Independent Project Analysis

Alberta Productivity Trends

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Outline

- ***Current State of Capital Projects in Alberta***
- **A Look at Contracting**
- **Productivity in Alberta versus USGC – Now and Then**
- **A Few Case Studies**
- **Wrap-Up**

Extreme Cuts to Capex

- **The Alberta region has been through highs and lows in the past 10 years**
- **The low oil price has brought drastic cuts to capital spend**
- **Last year IPA evaluated ~700 capital projects around the world totaling $67 billion in capital spend**
  - **Only 2% of projects were in Alberta- just $0.7B**
- **In peak years up to 10% of global project activity that we saw was in Canada**
  - **We commonly benchmarked $10B to $15B in capital investment in Western Canada in a given year**

A Changed Landscape

- The low oil price has increased desire for capital effectiveness
- This has driven
  - Changes to contracting strategy
  - Increased interest in standardization
  - Efforts to make work processes fit-for-purpose for smaller projects
- As the oil price has stabilized, we see some major project activity starting to creep forward again

Now and Then

- **This presentation will examine trends and performance pre- and post-2010**
  - **Projects authorized and executed largely during the hot market, versus largely during a softer market**
  - **Dataset includes mix of project sizes and industries (oil sands, refining, chemicals, consumer products)**
  - **Excludes small sustaining capital projects**
- **We know that productivity suffered during the hot market**
- **Has productivity improved in this slower period?**
- **What can we do to improve productivity?**

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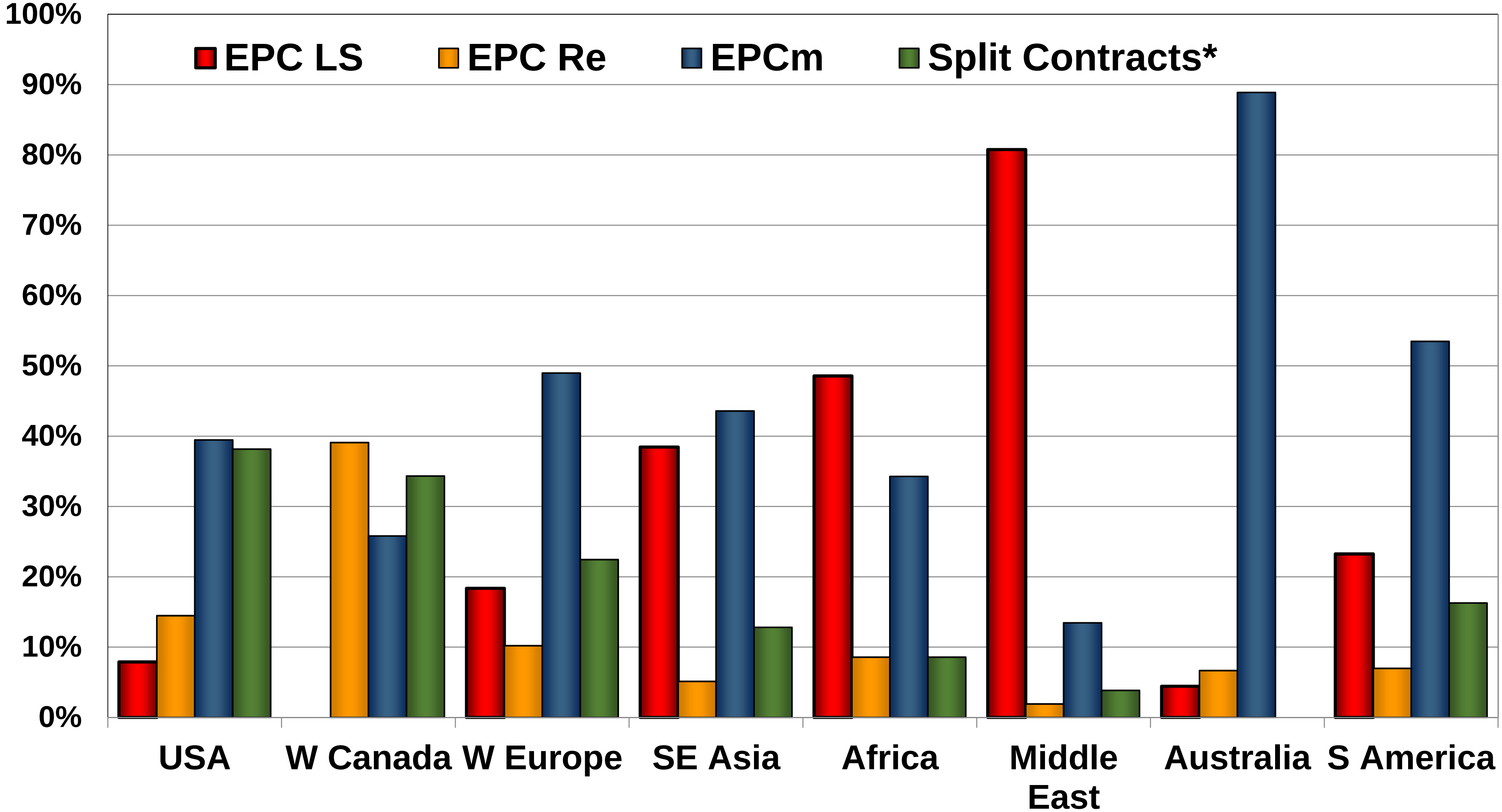
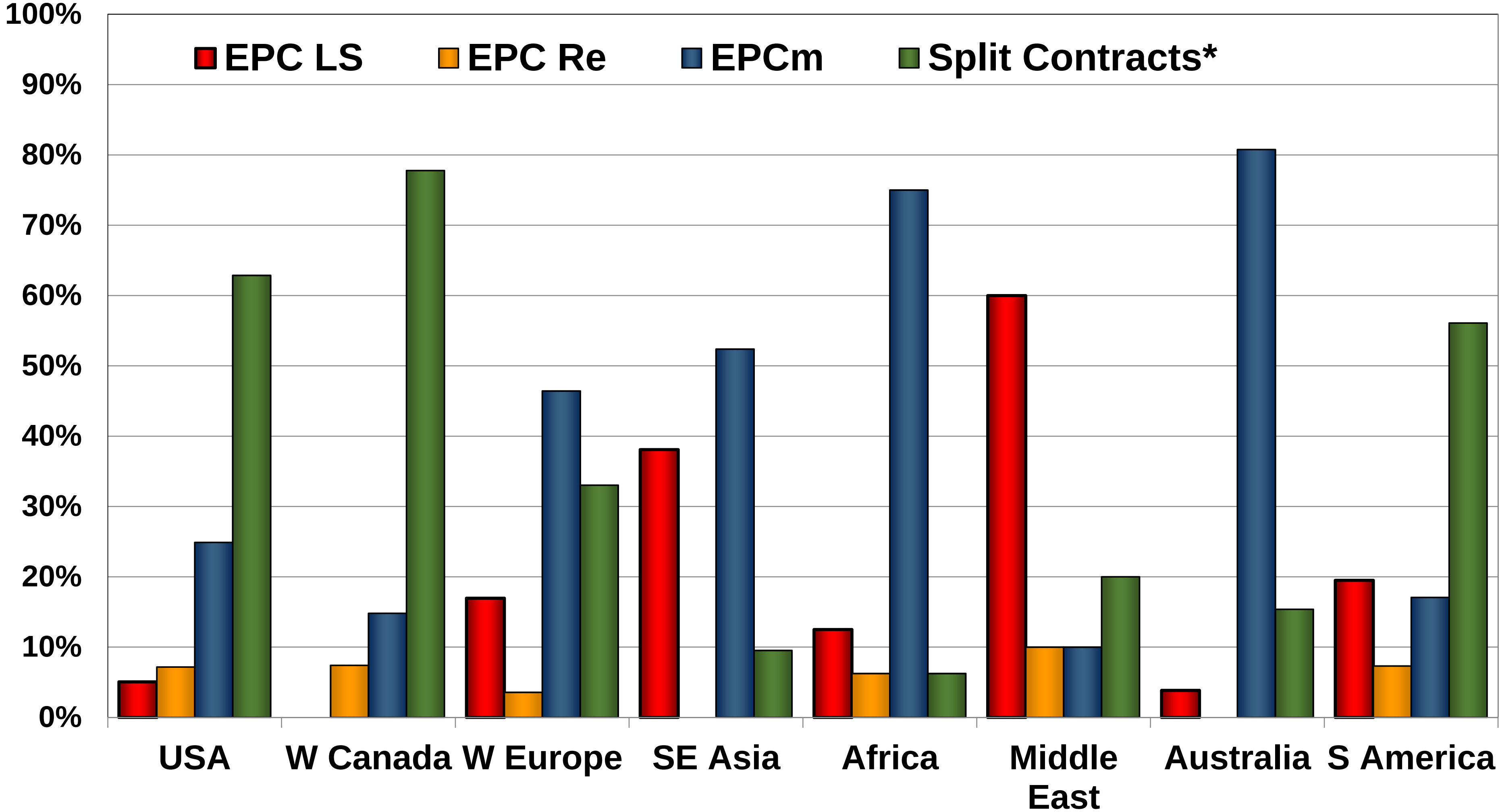
Alberta Remains Somewhat Unique in Favoring EPC Reimbursable Contracts for Major Projects



**Split Contracts include Re/LS, Re/Re and LS/LS contracting approaches*

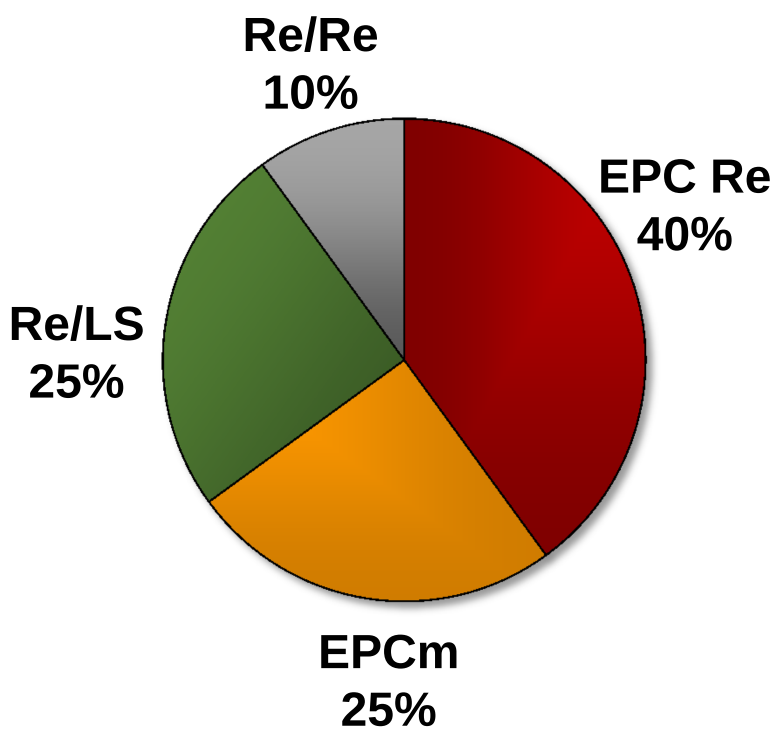
Midsize Alberta Projects Usually Apply a Split Approach, as in the US

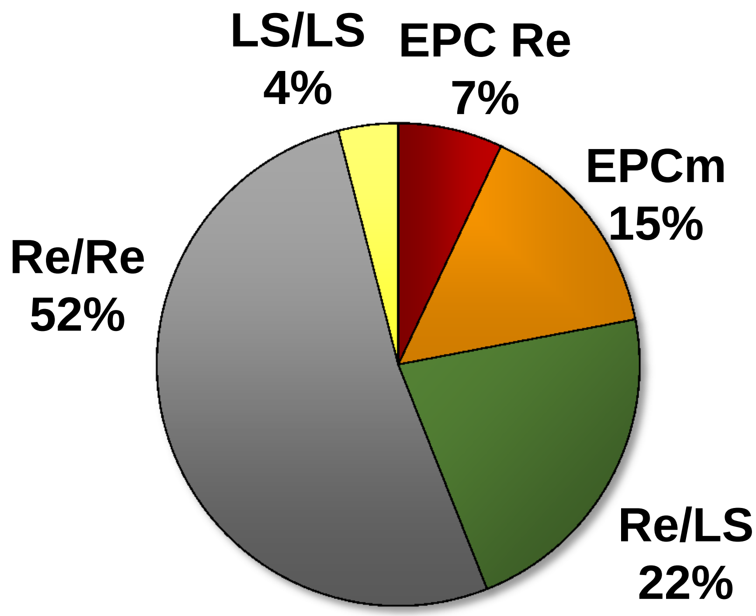


**Split Contracts include Re/LS, Re/Re and LS/LS contracting approaches*

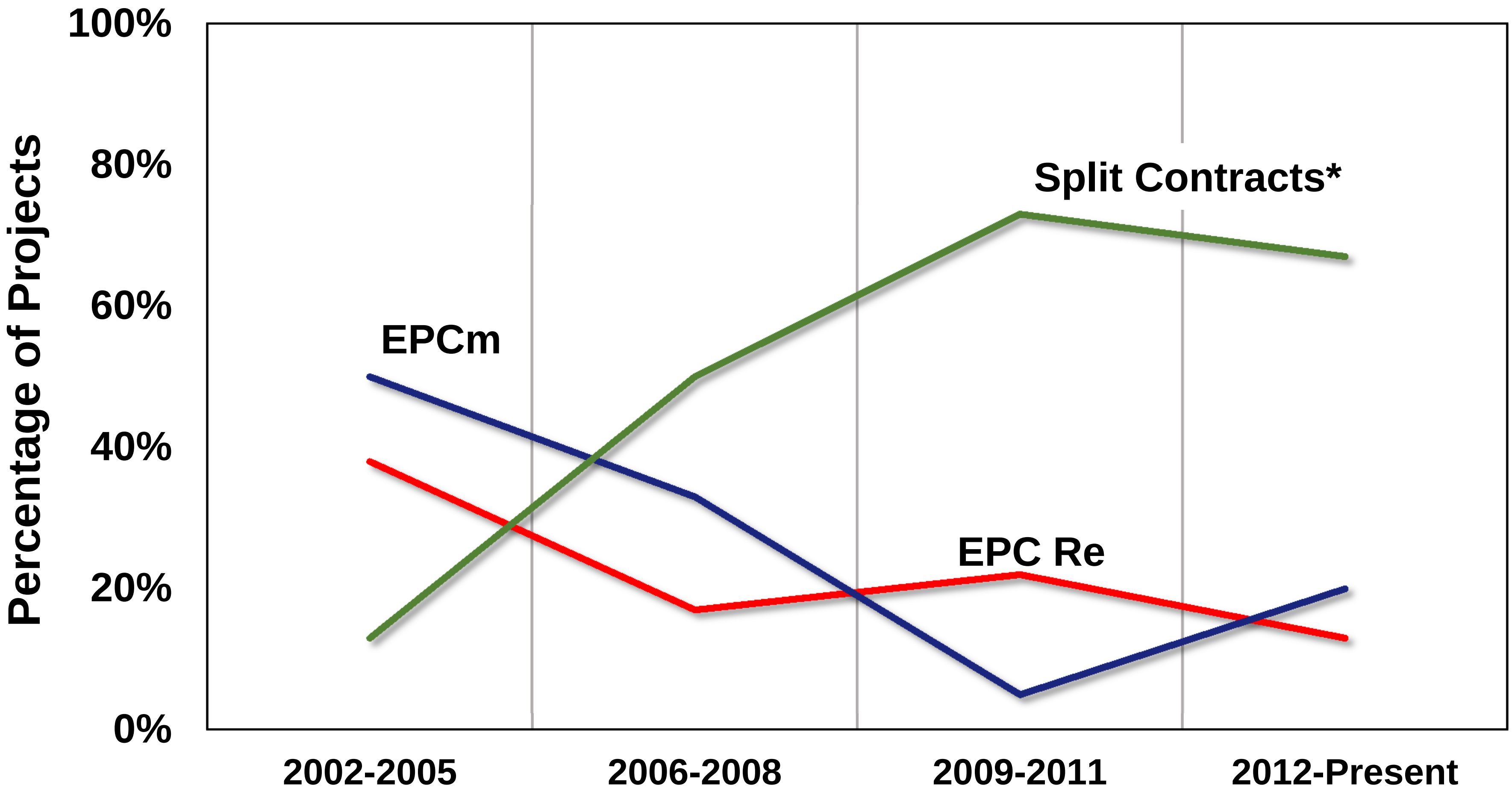
Clear Difference in Approach Between Large and Midsize Projects in Alberta

Large Projects	Midsize Projects





Split Contracts Have Become the Dominant Form in Western Canada Over Time



***Split Contracts include Re/LS, Re/Re and LS/LS contracting approaches**

Split Contracting Approach Saves Capital

IPA

- **8 percent more cost effective *(Pr.|t|<.0001)* than EPC and EPCm forms *(Even when controlling for all practices)***

- **More cost effective in every region in which the sample permits testing**
  - **Are 15 to 25 percent more cost effective in Europe**
  - **Re/LS form is 12 to 25 percent more cost effective in Western Canada**

- **Does not have an execution schedule penalty**
  - **Re/Re with FEED Contractor doing EP is the fastest approach**

- ***Much more cost effective for large projects***

Why Does “Split Contracting” Work?

- **Promotes more complete engineering before field mobilization**
  - **There must be enough engineering completed to create the bid packages for both Re/LS and LS/LS contracting**
  - **There is no incentive on the part of the engineer to get in the field too quickly, because there is no profit in it**
  - **Unfortunately, split contracting does not reduce engineering slip, but it does control the negative consequences**
  - **Construction is actually shortest following lump-sum engineering, but engineering slip is the worst under the LS/LS arrangement**
- **Because late engineering is the largest single problem that we face, it is not surprising the split strategy works**

What About Incentives?

- **IPA research shows that contractor incentives for cost and schedule bring no measurable benefit**
- **Our discussions with contractors and owners confirm this**
- **What may work instead?**
  - **Specific Behavioral Incentives (SBIs) target changing contractor behaviors that the owner believes will enhance project value (trigger specific contractor actions)**
  - **Not a "feel-good" practice, but targeted at something <u>specific and measurable</u>**

SBI Examples That Appear to Be Successful

Specific Behavior Incentive	Resultant Behavior
Key Contractor Personnel Turnover • **Bonus or fee-at-risk associated with any turnover of key personnel selected as part of project award** • **Only exceptions were disabling illness or death *(key feature)***	***No turnovers***
Reduce Engineering Error Rate • **Bonus awarded for low engineering error rates combined with timely completion of engineering** • **Errors defined and counted by owner *(key feature)***	***Enhanced contractor engineering QC and rapid mobilization of design***
No Negative Information Withheld from PM • **Incentive contingent on no negative information withheld from the owner PM by lead contractor** • **Decision to award solely by PM** • **Only incentive provided *(key feature)***	***Contractor PM ensured* he *got bad news quickly to protect bonus***

Contracting is a 2nd Order Issue for Capital Projects

- **Last December I was in Calgary and met with 4 different companies**
  - **The first told me, "We switched our $100 million project from reimbursable to bidding it out lump-sum – and saved 10%"**
  - **The second told me "We usually go lump-sum for this type of $50 million project but we switched to T&M – and saved 10%"**
- **The root cause of the savings was better planning, a strong owner organization, and a concerted effort to plan and implement these projects in the lowest cost manner – not just the contracting strategy!**

Key Takeaways

- **Split contracting approach – reimbursable engineering, lump-sum construction - is most cost effective approach *<u>provided that the owner organization has the staff and competencies to manage it</u>***
- **Traditional cost and schedule incentives do not work, but creative approaches to motivate and measure desired behaviors show promise**
- **Good planning and a robust owner team are first and foremost the key to success, irrespective of contracting strategy**

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Project Size in Alberta Has Decreased

- **In Alberta**
  - **Pre-2010, the average project size was about $500 million**
  - **Post-2010, the average project size is less than $100 million**
    - **Far fewer megaprojects executed**
- **In USGC**
  - **Pre-2010, the average project size is $120 million**
  - **Post-2010 the average has dropped to $90 million**
  - **Both sets include megaprojects, and megaproject activity increasing for chemicals sector**

Alberta Productivity Improved After 2010

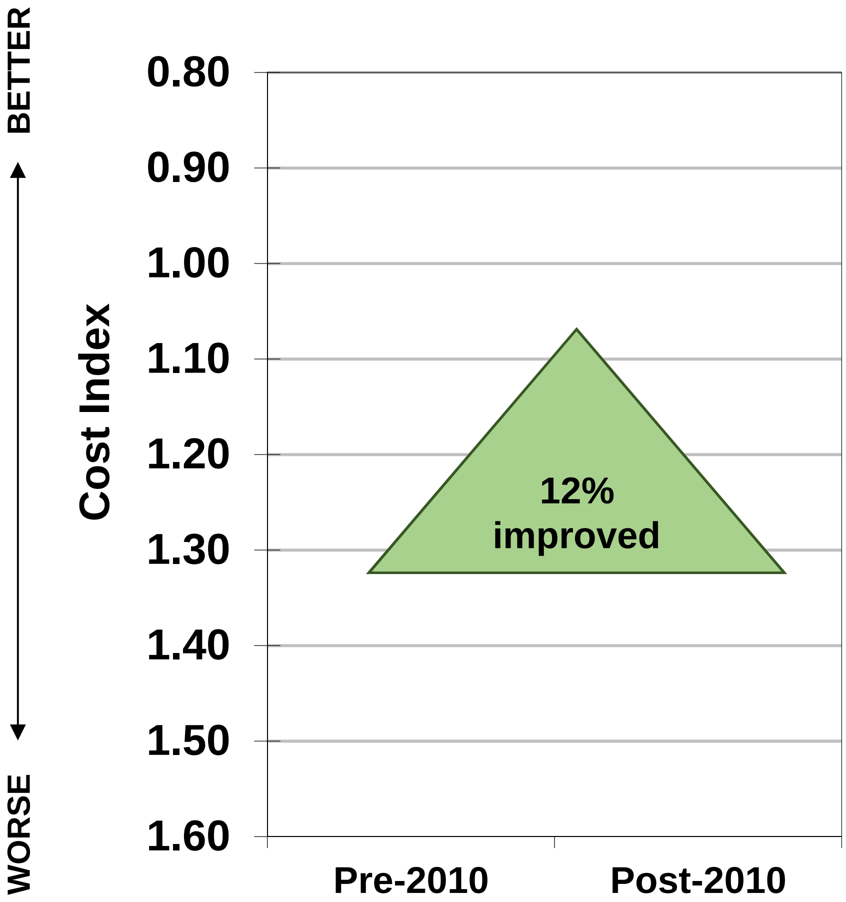
- **Pre-2010, average construction labor hours per foot of pipe in Alberta were about twice that of USGC**
- **Post-2010, activity has slowed down in Alberta, and productivity has improved by about 25 on average (range remains the same)**
- **In the USGC, activity has picked up post-2010, and productivity has declined slightly on average**
- **Average delta between Alberta and USGC has narrowed considerably, and range is similar**

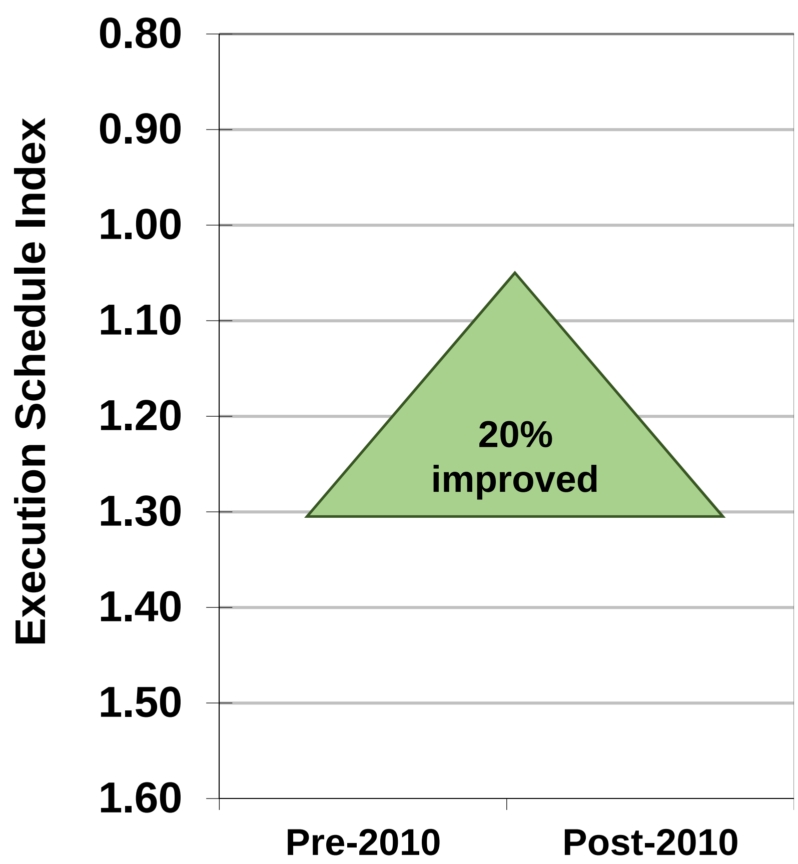
Other Measures

- **Steel labor hours/ton of steel shows a similar pattern**
  - **Holding steady in Alberta, degrading in USGC**
  - **Delta between Alberta and USGC has narrowed considerably**

Alberta Cost and Schedule Performance Improved After 2010

- **Post-2010, cost performance on major projects in Alberta has improved by about 12%, and schedule by about 20%**





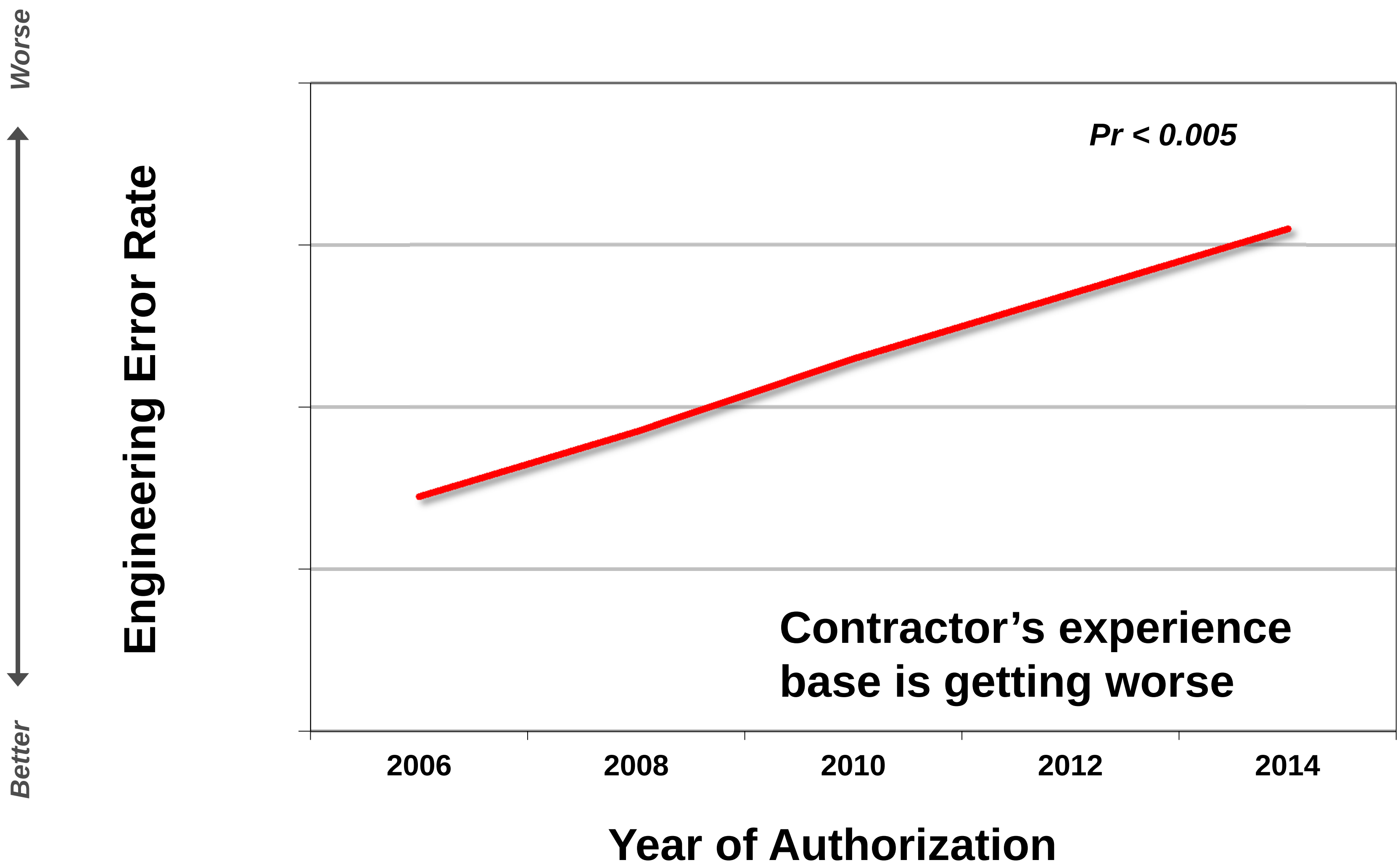
Construction Costs (Labor Plus Material) Significantly Higher in Alberta

- **Productivity improving, but wages still significantly higher**
- **Piping construction costs (labor plus material, relative to foot of pipe) and steel construction costs (labor plus material relative to ton of steel) both significantly higher in Alberta than USGC, for both time periods**
- **Post-2010 Alberta data shows higher variability; some projects benefited from improvements; others not**
- **On average wage rates in Alberta have escalated more rapidly than in USGC over this time period**

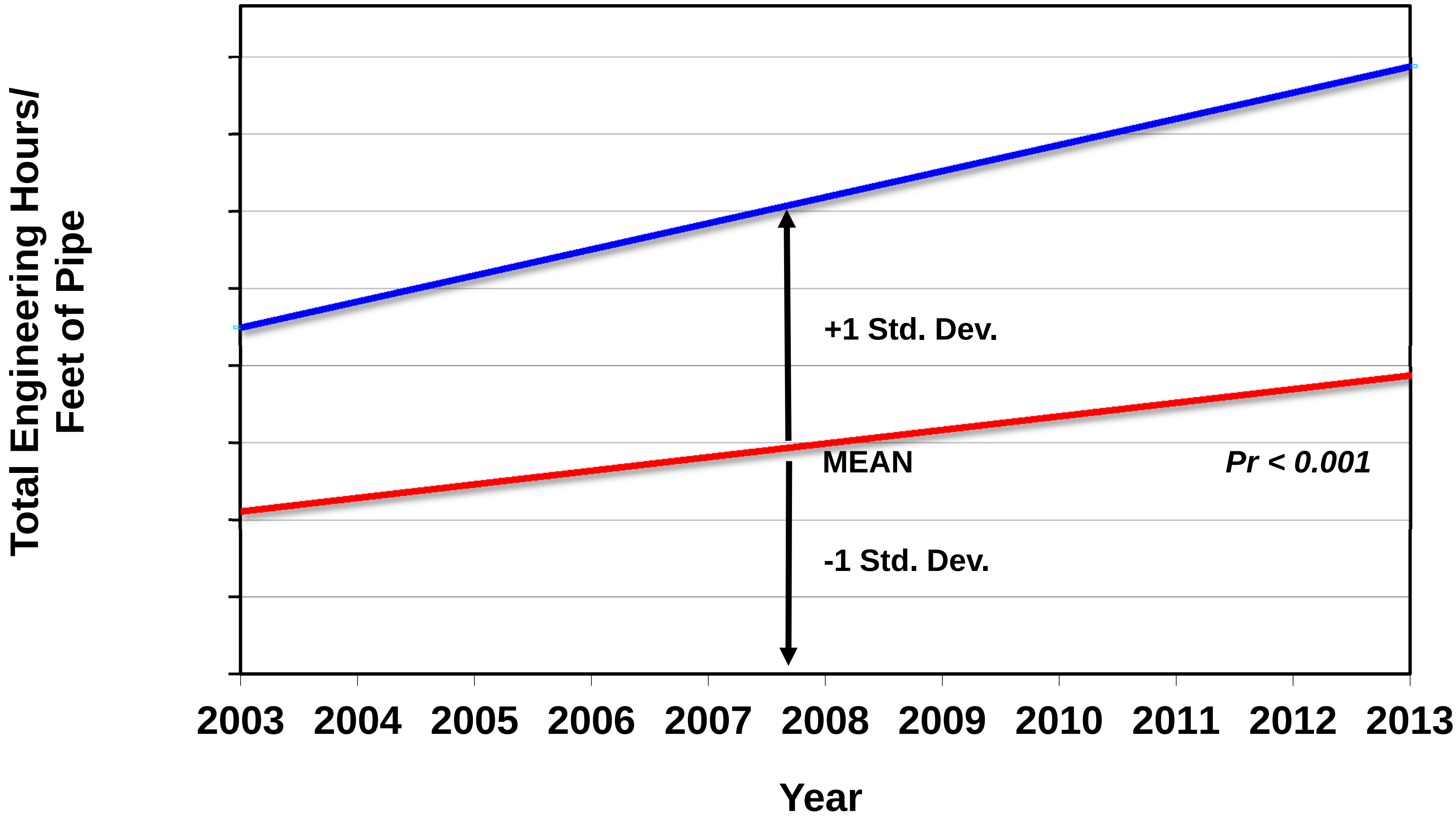
Engineering Productivity is Degrading in Both Regions

- **Engineering productivity is a current issue for both USGC and Alberta**
- **Experience is falling rapidly because of engineering workforce demographics**
- **Lack of engineering experience is translating into lower quality engineering design**
  - **Owners have mostly been able to identify and correct engineering quality problems before they show up in the field**
  - **However, frequency of *basic design errors* in vessel sizing, pipe stress calculations, and other core tasks is increasing**
- **When this happens, it places field productivity at risk**

Continuing Decline in Engineering Quality Is a Major Concern



Engineering Is Taking Longer Per Feet of Pipe



Controlled for FEL, EVC use, industry, and project type

Key Takeaways

- **With the current capital-constrained environment, cost and schedule performance has improved in Alberta**
- **Productivity has improved, and is closer to what we see in USGC**
- **Any further improvement in field labor costs has to come from better productivity – wages are not coming down**
- **Engineering productivity, however, is a concern for both regions**

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Example of Successful Project in Alberta (1)

- Project installed oil sands tailings infrastructure
- $90 million authorized in 2015
- Project finished 30 percent under budget and 10 percent faster than planned
- Cost and schedule were both significantly better than similar projects in Alberta, and competitive relative to Industry as a whole
- How did they do it?

Example of Successful Project in Alberta (2)

- **After a review between the team and site operations, the team adopted site's piping installation protocol rather than capital project system protocol**
  - **This saved the project about $7 million**
- **The owner and contractor management team reorganized to reduce headcount and save office costs**
  - **For example, team fused operations construction management (CM), project CM, and contractor CM into a single team, reducing staffing from 18 to 6 persons**
  - **Organizational changes saved the team around $8 million**
- **The team changed to a split form, re/ls approach, for piping and changed to a lower cost piping material**

Example of Successful Project in Alberta (3)

- Keys to success were a pause in the planning phase to recalibrate the project for the current market and seek lower cost options
- Willingness to go outside traditional standards and strategies
- Time spent to fully incorporate these changes before execution

Example of Problematic Project in Alberta (1)

- **Project installed a new pump-house and revamped others**
  - **$38 million authorized in 2012**
- **The cost overran 60 percent and the schedule slipped 80 percent**
- **Cost was more than 50 percent higher than Industry, and the schedule was 15 percent longer than Industry**

Example of Problematic Project in Alberta (2)

- **The team had a poor understanding of the business' need for the pump-house's (PH) asset life and functionality**
  - **Engineering contractor started design assuming the new PH would be similar to existing ones; however, business needed a PH with a longer asset life**
  - **Initial tentative PH vendor contributed to design, but team changed to another vendor when bids came in**

Example of Problematic Project in Alberta (3)

- **Team had few visits to fabricator site due to company's internal reorganization assigning quality inspectors to other roles**
  - **When units were delivered to site, rework was needed to fix quality issues**
- **Construction slipped due to engineering and procurement issues mentioned**
  - **In addition, construction quality issues caused construction crews to sit idle for 1 month while waiting for next opportunity to have an outage**
  - **The team decided during construction to increase scope by adding drainage throughout the site**

Example of Problematic Project in Alberta (4)

- **Finally, the team had several personnel turnovers**
  - **The business sponsor turned over twice in FEL, likely contributing to poor understanding of business needs**
  - **The project manager turned over once in execution, and the construction manager turned over twice in execution**
  - **There were several turnovers within the contractors' teams**
- **Business/organizational issues, and frequent changes on the fly, led to failure**

Key Takeaways

- **Labor productivity doesn't occur in a vacuum – the use of good or poor practices can make or break a project's field labor productivity**
- **Alignment with the customer, team member stability, timely review of standards and specs (not last-minute value engineering) all can drive better productivity**

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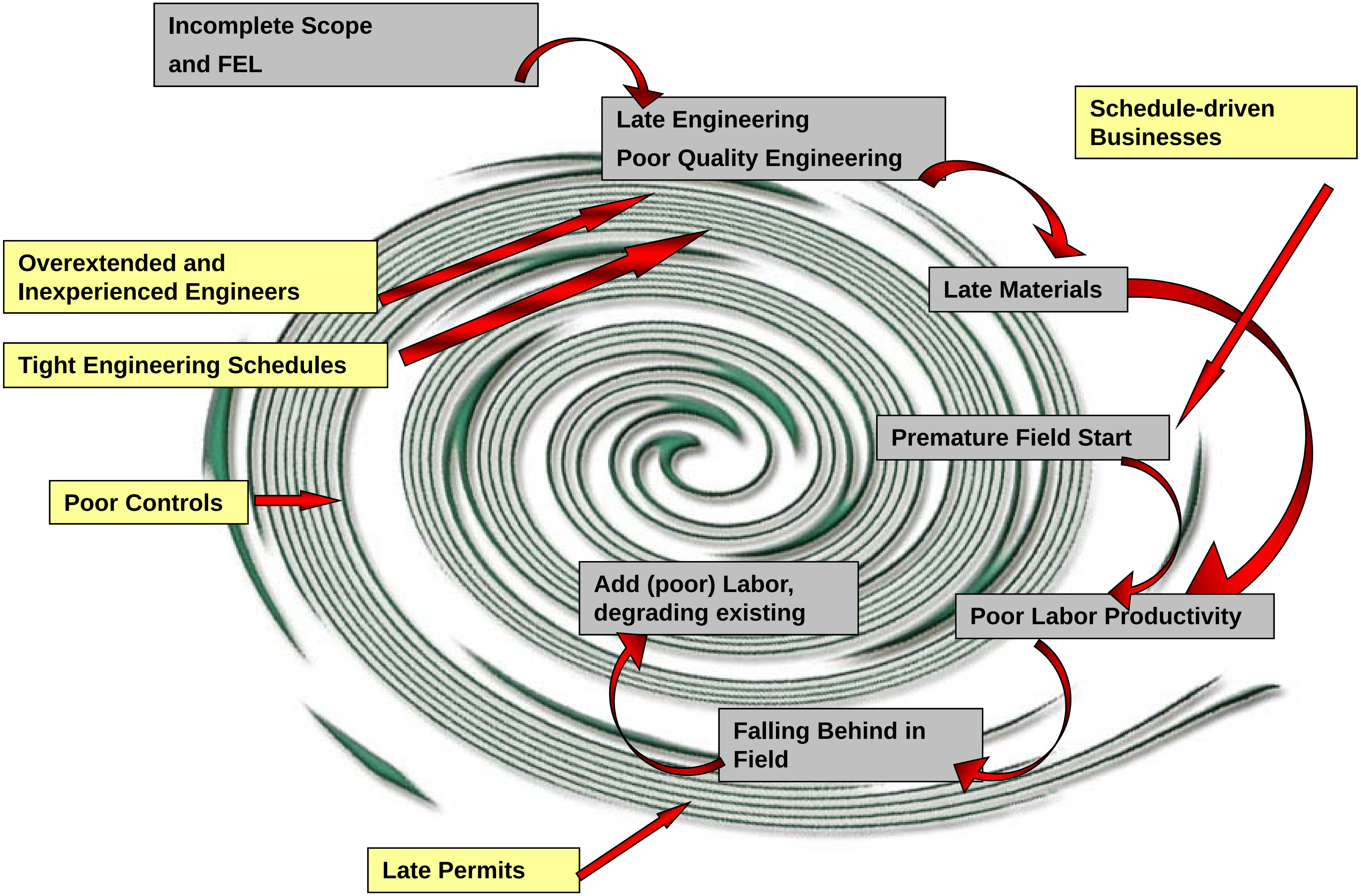
The Downward Productivity Spiral



What Should We Do to Improve Productivity?

- **Good planning is the most critical driver of good productivity**
- **The right contracting strategy – especially splitting EP and C, can help if you have the right resources to manage it**
- **Reduce overlap between engineering and construction**
- **Stop and regroup if scope changes occur**

Questions?

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Independent Project Analysis

Thank You for Your Time!