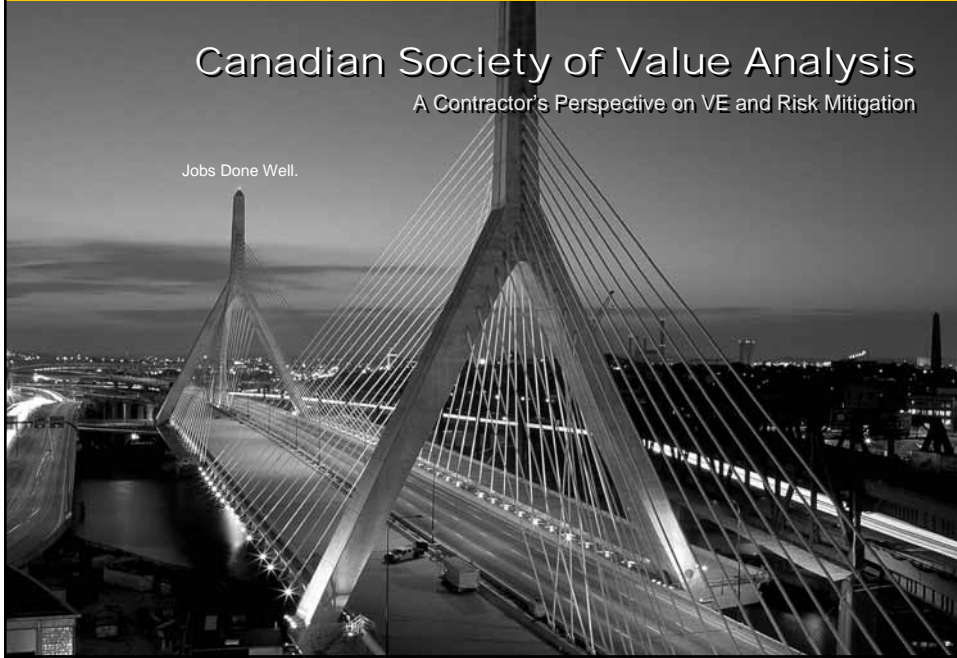




# Canadian Society of Value Analysis

A Contractor's Perspective on VE and Risk Mitigation

Jobs Done Well.



## Who is Kiewit?



## Kiewit Corporation



Kiewit has been in business since 1884

100% employee owned

US \$4.15 billion in revenue

- 92% construction
- 8% mining

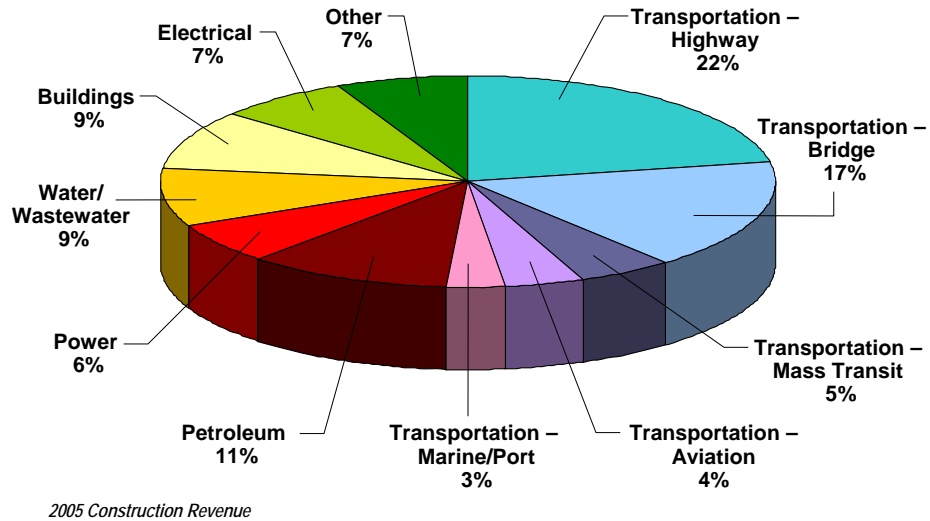
Headquartered in Omaha, Nebraska

Active in Canada for over 65 years

## Facilities Across North America



## Construction Markets



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## Self Perform Contractor

*ENR* Top 10 Contractor since 1995 in roads and bridges

Design-Build comprises over 45% of annual volume

Over 13,000 pieces of equipment worth over \$1.9 B

Caterpillar's largest private customer



Oakland, California

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## Kiewit in Canada

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Kiewit's Canadian operations began in 1941

Two Districts: Eastern Canada and Western Canada

Permanent offices in Richmond, BC, Edmonton, AB,  
Calgary, AB, Milton, ON, Boisbriand, QC, St John's, NF

2005 revenues over \$700M in Canada

## Husky's Whiterose FPSO

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*Marystown, Newfoundland*

## Keenleyside Hydroelectric Facility



*Castlegar, British Columbia*

## Diavik Diamond Mine



*Northwest Territories, Canada*

## Diavik Diamond Mine



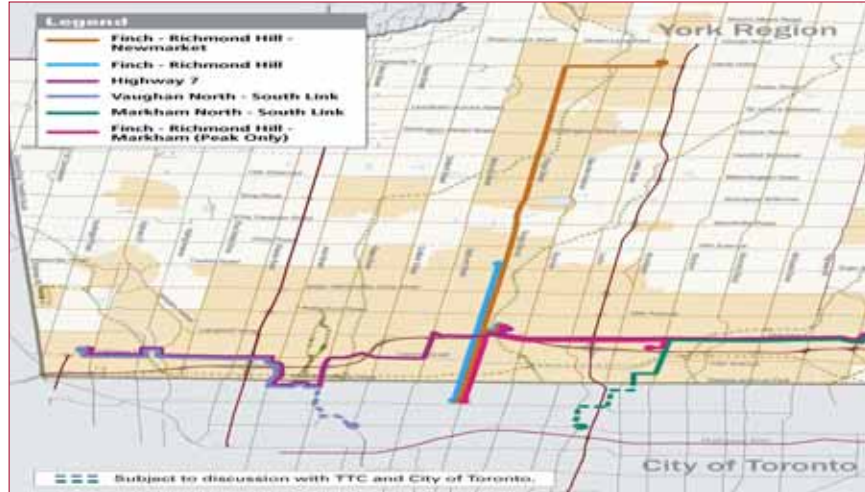
*Northwest Territories, Canada*

## Diavik Diamond Mine



*Northwest Territories, Canada*

## York Rapid Transit Plan – Quick Start Phase



York Region, Ontario

## York Rapid Transit Plan – Quick Start Phase



York Region, Ontario

# Sea to Sky Highway Improvement Project

Introduction



## Location of the Project

The project starts just north of Vancouver and extends approx. 95km north on Hwy 99 to Whistler, BC

The project travels through several communities including Horseshoe Bay, Britannia Beach and Squamish

AADT of 14,000 vehicles/day

Highway built in 1950's primarily to serve timber and resource industries

Recent heavy tourism, recreational and commuter use



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## Scope of the Project

25 year Concession to finance, design, build, operate and rehabilitate 95km of highway

Operation of highway during construction (Miller/Capilano) and for 21 years after construction completion

Kiewit: \$500M design build contract  
Add 2 lanes to existing 2 lane highway under live traffic conditions

4 years of construction – highway broken into 10 segments with interim milestone dates for completion

48 bridges  
219 MSE walls

Over 2,400,000 m3 of excavation, primarily rock



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## PPP Process and Parties Involved

BC Government (MoT and partnerships BC) procured contract through PPP process

Business model:

- Monthly availability payments to Concessionaire based on roadway availability
- Operating performance standards to be met to entitle payment
- Deductions/abatements to payments for non-conformances

3 consortiums prequalified to bid - 13 months from start of bid to financial close

S2S Transportation Group the successful bidder:

- Macquarie North America Limited – equity, financing
- Kiewit – design-builder
- Hatch Mott McDonald – lead designer
- Miller Paving/Capilano Highways – operations, maintenance and rehabilitation

## Risk Allocation and Mitigation



## Risk Issue: Traffic

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Traffic Management was one of Owner's key evaluation criteria and performance indicators during construction:

- Safety of the traveling public adjacent to work zones
  - In most areas Kiewit is building 1 or 2 new lanes within a few feet of live traffic
  - Although volumes are not high as compared to major freeway, conditions are hazardous due to rugged terrain and lack of room
- Travel times between Horseshoe Bay and Whistler
  - Owner established tightly controlled stoppage and closure regime
  - Contract required that motorists could not be delayed more than 40 minutes cumulatively from end to end - due to either construction or OMR work
  - Significant penalties for non-conformance (\$'000's/minute)

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## Risk Mitigation: Traffic

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- Safety of traveling public
  - Build 2 new lanes behind median and shift traffic over to maintain separation wherever possible
  - Schedule high impact work off peak/night time
  - Entire project team focuses on traffic planning and management - highest priority – significant dedicated resources
- Travel time management
  - Significant daily planning and coordination effort
  - Constant coordination with Miller/Capilano and their OMR program
  - Installed ITS system comprising high speed network, cameras, license plate readers with optical character recognition software (ie: 407) to monitor travel times
  - Use of visual checks, patrols and communication amongst traffic control crews

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## **Risk Issue: Schedule**

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- 4.5 year construction schedule to Oct/09 – Substantial completion for Olympics
- Significant penalty for late completion – “Termination”
- 10 interim completion milestones
- Kiewit’s liquidated damages for late delivery of any section high – approx. \$150K/day

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## **Risk Mitigation: Schedule**

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- Kiewit has elected to self perform virtually everything including
  - all drill and blast, grading, crushing, batching of concrete, and bridge construction
- Subcontracting rebar and placing of asphalt – Kiewit supplying paving aggregates
- Broken job into 4 distinct segments with 4 management teams
- Have set up hub office
  - Owner, Contractor, Designer, Operator, Concessionaire in same building
- Integrated design and construction schedule
  - Pre-bid and modified as overall schedule modified

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## Risk Mitigation: Schedule

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### Hub Office

Kiewit and MoT on 14<sup>th</sup> floor: “across the hall”

OMR and Designer on 9<sup>th</sup> floor

Concessionaire on 15<sup>th</sup> floor

All project managers speak to each other daily

Reviews of regular design progress by discipline (“task forces”)

Speed of field implementation tied to submittal review process, including by external agencies

Reviews of critical issues as they arise – co-location offers better means of communication than email or phone

Other advantages that have resulted include:

- Ready access to the entire team when quick action is required
- Partnering at all levels in the organization
- Smooth design review/approval process
- Commitment of design resources to the project

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## Risk Mitigation: Schedule

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### Integrated Design and Construction Schedule

A realistic design schedule was prepared during the proposal stage which attempted to match the needs of construction sequence

Design schedule is resource loaded to determine staffing needs

Identified early start constraints: multiple plans or reports by same discipline (or even same firm) needed to stay on schedule

We have continued to refine design schedule following start of work – this requires commitment and resources

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## **Project Risk: Schedule**

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### **Integrated Design and Construction Schedule**

Steps to develop an integrated design-build schedule

- ① Develop preliminary list of basic design packages
- ② Develop a preliminary design sheet count
- ③ Identify early design packages
- ④ Identify preparatory design activities
- ⑤ Develop a preliminary design schedule
- ⑥ Integrate the design and construction schedule
- ⑦ Man-hour and cost load the design schedule
- ⑧ Coordinate with the designers to finalize the design schedule
- ⑨ Level the design schedule to maximize time and designer resources
- ⑩ Proposal design-build schedule

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## **Project Risk: Labour and Commodities**

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- BC facing a very tight labour market due to level of residential and commercial construction activity, and draw of tar sands market on available labour
- Skilled labour shortage also means higher risk on meeting historical productions
- Subcontractors facing same crunch as general contractors
  
- Supply issues: global demand for typical construction commodities such as fuel, cement, steel, lumber, heavy equipment and parts
- Price instability
  
- Kiewit's contract is fixed price over 4.5 years: no escalation protection

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## **Risk Mitigation: Labour**

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- Kiewit had just completed two projects of \$55M and \$38M in the same general area – a “core” to start with
- Spent time canvassing the labour availability in corridor pre-bid
- Kiewit elected to self perform most of the work to eliminate dependence on subcontractor price and schedule
- Kiewit required by contract to offer employment to two First Nations (Lil’Wat and Squamish) – we see this as part of the solution
- Extensive training program to bring skill level up to anticipated productivity – money well spent – better retention

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## **Risk Mitigation: Commodities**

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- Kiewit has commodity hedging capabilities in-house – considered fuel hedging but elected not to (right choice)
- Source critical equipment from within the company (look to other districts that may not have the same market/schedule pressures)
- Order new pieces of equipment with flexibility in mind – if not used for Sea to Sky can be used elsewhere
- Locked in sub and material purchase prices shortly after award
- Performance security requested in some cases

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## Value Engineering Initiatives



### **VE Example: Owner's Procurement Method**

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BC Gov't established a maximum availability payment (approx. \$60M/year)

After costs of financing and OMR, left approx. \$500M for capital improvements

Owner provided bidders with list of minimum requirements to be compliant

Owner provided bidders with list of corridor objectives which indicated items which the Owner valued, and the relative value of those items

Evaluation of bids based on 1000 point system

Most points awarded to bidder who offered highest value for the maximum availability payment



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### **VE Example: Lifecycle/OMR Input**

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Fundamental OMR Performance Measurements on:

Level of service

Pavement (smoothness, surface condition, rutting)

Bridges (condition)

Response times (snow removal, accidents)

Highway Accident rate which compares Sea to Sky to provincial averages

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## VE Example: Lifecycle/OMR Input

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### Pavement Design:

We elected to use a variety of different pavement designs based on subsoil conditions and traffic volumes

We opted for minimum asphalt depth with tighter QA/QC during placement

### Culverts:

Replacing them a big issue in live traffic

Did extensive evaluation of existing culverts (replace now in stages while closure is "free") and elected to leave many as is, and selected high quality material for any new

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## VE Example: Lifecycle/OMR Input

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### Bridges:

Upgraded/repared 12 during initial DB period and were able to assume minimum amount of intervention during 25 years (joints, waterproofing, bearings)

Remainder of existing will be repaired during 21 year OMR term at optimized time – some risk in this but lower overall NPV

### Slope Stability

OMR contractor assumes high degree of risk with slope stability and avalanches through corridor – worked to optimize alignment/cuts through stable cut material – eliminated contingency for future rock bolting

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## VE Example: Roadway Design Solutions

Alignment/curvature:

Owner preliminary design assumed bigger and more rock cut, more “split grade” profile, more 3 lane/passing lane areas

We eliminated virtually all split grade, went to more down slope MSE walls which allowed more 4 lane sections which the Owner valued the most

We determined it was almost as cheap to build 2 lanes as compared to 1 lane because of the cost of traffic control, initial set up and staging

We also refined alignment to avoid expensive PAG (potentially acid generating) rock, which required specialized disposal – we were successful in avoiding virtually all of the Owner’s estimated 35,000m<sup>3</sup>

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## VE Example: Structure Design Solutions

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### Bridges:

We opted for standardized girder types/lengths/spans where possible (longer spans than necessary in some cases but more economical than a new girder length), similar foundation approach

Standardized girders and structure types also made for easier planning for erection during nighttime closures and more certainty around OMR costs

OMR contractor provided input on deck waterproofing system and concrete mix properties

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## VE Example: Structure Design Solutions

### MSE Walls:

Some of the most complex and risky work on the project

Most walls are built on side of cliff above active railway, and most require diagonal “toe” anchors for support, in addition to horizontal straps/tie backs

Developed standardized wall types (ie: cast-in-place, cruciform panels, wire walls with precast facing, etc...), depending on height and foundation

Each wall type was optimized for constructability using crushed/processed materials from project cut material

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