The Source of Degradation of the Construction Industry Performance

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The construction industry performance has been analyzed for the past 20 years. There has been no simple answer to the source of the construction industry problems. In 1991, the Construction Industry Structure (CIS) was formulated, and identified that the price based environment was more inefficient than the best value environment. Over the past 18 years, the analysis of the CIS has led to the hypothesis that the price based sector is inefficient because the buyer controls it. The hypothesis has been tested through case studies, and test results show that the owner is the biggest source of project risk and deviations. The dominant information was formed through repeated testing by moving the control to the vendor, and documenting all sources of project deviation. The studies have shown that the use of decision making, management, direction and control of the contractor by the owner increases the project risk. Two longitudinal studies are used to confirm the potential accuracy of the deductive logic. Key words: contractor control, owner releases control, contractor defined scope

Keywords: construction industry structure, deductive logic, degradation, and longitudinal studies

Introduction of Construction Industry Performance

Poor performance in the construction industry has been a stubborn problem for many years. Projects not on time, not on budget and with poor customer satisfaction have been a problem for the last twenty years (Berstein 2009, British Property Federation 1997, Cahill & Puybaraud 1994, CFMA 2006, Chan & Chan 2004, Davis & Sebastian 2009a, 2009b, Doree 2004, Egan 1998, Georgy Luh-Maan & Lei 2005, Glancy 2008, Imtiaz & Ibrahim 2005, Ibrahim et. al. 2010, Langlinais 2011, Lepatner & Barry 2007, Murphy 2012, Post 2000, Rijt 2009, Rwelaimila et al. 2000, Simonson 2006, Tucker 2003, Wang 2009, Wearden 2008). Different solutions have been attempted: lean, preplanning, partnering, integrated project delivery, design-build, CM@Risk, and Building Information Modeling (Egan1998, Grimsey 2002, Grout 1997, Hopper & Goldman 2004, Konchar & Sanvido 1998, Kumaraswamy & Morris 2002, Matthews & Howell 2005, Nellore 2001, Pietroforte 2002, Williams et. al. 2003, Wong 2006).

Even though the different approaches have worked in limited case studies, the solutions have not been dominant enough to change the industry structure and the practices of large government agencies to eliminate the issues of non-performance (Hutton & Solis 2009). The economic downturn in the early 2000s has made the focus on competition and lower prices. This led to overregulation by the owners resulting in inefficient practices, contractor collusion, poor

performance and low contractor profit margins (British Property Federation 1997, CFMA 2006, Cahill & Puybaraud 1994, Chan & Chan 2004, Doree 2004, Egan 1998, Glancy 2008, Langlinais 2011, Murphy 2012, Rijt 2009, Rwelaimila et al. 2000, Tucker 2003, Wearden 2008). The culture of the traditional owner controlled, directed and managed approach has overridden the meaningful impact of almost all innovative delivery systems (Gransberg 2008, Hale et. al. 2009, Konchar &Sanvido 1998, Lam et al. 2004, Ling et. al. 2004, Williams et. al. 2003). The latest report on contractor performance by the Western Australian Construction Industry Board reconfirms this observation. Integrated Project Delivery (IPD), relationship contracting and alliance contracting have not impacted the overall construction performance (Murphy 2012). The GAO report also identifies that the construction industry is not alone in poor performance (Hutton & Solis 2009).

Examples that substantiate this abound (Kashiwagi 2012). The collusion of the Dutch construction industry in the early 2000s and the movement to the Best Value (BV) Performance Information Procurement System (PIPS) where the vendors and not the clients controlled the delivery of construction gives a potential explanation of the problem and a possible solution (Ang 2011, Kashiwagi 2012, PBSRG 2012). In the United States, the changing of the laws of the State of Minnesota and the State of Oklahoma to allow a best value vendor driven approach are two other examples of government agencies changing their structure from an owner controlled price based environment to a best value vendor controlled structure. The willingness of the U.S. Army Medical Command to move to a vendor controlled environment gave researchers another opportunity to test the concept.

The authors propose that there is a misunderstanding of what causes construction non-performance. The authors propose this is an industry structural issue, and not an issue with the lack of technical expertise of the construction industry. The authors also propose that the current industry structure is degrading the industry's capability to sustain high quality construction management and a force of highly skilled technical craftspeople.

The Construction Industry Structure (CIS)

The Construction Industry Structure (CIS) (Figure 1) has been around since 1991 (Kashiwagi 1991). The CIS divides the highly competitive marketplace into two environments:

1. The price based environment is where the owner is in control, directing, controlling, and managing the delivery of construction.
2. The best value based environment is where expert vendors are directing, controlling, and managing the project.

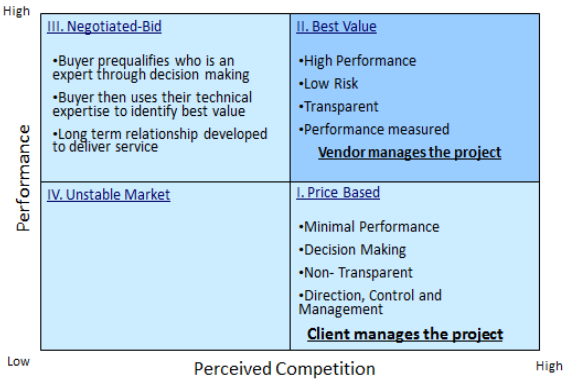

Figure 1. Construction Industry Structure

If the owner is controlling, directing and managing the delivery of contractor services, the owner is required to be the expert. If the owner is the expert the following are logical ideas:

1. The contractors become more reactive than proactive. It is difficult to have two experts when one of the experts is the owner who is constantly directing and controlling the real expert.
2. The competitive value of the contractor's expertise diminishes.
3. As the value of the contractors' expertise diminishes, the contractor's price becomes more important.
4. As price becomes the sole factor of selection, high performance contractor's prices are pressured by lower performing contractors' prices, which may not meet the owner's determined scope. There is no proven methodology to identify if the lower priced proposals are complete. Lower performing contractors may also not use the high quality craftspeople and therefore are not offering the same finished product. This drives the delivered contractor's performance down even further.
5. An additional problem that may occur, if the owner and their expert's scope is incomplete, the high performing contractors who attempt to price a completed scope, and not the incomplete scope, become non-competitive. This results in the lower performing contractors getting the project, and resulting change orders.
6. When the owner causes the problem of non-performance, non-transparent practices or transactions must be initiated to stop the detection of seemingly "inefficient and non-expert" owner actions. The lack of clear and convincing documentation of non-performance minimizes owner and low performing contractor accountability and responsibility.
7. If the owner is the expert, than they are hiring a non-expert vendor. The non-expert vendor must be managed, directed and controlled. The non-expert, by definition is more reactive and does minimum standard work.

The following summarizes the "price based environment" which uses management, direction and control to minimize risk to meet the owner's expectations of performance (Kashiwagi et. al. 2012):

1. The owner is the expert. If the owner was the expert, why is the owner hiring a contractor?
2. The contractor is not an expert. Why is the owner hiring non-expert contractor?
3. The owner attempts to hire a "non-expert" to do the work efficiently and effectively to get value.
4. The owner uses a contract to manage, direct and control a contractor. The more the contract is used, the worse the observed result.
5. The owner assumes that all qualified contractors offer the same level of performance. This has not been proven. Neither has this ever been observed. This is not logical.
6. The owner communicates to the contractors in terms of "minimum acceptable" performance. This focuses the contractor's performance and the owner's attention on the minimum levels of performance.
7. The owner must have a system in place to ensure a minimum level of performance, and that the performance is not lower than specified.
8. The owner's management, direction and control of minimum levels of qualification have not improved the level of performance of contractors over time.
9. The contractors' profit margins decrease in the price based, owner controlled environment. This has been confirmed in two documented studies in the State of Hawaii and the University of Minnesota tests, when the contractors became the experts and dictated their scope.

The price based environment has several practices that have been proven to be inefficient and illogical (Kashiwagi, J. 2012):

1. One party can control another party through use of a contract or other mechanism.
2. Management, direction and control are an effective means of minimizing risk.
3. An expert can make a non-expert deliver high performance services.
4. It is more efficient to manage, direct and control, than it is to hire an expert who knows what to do.

The authors propose that a more efficient method to minimize risk is to hire contractors who are experts and who know what they are doing. The author proposes that an expert contractor has very little risk. The only risk that the expert has is the risk that they do not control. The authors propose that the number one source of risk is the owner or buyer, that unforeseen risks are minimized to acceptable levels when hiring an expert, and that the expert contractor causes negligible risk. The authors also propose that the traditional processes where the owner assumed they could direct and control the contractors resulted in the following:

1. Reactive contractor behavior.
2. Over-emphasis of the importance of price at the beginning of the project.
3. Degraded contractor project management and craftsperson's skills.
4. Transactions from all parties trying to protect their own interests.
5. Minimal levels of performance due to process of specifications.
6. Poor overall construction industry performance.

The Best Value Environment

The best value environment assumes that the vendor or contractor is the expert. The major difference between the best value environment and the price based environment is that owner does not use direction and control to minimize risk, but uses the alignment of expertise to eliminate risk. The best value environment has the following characteristics:

1. The contractor is an expert and acts as the expert. The owner does not manage, direct and control the expert contractor. If the contractor is not an expert, the environment is price based.
2. The contractor receives the owner's requirements as an intent and determines the delivered scope and cost. A contract is created; however, the contract is never used to minimize risk. Instead it is put away and never used. Some question why so much resources is put into creating the contract if it will not be used. The proposal of the authors is that to "not use a contract" would require convincing the legal representatives of all parties, and the cost and time to achieve would be prohibitive. The authors propose to do what expert contractors do, sign the contract, and never use the contract. Use expertise to resolve issues.
3. The contractors compete for the best value project by showing that they have the capability to do the project, can identify their scope (submitted in the clarification phase) and what is not in their scope and can identify risk that they do not control and assist in tracking and mitigating the risk, so the risk does not impede their performance.
4. Contractors compete based on price and proven capability to perform. The capability to perform is in terms of performance metrics on similar type projects showing their capability to satisfy the customer and minimize cost and time deviations. It also allows contractors to use their cutting edge technology and processes to efficiently deliver construction. In the best value environment, a contractor will now receive the competitive advantage due to their performing construction project management, craftsperson skill of critical subcontractor components, and the ability to see a project from beginning to end before the project is awarded.
5. The contractor writes the final scope (which includes all requirements of an owner's financial, bonding and insurance requirements, scope, and identification of risk and risk mitigation), manages the contract and practices risk management and quality control. The owner practices quality assurance.
6. The owner gets the project at the highest possible value and the lowest possible cost and a high performance contractor uses their expertise to deliver a risk free construction project while maximizing their profit. This creates a "win-win" situation.

The best value environment is efficient, effective, minimizes communications and flow of detailed information, creates a "win-win," the highest possible value at the lowest possible costs, high vendor profit and minimal project cost and time deviations. The best value environment will attract high performance contractors due to the opportunity to use their capability and maximize their profit.

Transition from Price Based to Best Value

The authors propose that to move from a price based environment to a best value environment, the following must transpire:

1. A visionary owner must be identified. If the vendor is the visionary, they must practice extreme discipline in following the best value approach.
2. The control of the project must move from the owner to the contractor.
3. The contract cannot be used to direct and control the contractor.
4. The contract, which includes the scope and cost, is put together by the best value contractor. They are the offeror, and the owner is the acceptor of the offer.
5. Management, direction and control are replaced by the alignment and use of expertise by expert contractors.
6. The best value environment is transparent. A transparent environment shows that the best value is delivered by experts who increase value and deliver it at the lowest possible cost. Eliminate all decision making and subjectivity, which causes confusion and fear.
7. The contractor measures performance of the project of both the contractor's performance and the performance of all other entities in the project.
8. Moves from a win-lose, to a win-win environment. If someone loses, everyone loses.

Moving from a price based environment to a best value environment requires a change of paradigm and concepts that are different from traditional practices. Many industry personnel believe that the transformation requires legal changes. They are mistaken. Legal changes may make the transition easier, but the transition is one of a paradigm change. The following are transition concepts:

1. Top down, or manage, direct and control practices and mechanisms need to be discontinued.
2. Owner decision making, expectations, direction and control need to be released to those doing the work.
3. Owner approvals need to be minimized.
4. All risk must be given to the owner.
5. Experts must minimize their scope, taking all risk out of their scope. If there scope is unacceptable to the buyer, the buyer does not need to accept their offer.
6. Risk is also defined by the difference between the expectation of a non-expert and the future project result that is dictated by the initial project conditions and natural laws. If the contractor is an expert, there is very little risk. They will explain to the owner, before they start, the expectation from beginning to end.
7. Decision making should be minimized. Decision making is when someone who is not an expert uses their own experiences to create a future expectation. Risk is caused because the non-expert's expectations are not related to the initial conditions.
8. Risk cannot be shared. Risk cannot be transferred. Shared risk leads to decision making. Decision making increases risk.

The most difficult transition actions by owners include changing their requirements into intents, not having expectations, admitting that they are not an expert and they themselves are the major

cause of risk. The owner needs to select a contractor based on dominant performance metrics (information that does not require decision making by the owner). The owner should use a best value expert to initiate the process. Contractors should also do the same. 18 years of experience of assisting owners to change their paradigm have produced the following lessons learned:

1. Owners need to use best value expert consultants to help change their paradigm. Attempts to change their own paradigm or culture have led to terminations of the effort [State of Idaho, GSA, University of Minnesota, and the FAA] (Kashiwagi 2012).
2. Best value may seem simple, but it is very difficult to implement due to the owner's organizational culture and people's instinctive need to direct and control others. People also have a need to communicate and therefore have many meetings. Best value consultants are required to change the paradigm.
3. The owner is their own worst enemy.
4. The number one cause of failure in moving from the price based environment to the best value environment is the owner's lack of or misunderstanding of best value and the Information Measurement Theory (IMT) concepts. Owners who think they know are actually the biggest source of risk.
5. The owner tries to take over the program prematurely, and ends up destroying the best value program. Premature takeover can be easily identified by not having the proper best value (BV) test documentation listed in the BV manual. If there is no documentation, a best value expert is needed.

Management, Direction and Control

The authors propose that management, direction and control (MDC) cannot be used to minimize risk by owner or vendors. This eliminates top down behaviors and structures. This forces the hiring of an expert contractor who knows how to meet the owner's intent. The owner should ensure that the expert contractor can accurately identify their intent, see and define the service from the initial conditions to the final project conditions, and can identify risk that they cannot control and assist in the mitigation of the risk. The owner's representatives should always listen to the best value contractor before communicating their concerns. The expert contractor becomes the project leader, expert and controller of the project. Under the BV PIPS approach, if a contractor cannot do this, they should not be hired.

Risk

The authors propose that risk is what the expert contractor has no control over, or areas where the expert contractor has insufficient information to clearly see into the future (Kashiwagi, et. al., 2012.) Risk is when the contractor cannot see into the future. If a contractor cannot see the entire project (milestones, activities that they do not control) from the initial conditions to the final project outcome, they are not an expert and have risk. An expert does not have technical or project risk. If they perceive risk, they should minimize their scope, so the risk is not in their scope. Owners can also cause risk by having expectations that do not match reality or the initial conditions.

Decision Making

The authors propose that decision making (DM) should be minimized on a project. An expert is one who can clearly and simply explain the initial conditions and the final project conditions. An expert can see into the future, which minimizes DM. An expert understands that the initial conditions will change into the final conditions, as dictated by natural laws at the end of the project. An expert understands that they cannot override natural laws. An expert speaks simply, in dominant language (everyone understands without having to use their own expertise or experience). Therefore an expert minimizes everyone's DM.

Risk Sharing

Risk cannot be shared. If a partnership is formed and the risk is split "50 – 50", decisions will be made to assign the accountability for the risk that occurs. If an expert can see into the future, they have no risk. If someone cannot see into the future, they create risk with their DM. Theoretically, the only way to minimize DM and mitigate risk at the same time is to assign all risk to one party. Tests have shown that the client is the source of almost all risk. Therefore, in the best value approach, the authors propose that the contractor has no risk within their scope. The only project risk is the risk that they do not control and the risk that is caused by insufficient information, which is the owner's risk. The risk should always be the financial obligation of the owner.

Proposal: Best Value Approach

The authors propose the only remaining issues are:

1. Are there expert contractors who have no risk?
2. Why would the owner take all the risk of the project, and pay for the results of the risk?

The authors propose that if the owner uses a best value approach:

1. The contractor generated risks are minimal.
2. The cost and time deviations decrease.
3. The customer will be satisfied.
4. The visionary client will clearly understand that they cause the majority of the risk.
5. The project cost would not increase, and in many cases the expert contractor would be the lowest cost.
6. The owner will not manage, direct and control the contractor, thereby increasing the number of projects they can effectively manage. They will have more time to observe the contractor's performance.

Testing of the Best Value Deductive Logic

The authors will use two longitudinal studies to confirm the potential accuracy of the deductive logic. The first is the implementation of the best value approach by the U.S. Army Medical Command (Medcom) to minimize the risk of the Indefinite Delivery Indefinite Quantity (IDIQ)

contractors doing modification and repair projects on 26 U.S. Army Medical Command sites. The second case study is the implementation of best value projects by the University of Minnesota (UM) and other government groups in the State of Minnesota including the Rochester School District, the City of Rochester, School District 287, Hennepin County, and the City of Roseville. The constraints of the two tests included:

1. The implementation of the best value process changed over the duration of the tests.
2. The owners' understanding of the process improved over time.
3. The owners' use of management, direction, and control was minimized over time.

Medcom Test Results

The Medcom tests facts include (Figure 1):

1. Date of tests: 2006-2011
2. Number of projects and value of projects: 619 projects ($1.02B)
3. Number of contractors: 12
4. Project cost deviation (%): 5.5%
5. Owner caused cost deviations (%): 5.44% (1.31% due to unforeseen conditions)
6. Vendor caused deviations (%): .06%
7. Change in cost deviations (2006 – 2011) over time (%): 44%; 6.42% - 3.61% = 2.81% reduction
8. Change in time deviations (2006 – 2011) over time (%): 40%; 47.78% - 28.53% = 19.25% reduction
9. Customer satisfaction of contractor performance: 9.27 (out of 10)

The Medcom test led to the following results:

1. The client/owner was the source of project cost and time deviations (risk).
2. The best value environment minimized project deviations by 40%.
3. The contractors caused very little risk.
4. The clients/owners were satisfied.

The results support the proposal that the client/owner is the major source of risk (Figure 2). It also showed where the owner transferred their control over to the contractor and their risk was minimized.

Criteria	NTP 2006-2011
# of Projects	619
# of Projects with RMP	305
# of Contractor Companies	12
# of Facility Locations	48
# of Owner Participants	300
# of Contractor Participants	161
$$ of Projects Tested	$1,027,534,878.97
$$ for ASU Support (9 years)	$ 856,000
Estimated Savings ($$)	$ 8,673,591.59
Estimated % Saved ($$)	0.89%
Estimated Savings (Days)	16541.34
Estimated % Saved (Days)	7.24%

Figure 1. Medcom BV project performance

Completed Projects	NTP 2007	NTP 2008	NTP 2009	NTP 2010	NTP 2011
# of Projects	110.00	129.00	122.00	92.00	27.00
Original Awarded Cost ($$)	$181,945,282.27	$177,275,551.80	$183,989,041.03	$107,091,486.62	$16,278,439.41
Final Awarded Cost ($$)	$193,881,007.60	$187,844,708.77	$192,602,961.59	$110,952,677.38	$16,352,909.79
Total Over Budget ($$)	$11,935,725.33	$10,569,156.97	$8,613,920.56	$3,861,190.76	$74,470.38
Total % Over Budget	**6.56%**	**5.96%**	**4.68%**	**3.61%**	**0.46%**
% due to owner	4.58%	5.59%	3.61%	2.36%	0.46%
% due to Designer	0.00%	0.14%	0.00%	0.21%	0.00%
% due to contractor	0.11%	-0.17%	-0.01%	0.08%	0.00%
% due to unforeseen	1.88%	0.40%	1.09%	0.96%	0.00%
Total % Delayed	**51.56%**	**48.43%**	**36.77%**	**28.53%**	**3.31%**
% due to owner	41.38%	39.96%	28.51%	16.53%	9.20%
% due to Designer	0.00%	0.49%	0.00%	1.32%	0.00%
% due to contractor	1.86%	-0.02%	1.29%	0.12%	-6.40%
% due to unforeseen	8.32%	8.01%	6.97%	10.56%	0.51%

Figure 2. Project cost and time deviations over time

Other interesting observations of the test include:

1. The visionary who brought the best value system retired, and his replacements attempted to control the performance information, and use direction and control to minimize their project risk.
2. Two of the six IDIQ contractors adopted the best value approach as their operational model. One contractor did three times as much work with the almost the same staff. Another contractor duplicated the Medcom system internally using the performance information to mitigate risk.

The best value system changed the Medcom into a transparent environment. The IDIQ contractors immediately received their current performance information along with the performance information of all other contractors once a week. All Medcom facility managers and their representatives were offered education in both the deductive logic and the best value approach. The approach had allure due to the potential time savings of minimized transactions. However, when the visionary Medcom leader retired, his successors halted the immediate posting of performance information, stopped the best value educational training for Medcom FMs and the vendors, and put in place a system that required lengthy approval for access to performance information.

Instead of giving the contractors the information to improve their performance, the system was changed into a management system, which attempted to mitigate risk through management, direction, and control.

State of Minnesota BV Tests

The UM and other tests in the State of Minnesota facts are listed below:

1. Dates of Tests: 2005 - present
2. Total number of projects and value of the projects: 399 projects | $433.9M
3. Customer satisfaction of contractor performance: 9.5 out of 10
4. Number of contractors: 95
5. Project cost deviation (%): 8.2%
6. Owner caused cost deviations (%): 7.6%
7. Vendor caused cost deviations (%): 0.2%
8. The full performance data is in Table 3 shown below.
9. The construction cost vs. the construction budget (%): -6.2% (awarded cost is 6.2% less than budget)
10. The percent of times the best value was the lowest cost (%): 54%

The Minnesota test results were very similar to the USA Medcom test results (Figure 3). The owner was identified as the major source of risk. Contractors caused very little risk. There was no perceived increase in construction cost. Customer satisfaction was high. Based on these high performance results, the construction law was changed in the State of Minnesota to permit local municipalities (counties, cities, and school districts) to use a best value selection and contract management process.

Project Overview	**Overall**	City of Roseville	City of Rochester	Hennepin County	Olmstead County	Rochester Public Schools	School District 287	University of Minnesota
Total number of projects	**399**	1	8	10	1	21	3	355
Total awarded cost ($M)	**$434.9**	$0.2	$37.8	$5.1	$12.4	$17.3	$29.5	$332.7
Projects where BV lowest cost	**54%**	0%	83%	33%	0%	42%	33%	55%
Percent Awarded from budget	**6%**	11%	1%	-13%	29%	9%	12%	5%
Cost Deviations								
Overall Change Order Rate	**9%**	-	4%	1%	5%	4%	3%	10%
Client	**8%**	-	2%	0%	1%	1%	0%	9%
Designer	**1%**	-	2%	1%	3%	2%	2%	0%
Contractor	**0%**	-	0%	0%	0%	0%	0%	0%
Unforeseen	**1%**	-	0%	0%	1%	1%	1%	1%
Schedule Deviations								
Overall Delay Rate	**47%**	-	35%	16%	13%	2%	7%	52%
Client	**22%**	-	15%	7%	5%	0%	4%	24%
Designer	**4%**	-	6%	9%	7%	2%	0%	4%
Contractor	**3%**	-	11%	0%	0%	0%	4%	2%
Unforeseen	**5%**	-	3%	0%	0%	0%	0%	5%
Satisfaction Ratings								
Satisfaction rating - Vendor	**9.5**	-	9.0	-	8.8	9.9	-	9.5
Satisfaction rating - PIPS	**9.7**	-	8.5	-	10.0	10.0	-	9.6
Number of returned surveys	**233**	0	2	0	1	18	0	212

Figure 3. Project performance of Best Value tests in Minnesota

Similar to Medcom's experience, when the visionary (who had brought the best value approach into the University of Minnesota) retired, the replacement changed the best value system to an owner managed, directed and controlled system.

Conclusion

Two owners who procured construction services were in the owner controlled price based marketplace. Both owners, led by visionary representatives, heard and implemented the best

value approach. Both owners had a culture, and faced resistance in implementing the best value approach. Both owners were very successful in minimizing their project risk (cost and time deviation.) Both owners followed the transformation proposals including:

1. Identified that the owner was the major source of risk.
2. Identified that best value contractors do not cause project deviations.
3. Minimizing owner direction and control.
4. Minimizing owner decision making.
5. Transferred the control of the project to the best value contractor.
6. Minimized project communications and meetings.

The two case studies show that the major source of construction project risk is the owner. It shows that when the control of the projects was moved to the contractors, and risk was documented, the risk created by the contractor was negligible. It also shows that the risk by unforeseen events was also negligible. It shows that the overall project deviation over time also decreased, showing that an expert contractor also had impact over and the capability to minimize the risk caused by the owner. The results of the two case studies match other results of the best value approach in construction and non-construction results (PBSRG 2012). There are also documented case studies where the owner refused to release control to the vendors resulting in owner decision making, management, direction and control (Kashiwagi 2012). This creates non-transparency, unclear accountability and no documentation of the actual source of risk. In both case studies, the visionaries who brought the best value approach and a change of paradigm were followed by replacements who returned to the traditional owner controlled and directed paradigm.

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