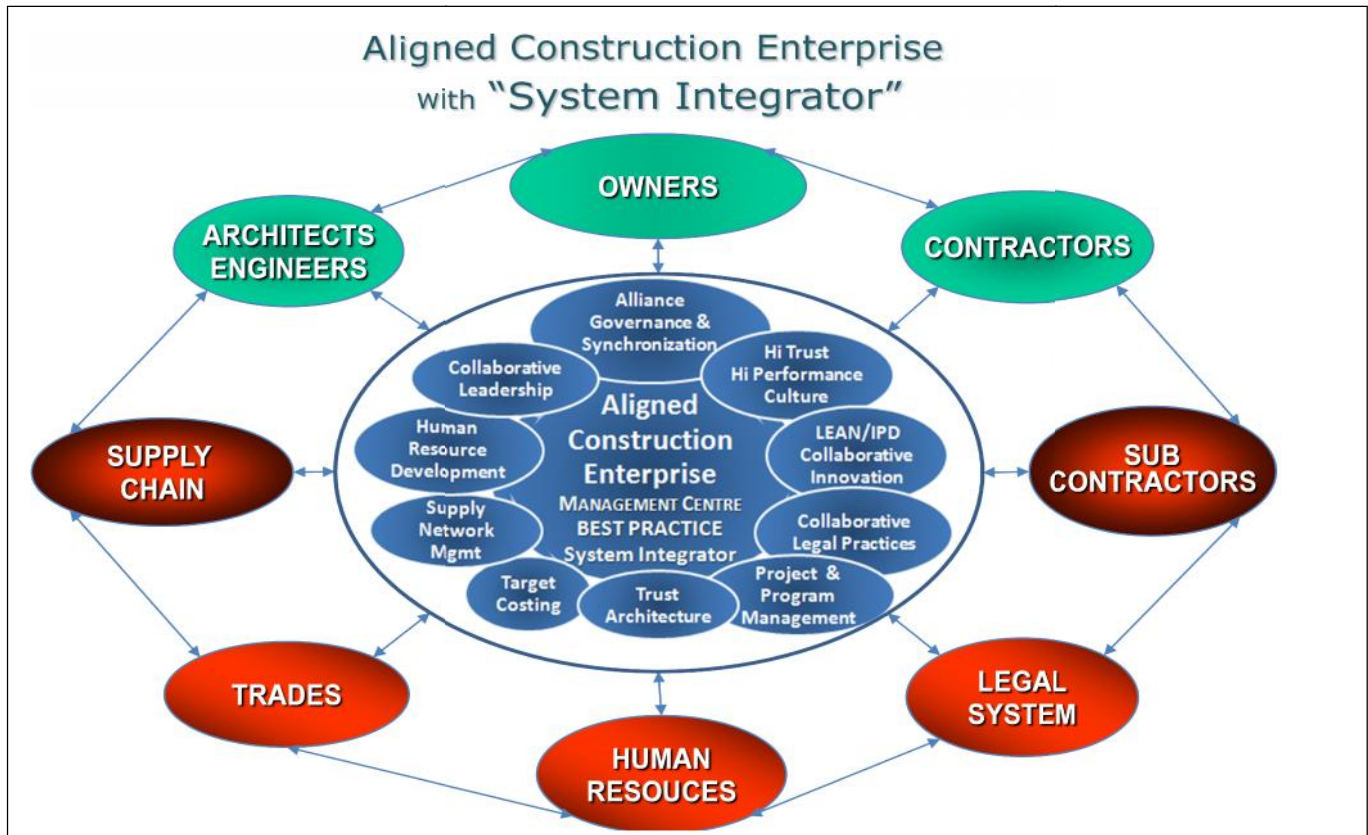


Figure 3: Aligned Construction Enterprise Management Centre

Purpose

The core purpose of the ACE Management Centre is to implant, dead-centre in the middle of the delivery system, an entity imbued with best practices to link the pieces, plug the gaps, expedite the flow, anticipate problems, keep the stakeholders in alignment, integrate the interfaces, manage complexity, and turn breakdowns into innovative breakthroughs.

Its task is to ensure that the whole is greater than the sum of the parts; that all players are winners; and that the mechanisms for fast time, cost reduction, and fair play are at work on the job site 24/7. It will be responsible for solving problems and creating the impetus for achieving the key success criteria, thus keeping the value network in alignment as a holistic system.

Future Pathway for Industrial Mega-Project Delivery

Functions of Systems Integration

The ACE Systems Integrator will analyze the core competencies of the key stakeholders to determine if any skill sets are missing that could prevent achievement of objectives. Should critical competencies be missing, or incomplete, like information systems, integrated supply chain management, or lean construction skills, then the service integrator will seek those skill sets and ensure they are imbedded into the project.

The ACE Management Centre systems integration functions are to:

- Define and forge alignment on common goals and objectives between the alliance partners, developing plans for their achievement, and establishing working relationships endorsed by senior leadership, and supported by the project owner.
- Create an environment where open and honest communication, trust and teamwork foster a cooperative bond, promote innovation and prevent breakdowns at interfaces.
- Plug the gaps in missing competencies and capabilities to create a whole system.
- Establish cross-functional leadership teams for managing ever-changing alignments.
- Discuss and resolve any conflicts or adversarial relationships that may emerge.
- Provide facilitation, team training and conduct regular organizational "health checks."

Management Centre Ownership

The ACE Management Centre could be an independent project management firm or project management office established jointly-owned and controlled by the stakeholders (owners, contractors, EPCs, employees, suppliers, labour unions, and the public) who put up the money to for its staffing in proportion to the amount of reward they share in the venture. The reward is the *value* producing on-time, on-budget results far exceeds the *costs* of running the Centre.⁸

Management Centre Staffing

The ACE Management Centre should be staffed by highly competent professionals assigned to help give the whole Mega project a major uplift, injecting best practices and integrating the fragmented parts of the system to ensure high performance and innovation. The authors foresee that the ACE Management Centre will be staffed by three full-time professionals:

1. **Senior Alliance Leader** who champions the ACE concept and sits on the ACE Leadership Team. This person should be a seasoned executive with a strong track record of success and capable of systems integration functions, alliance coordination, fast-time delivery, implementation of collaborative innovation functions (Target Costing, Value Stream Mapping, Partnering, Lean Construction, etc.) and be familiar with advanced supply management.
2. **Alliance Manager** with field experience who crosses organizational boundaries, monitors flow, engages in early identification of problems, ensures schedule, prevents break-downs in operations, and ensures communications across the network.
3. **Human Resources Specialist** to provide expertise in recruiting, hiring, training, placement, career-pathing, retention, labour relations, morale, personal recognition, and teamwork.
4. **Adjunct members** (part-time on an as needed basis) for:
 - a. Data management linking suppliers, buyers, engineers, and other providers
 - b. Community involvement/benefit with public engagement and trust building
 - c. Systems "health diagnosis" to spot problems before a crisis
 - d. Legal assistance/advice in relationship-based, trust building contracting processes

The Collaborative Construction Advantage

The Sequence to Ensure Success

The ACE model *avoids* the Design-Bid-Build strategy (which often becomes adversarial). There are three key aspects to ensuring a high quality, results-oriented project delivery:

1. A high performance Design, Construction, & Supply Chain Team is *pre-selected* based on integrity, quality, fast-time delivery, and collaborative innovation skills. This team will be engaged *early on* in engineering and implementation.
2. Instead of bidding on designs, the Design, Construction & Supply Chain Team uses "Target Costing Estimates" with "guaranteed maximum" (based on "business as usual" standard costing) to devise faster schedules and even lower than normal/expected costs.
3. The integrated teams then set out to break targets, being incentivized to breakthrough further, with a portion of any financial benefit of early delivery allocated to stakeholders.

Collaborative Construction Requires Strong Leadership

Especially for companies that have had a long history of engaging with suppliers and contractors *transactionally or adversarially*, making the shift to collaboration may be difficult. Senior leaders must be united in their resolve to stay on course. For Devon Canada Corporation, the shift evolved over three Jackfish projects. Steve Bass observes:

A collaborative strategy needs dedication by leaders at the top, middle, and bottom of our organization. Leadership stepped up to make a major difference.

Being a leader means you are doing something different, something better – not the same thing that had failed before.

We needed a strong, collaborative vehicle for change to enable us and our partners to move past being transactional, past the adversarial blame game, into genuine joint problem solving.

Strategic Alliances Enhance Alignment & Integration

To optimize the power of value chain integration, ACE utilizes strategic alliances to link and align each organizational entity that plays a key role impacting the project delivery system at both the strategic and tactical levels. The issues of control and trust worry many executives. In the last 20 years the alliance profession has deeply codified the organizational architecture of best practices that create repeated success.⁹ When using best practices to form, align, and manage alliances, the control issues are replaced by highly synergistic leadership, governance, and trust. In the end, collaboration and integration continually beats distrust and fragmentation in the creation of competitive advantage for those making the partnering decision.

A formal governance structure is established enabling the multiple partners to make adjustments in real time, addressing immediate problems, allocating priorities and resources, and ensuring high trust partner relationships. The alliance framework calls for a shared risk, shared reward to incent and align the stakeholders. The owner sets aside a significant reward that is fairly allocated and distributed to stakeholders when project milestones are met or beat.

Critical Success Factors: Foundation of the Aligned Construction Enterprise

From the authors' experience studying and building high performance teams across Canada and in the United States, several over-riding factors have been found that produce success:

Trust, Teamwork, & Innovation as Central Organizing Principles

ACE isn't just a *delivery methodology* change; it's also a *cultural* change. Senior leadership must make *trust, teamwork, and innovation* the new culture's *central organizing principles* to be successful.

Future Pathway for Industrial Mega-Project Delivery

Complete Value Chain Alignment

High performance organizations start with highly collaborative strategies for engaging all parts of their value chain internal and external, founded on tight linkages between all organizations.

Senior Executive Commitment

The use of ACE requires top-rank support from every partner. It cannot be successful unless the senior leaders of each of the essential stakeholders are fully committed and engaged.

Rigorous/disciplined use of Best Practices

ACE carefully utilizes the best practices of several collaborative construction models, which, if used rigorously, doubles or triples success rates.

Gaining Value from Lessons Learned

Too often lessons learned are collected, but sadly, the lessons are mostly nonsense, failing to address real root causes. What's learned is superficial, blindly reinvented in the next project.

High Performance People

Collaborative construction relies heavily on hard-charging, trustworthy people who like to excel, are committed to performance, and work creatively in teams -- the essence of value *creation*

Careful Selection of the Delivery Team

Prequalification of engineering, contracting, and supplying companies is a critical factor for success. While cost is always a factor, this is balanced with other key considerations such as a history of delivering on time, a track record of little or no disputes/litigation, strong customer satisfaction, aptitude for innovation, positive working relationships with subcontractors, and the ability to retain quality personnel who will be assigned to and remain on the job.

Focus on Schedule Over Cost

Oil sands Mega projects must emphasize schedule over cost. Low cost is elusive and a delusion if the project sustains substantial and cumulative changes, and fails to be delivered on time. Falling behind schedule ruins all Return on Investment (ROI) projections, which can be ruinous when the price of oil fluctuates wildly. For Mega projects, the total, all-in cost (including lost production) of falling behind schedule can be as high as a \$1 million per hour. Therefore, project planning and execution must make staying on schedule paramount from owner to labourer.

From Supply Chains to Value Networks

The idea of 'supply chains' evolved from the transactional exchange of goods for money between companies. However, when supply chains are integrated and when independent suppliers are provided with a trustworthy relationship they begin sharing ideas interactively.

Matt Knight at GO Productivity refers to this transformation as a "value network". It describes a system of partners who share similar values and business strategies and are committed to working together to achieve a thoroughly discussed goal." He says it "works faster, is far more innovative, and thus it creates a major competitive advantage over slower chains."

But he maintains the standard RFP (Request for Proposal) process is severely limiting, "The whole RFP process is broken; it doesn't build trust, nor does it encourage innovation flow." Once we integrate suppliers in a collaborative network, we establish an environment that can grow new value.

When you know your requirements, you interview supplier partners and say, 'Here's our vision and here's our commitment to you,' so it's a mutual commitment over time to sharing risk and rewards, which increases efficiencies during the execution of the project."

Safety is Designed into the Project from Inception

The Devon Team spent time creating a system resulting in on-time, on-budget, zero injuries, according to Steve Bass:

We've had a spotless safety record because we first aligned through values, then we made a strong commitment to safety, innovation, joint processes. data sharina. and trainina.

The Collaborative Construction Advantage

Devon's Commitment to Excellence

Devon's success meant going beyond transactional thinking. Steve Bass comments:

Devon employees made a real commitment to mentoring local contractors doing business on the Jackfish 3 project. They helped suppliers set up systems and paperwork, coached them on logistics, construction and project management, and trained them in environment, health and safety requirements. Sometimes the suppliers ran into problems; we were there to help them, not to blame them.

The result? Jackfish 3 is a great success for local communities, whose people have now proven to be commercially successful and have developed a robust workforce. It's very rewarding.

What's crucial is the interplay between companies:

The integrated supply chain brings the partners together and creates the understanding of how we're going to succeed in this project.

SHIFTING MINDSETS

Implementing ACE entails a shift in industry mind set. Considerable up-front investment in time and resources to bring the right people into the process, to transcend typical industry resistance, and to forge a common team identity among different stakeholders in the delivery chain.

Myopic versus Holistic Risk Management

The fast track nature of major industrial projects, combined with rapidly evolving new technologies, and complexities not easily perceived at conception always result in major and multiple scope changes during the execution phase. These risks must be fairly factored into the operating agreement, not thrown mercilessly and adversarially into contracts that kill trust, turn allies into enemies, and doom the project to finger pointing, poor coordination, and ultimately litigation.

Collaborative leaders understand something their *adversarial* and *transactional* counterparts fail to grasp: *culture risks* (such as the lack of teamwork, innovation and mistrust). may be the biggest risks of all, a risk that is amplified and magnified the more complex the project.

Failure to put a high trust/ teamwork culture in place triggers poor quality, grievances, sabotage, labor strikes, employee disengagement, absenteeism, employee turnover, non-value added work, lack of foresight, poor communications and coordination, low performance and productivity, silo mentality, lack of innovation, and slow speed -- all ultimately leading to cost overruns and schedule breakdowns. Seeing these risks is the essence of *holistic* risk management.¹⁰

Trust Reduces Risk

Collaboration is both a trust mitigator and a reward enhancer. Here's how Devon's Steve Bass views risk:

Sharing risk and creating value together helps build trust. When solutions are created collaboratively, it lowers our risk

We cannot be caught in a blame game. That just increases the risks. We need to work as a team in the supply chain; a team in the development phase, and a team in the project rollout – we work like a network. That helps them recruit and retain a highly skilled labour force, which helps reduce our exposure to risks

If we can find partners for the long-term journey, we can create something special. We can manage risk together, share learnings, knowledge and observations of what's going on in the marketplace. That can yield a truly rewarding relationship.

Future Pathway for Industrial Mega-Project Delivery

The Most Important Thing for Leaders to Know

The Aligned Construction Enterprise is not just a structural solution; it is a culture of collaboration. What every leader must grasp is that *leaders, more than anything else, create the culture that draws forth or suppresses good or bad, wanted or misguided behavior.*

At the outset of any project, leadership must make a distinct decision as to the type of culture to be deployed: *adversarial, transactional, or collaborative*, which then defines manner of how the "game" of business is played. This is often overlooked, with dire consequences, especially if the "game" is a crude mixture of all three approaches, which will divide people against themselves.

Senior executive must align the leadership and middle management teams into coherent units by:

1. Building a unified vision, based on teamwork, trust, and innovation as the three central organizing principles of high performance, high profitability, and high sustainability
2. Any leaders committed to *adversarial* or *transactional* thinking must be swapped out.
3. Developing a set of high performance values, metrics & rewards that support a *collaborative* culture, then living by these.
4. Making collaborative innovation the source of co-creative problem solving, adaptation to changing environments, and competitive advantage in meeting emerging customer needs.

Devon's Commitment to Building Trust

Trust is the foundation of all collaborative enterprise. Here's what Steve Bass at Devon says:

If we're good at collaborating and do it right, we create trusting relationships.If we stand by the values we've agreed to stand by, trust develops.....earned by dealing with difficulties fairly along the way.

You have to say what you're going to do and do what you say. Be consistent with behaviours and values. We hold each other accountable in a collaborative relationship. The traditional model of buying and contracting, holding you liable—and maybe suing you—is an arm's-length, even adversarial, style.

Case Example – A Failure to Innovate

In an atmosphere of intense distrust, systems fragmentation, bureaucratic control, and adversarial contracts, collaborative innovation withers and dies. Innovative solutions never see the light of day, buried in the trash-heap of fear.

For example, in one recent Mega Project, in an effort to stay on schedule, one contractor recognized the approach to lifting a 900 tonne reactor typically required a specialty crane which needed to be pre-ordered years in advance, costing several million dollars.

Faced with an inflexible and aggressive schedule, a senior Construction Manager suggested modifying the design of the reactor support structure so that the reactor could be jacked in place, eliminating the need for the specialty crane, reducing both cost and time.

While the idea was sound, and in the best interests of the project, in a poisoned atmosphere of distrust the engineers saw the suggestion as a threat to their competency, and the Project Control team saw it as a change in specs, suspicious that the Construction Manager was trying to pad his profits.

Needless to say the idea was squelched, and the Construction Manager ended his efforts at innovation.

The Collaborative Construction Advantage

CONCLUSIONS

Mega projects are characterized by extreme complexity and risk; they cannot be successful when the risk and complexity is compounded by an *adversarial* operating environment.

The Aligned Construction Enterprise (ACE) model is an evolutionary product best practices and implementation of major projects in Canada, North America, and Australia, that promises to:

- Produce on-time, on-budget, on-target project delivery in a mutually profitable manner.
- Bring key stakeholders together to develop an aligned and focused value flow.
- Directly address the counter-productive nature of adversarial relationships.
- Encourage openness, fairness, and integrity foundation for collaborative innovation.

In the authors' many years of building and studying high performance project teams and organizations, there are several over-riding conclusions:

1. High value leaders collaboratively engage all parts of their value chain, internal and external.
2. Organizations that sustain their advantage over the long term place great value on their people, culture, and, in particular, they emphasize trust.
3. Success requires the rigorous use of best practices in collaboration and trust building.
4. Collaborative construction requires strong, leadership united in their resolve and vision.
5. Being a leader means doing something different, something better, not the same thing that failed before. Leadership is the primary means of affecting the mindset and cultural shifts in any organization. This is why leadership is more important than anything else, even money.

Launching collaborative construction can begin with pilot projects -- staking out a new vision and a new era in the construction industry.

But it takes a whole new level of thinking. As Einstein advised, problems cannot be solved with the same level of thinking that created the problem, otherwise risking doing the same thing over and over again, expecting a different result

Canada is one of the most trusted nations in the world; we need to use our inherent trustworthiness as a capital asset.

***The future of Canada's Energy Industry is at stake;
the future is beheld by those who create it.***

Future Pathway for Industrial Mega-Project Delivery

APPENDIX: WHY COLLABORATION PRODUCES BETTER RESULTS

The Situation: Thousands of Complex Interconnected Interfaces Mega Oil Sands Projects

Example: \$2.5 billion Project

Engineering Effort

- 3.5 million man-hours
- 40 - 50,000 design drawings
- 10 - 20,000 vendor & shop drawings

Supply Chain Logistics

- Organize, order, store and retrieve 80,000,000 material items

Construction Effort

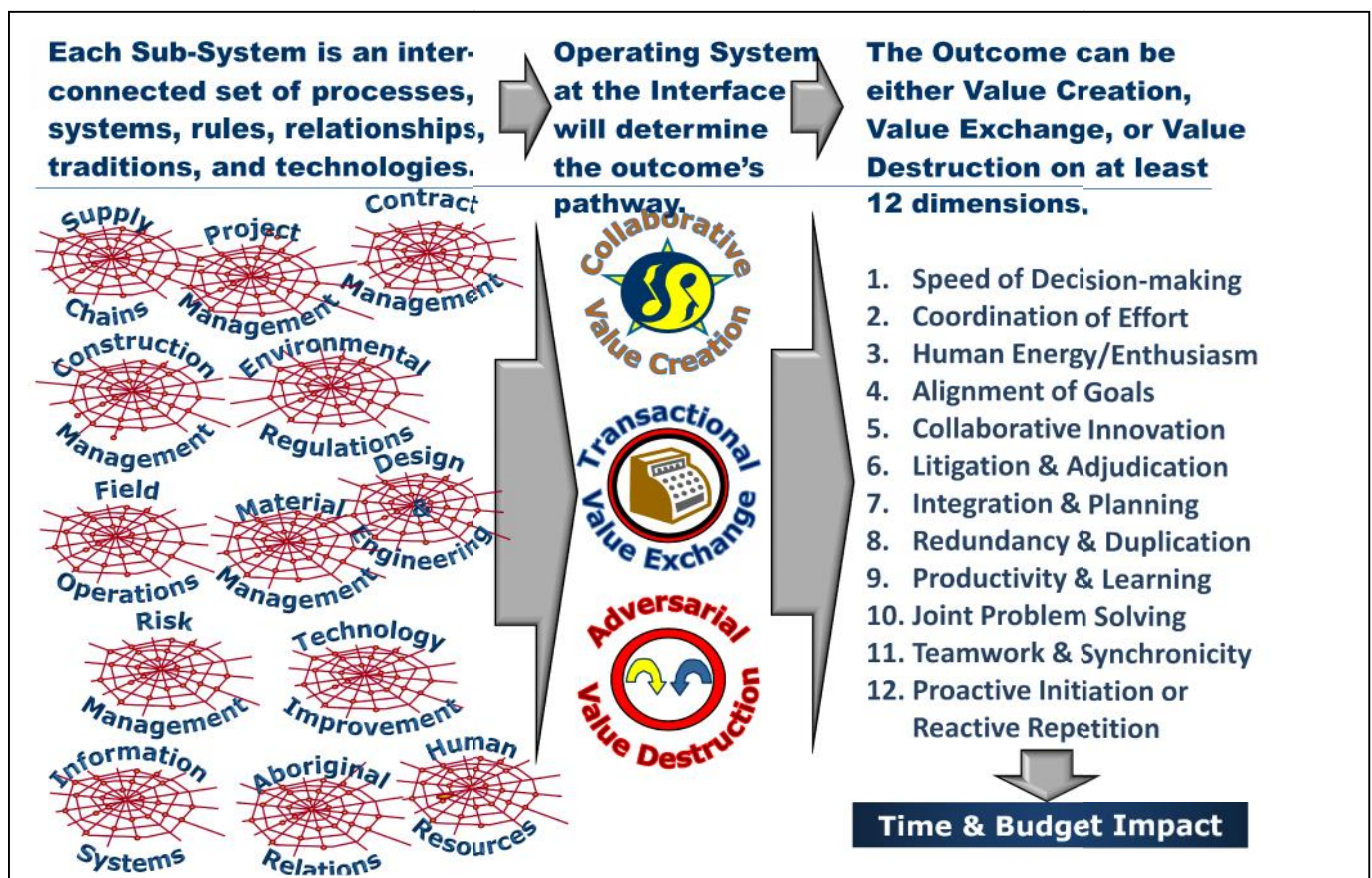
- 15 million construction hours
- Labour force of 8,000 workers with a turnover of 200%
- Supported by 500 - 800 staff personnel

Management Effort

- Managing a craft mix of 8,000 workers working in pairs doing at least two different activities per day results in a never ending 80,000 individual jobs in a 10 day shift.

Operational Requirements

- Each job requires a combination of the correct, materials, location, access, tools, equipment, scaffold, safety, quality, rigging, consumables, welding, x-ray and many other inputs to allow the worker to get his job done.



Future Pathway for Industrial Mega-Project Delivery

ACKNOWLEDGEMENTS

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NOTATIONS

The following acronyms are used in this paper:

ACE: Aligned Construction Enterprise;

LRT: Light Rail Train;

EPC: Engineering Procurement &
Construction;

ROI: Return on Investment;

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¹ Jergeas, G.F., "Analysis of the Front-end Loading of Alberta Mega Oil Sands Projects", Project Management Journal, Volume 39, Issue 4, 2008.

² Ernst & Young; *Spotlight on Oil & Gas Megaprojects*, (ey.com/oilandgas/capitalprojects), 2014

³ Study conducted in workshops throughout Canada and the U.S. from 2009-2015. Over 4,500 senior managers evaluated the impact of trust on key operational factors. Universally executives reported a minimum of 30% advantage in each of the factors when evaluating high trust over low trust organizational cultures.

⁴ Thomsen, C., Darrington, J., Dunne, D. & Lichtig, W. 2009. "Managing Integrated Project Delivery." (<http://cmaanet.org/fellows>) cited with permission

⁵ In addition to the 90 Canadian projects, the authors collectively have been involved in the successful implementation of hundreds of alliances globally in multiple industries. This experience has included the identification and codification of over 500 best practices in alliance formation, partner alignment, trust building, and operational excellence.

⁶ Morwood, Richard; Scott, Deborah; Pitcher, Ian; *Alliancing, A Participant's Guide, Real Life Experiences for Constructors, Designers, Facilitators, and Clients*, AECOM, Brisbane, Australia, 2008

⁷ Note: we are making a distinction here: value *creation* is a reasonably expected outcome of *Collaborative* Systems. In contrast, *transactional* systems engage in value *exchange*, and *adversarial* systems focus on value *protection*, which often actually degenerates into value *destruction*. Value *creation*, when implemented in a high-trust environment, becomes *regenerative*, while value *protection*, in a distrustful environment, becomes *degenerative*.

⁸ The total "all-in" costs of running over time can run as high as \$10-30 million per day. From an return on investment perspective, simply bringing in the project a few hours earlier would be enough to pay for the ACE Management Centre.

⁹ Lynch, Robert Porter; *Business Alliances Guide, The Hidden Competitive Weapon*, Wiley, 1993
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¹⁰ Rolstadas, Asbjorn; Hetland, Per Willy; Jergeas, George Farage; Westney, Richard E.; *Risk Navigation Strategies for Major Capital Projects*, Beyond the Myth of Predictability; Springer, 2012