

## A New Risk Management Model

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### Abstract

The identification of the source of project risk has been a troubling issue in construction management. A new risk management model has been developed. Analysis of the risk in the IT industry, construction industry, and also industry structure and supply chain delivery has resulted in the identification of the major source of risk: the major source of risk is the buyer. The buyer's attempt to transfer this risk to the contractor causes confusion and an increase of risk. The owner's lack of expertise and accountability, their use of management, direction and control to minimize risk, their inability to listen to the expert contractors who have no risk and the owner's decision making and expectations has resulted in increased project risk. This study uses deductive logic to design the new risk model. The new risk model is used by the expert contractor to minimize the risk they do not control. The new model identifies risk, mitigates risk by use of transparency and dominant information. The new model has been tested and the results have been documented. The preliminary test results are encouraging.

*Keywords:* risk, deductive logic, risk model, dominant information, construction management, IT management

### 1. Introduction

The delivery of construction has been studied by construction management researchers for the past twenty years. The performance of the delivery of construction services has been identified as poor (Cahill and Puybaraud, 1994; Lapatner, 2007; CFMA, 2006; Simonson, 2006; Flores and Chase, 2005; Adrian, 2001; Hamel, 2007; Post, 2000; Egan, 1998; Chan, 2004; Davis et. al., 2009). Many studies have been published which identifies the poor performance and suggest the need for risk management. Risk management has been a hot topic, and potential solutions have included pre-project planning (Hillson, 1997; CII, 1995; Gibson et. al., 2006; Griffith, 2001; Wang et. al., 2010; Hamilton, 1996), alignment of experts and expertise (Kashiwagi, 2009; Sullivan, 2010), more defined

contracts (Davis, et. al., 2009; Sweet, 2011), or the hiring of professional project managers (PMI, 2010; ICE & AP, 2005).

Construction delivery systems have evolved from the design-bid-build model, to design-build, to CM@Risk and lastly to Integrated Project Delivery (IPD) to minimize the risk of non-performance (Matthews and Howell, 2005; Konchar and Sanvido, 1998; Nellore, 2001; Hopper and Goldman, 2004; Yinglai, 2009; Chan, 2002; Williams et. al., 2003). Other systems such as Indefinite Quantity, Indefinite Delivery (IDIQ) which includes Job Order Contracting, and Cost Plus Fixed Fee, Cost Plus Variable Fee, Guaranteed Maximum Price (GMP) and other variations have been created to overcome procurement transactions and control the project time and price

deviations. Other creative processes such as Public Private Partnerships (PPP), Design, Build and Operate (DBO), and Privately Financed Initiatives (PFI) have been used to generate the funding for public projects (Grout, 1997; Grimsey, 2002; Kumaraswamy and Morris, 2002; Pietroforte, 2002; Wong, 2006; Boukendour, 2001; Papajohn et. al., 2011). However, there is little documentation to show that the overall cost, time, quality performance and value of services have increased (Williams et. al., 2003; Konchar and Sanvido, 1998; Hale et. al., 2009; Ling et. al., 2004).

Various concepts such as business process re-engineering, continuous improvement, quality control/quality assurance, and lean thinking have been suggested to improve the quality and minimize the cost of construction projects (Green, 2011). However, risk and nonperformance remains a stubborn issue in the delivery of construction. The perception of high risk remains. However, when looking for risk data that confirms that there is high risk in delivering construction, evidence remains anecdotal. Evidence includes the identification of failed projects, identification of construction quality issues, identification of the lack of performance, identification of the continuing decrease in craftsperson quality and the decreasing productivity of construction workers.

## 2. Problem

Risk management and non-performance in construction has been a hot research topic (Akintoye and MacLeod, 1997; Baloi and Price, 2003; Bernstein et al., 2011; Cooke and Davies, 2001; Crawford et al., 2006; del Cano and de la Cruz, 2002; Dikmen et al., 2008; Hillson, 1998; Muller and Turner, 2001; Raz and Michael, 2001; Themistocleous and Wearne, 2000; Tummala et al., 1997; Turner and Muller, 2003; Williams, 1995; Wood and Ellis, 2003; Zou et al., 2007). This research proposes to answer the following questions:

- What is risk?
- Is there risk on every construction project?
- What is the major source of risk?
- How is risk minimized?

## 3. Definition of Risk

Risk is defined by the authors as when project cost, time, or owner's quality expectation are not met by the contractor (Hillson, 2002; Hillson, 2009; Williams, 1995; Wharton, 1992). In a project environment risk is an uncertain event or condition that if it occurs has a negative or positive effect on the project objectives (PMI, 2010). According to Hillson (2009) risk is uncertainty that matters; it can affect one or more objectives. Risk is defined by others as (Hillson and Murray-Webster, 2006; Project Management Institute, 2010; Institution of Civil Engineers et. al., 2005; Williams, 1995; Wharton, 1992):

- Not achieving the expected goal.
- The difference between what is expected and what resulted.
- Unforeseen events that impacted cost, time, and quality.
- Negative impacts.

Risk is relative due to the expectations and understanding of the owner, contractor, professional or inspector. Some identify the risk level in construction as high. However, when compared with the delivery of IT systems, the relative risk level of construction is much lower than in the IT industry (Little, 2012; Jacob Kashiwagi, 2012; Al-ahmad, et.al., 2009; Brown, 2001; Connolly, 2006; Masing, 2009; Natovich, 2003; Peppard, 2006; Schneider, et. al., 2009; Schwaig, et. al., 2006; Skulmoski, 2010; Vries, 2006; Vital Smarts, et. al., 2006). The failure rate of the delivery of services in the IT industry has been documented at 70% (Kerzner, 2011) based on the following surveys:

- The Standish Group Chaos Reports (1995-2010).
- Robbins-Gioia, LLC (2001).
- The OASIG Study (1995).
- Chaos Report (1995).
- The Bull Survey (1998).
- The KPMG Canada Survey (1997).

The Bull Survey of 1998 identified the following on IT projects:

- Missed deadlines (75%).
- Exceeded budget (55%).

- Poor communications (40%).
- Inability to meet project requirements (37%).

The survey revealed that the major causes of project failure during the lifecycle of the project is a breakdown in communication (57%), lack of planning (39%) and poor quality control (35%). The Standish Group’s Chaos Report was the result of 365 surveys of IT practitioners and they identified cost overruns, time overruns, and quality issues as the main reason for nonperformance. The reasons for nonperformance as:

Table 1. Standish Group’s Result: Performance Report (Chaos Report, 1995)

	Performance Metrics	%
1	Incomplete Requirements	13.10%
2	Lack of User Involvement	12.40%
3	Lack of Resources	10.60%
4	Unrealistic Expectations	9.90%
5	Lack of Executive Support	9.30%
6	Changing Requirements & Specifications	8.70%
7	Lack of Planning	8.10%
8	Didn't Need It Any Longer	7.50%
9	Lack of IT Management	6.20%
10	Technology Illiteracy	4.30%
11	Other	9.90%

“The Standish Group research shows 31.1% of the projects will be cancelled before they get completed while 52.7 % of the projects will cost two folds (189%) of the original estimates.”

Another survey was carried by the KPMG (Canada) 1997. The study revealed over 61% of the projects that were analyzed was deemed to have failed. The main causes of project failure being:

- Poor project planning.
- Weak business case.
- Lack of top management involvement and support.

The key finding of OASIG study (1995) was 7 out of 10 IT projects ‘fails’ in some respect. Robbins-Gioia, LLC, a provider of management consulting services located in Alexandria - Virginia, made a study over the perception by enterprises of their implementation of an E.R.P. (Enterprise Resource Planning) package (2001.) This included 232 survey respondents spanning multiple industries including government, information technology, communications, financial, utilities, and healthcare. A total of 36 % of the companies surveyed had, or were in the process of, implementing an ERP system. Key findings included:

- 51% viewed their ERP implementation as unsuccessful.
- 46% of the participants noted that while their organization had an ERP system in place, or was implementing a system, they did not feel their organization understood how to use the system to improve the way they conduct business.
- 56% of survey respondents noted their organization has a program management office (PMO) in place, and of these respondents, only 36% felt their ERP implementation was unsuccessful.

The authors propose to use the clearly identified sources of risk in IT projects as a starting point in designing a new risk and project management model. This source of information will then be combined with the deductive logic results of the analysis of the industry structure and supply chain issues.

The above results from IT performance studies list the following as reasons for project failure:

- Incomplete requirements.
- Unrealistic expectations.
- Lack of planning.
- Changing requirements.
- Lack of project management.

Construction risk has previously been identified in terms of cost deviation, time deviation, and not meeting quality expectations. Comparing construction risk and

IT industry risk, the capability to accurately capture requirements, identify project scope, preplanning and manage the project from beginning to end are lacking in both industries. Due to the lack of success in mitigating the risk issue despite years of research and publication, the authors propose that project risk may not be inherent in the project as many have believed. Based on the results of the literature search in both the construction and the IT industries, the authors propose that risk may be due to the lack of expertise and decision making of the project managers in identifying the requirement, delivering the project from beginning to end, and managing the project to mitigate risk. The authors also propose that the project managers may not understand a workable and accurate definition of risk. The authors also propose that if a project manager had expertise, and a good understanding of the project, by definition of being an expert, the amount of their risk would be negligible.

#### **4. Proposal**

From the literature search, the authors identify that minimizing risk in the construction and IT industries have been stubborn issues. The proposal of this paper is that the source of risk may not be project complexity, but a systems or environmental issue that has not previously been sufficiently explored. By observation of potential sources of risk in the IT and construction industries, a lack of expertise may be a major source of risk. The authors, therefore, propose that the current systems and environment may be preventing the identification and efficient use of expertise at the proper time. Instead of analyzing the risk in the supply chain silos of design, procurement, construction and inspection, the authors are proposing to use a supply chain approach and allow the movement of expertise where it is needed. This practice has been utilized in the design-build and CM@risk delivery systems. The authors also propose to identify new sources of risk based on deductive logic and thinking.

#### **5. Methodology**

The authors propose to 1) identify the source of risk of the existing delivery system using deductive logic and observation instead of inductive research (identifying the proposed solution by using the perceptions and expertise of industry personnel), 2) design a new risk management model and environment and run case

study tests to verify the validity of the deductive logic and potential of the new risk management system. The proposed new system will have a measurement system to show the performance of the contractors and to identify the source of project deviations or risk. The objective of the new risk management model will be to measure and minimize contractor risk of project deviation to increase project performance and to identify the sources of project deviation and risk.

#### **6. Deductive Logic**

The authors will use a deductive approach. The deductive approach is the use of already accepted logic constructs, the building of a new risk management model using the constructs, and the testing of the risk management model by case study testing. The proposed new construct would be a starting point of future research. The authors will use a series of deductive logic concepts from the Information Measurement Theory (IMT) (Kashiwagi, 2012). They include:

- All event outcomes are predictable if all information is known about the initial conditions.
- Natural law regulates the change in one set of conditions to another set of conditions over a period of time.
- Anything that happens over time is an event. An event has initial conditions and final conditions.
- The change in the event initial conditions to the final conditions is regulated by natural law. If someone could accurately observe and identify the initial conditions, they could predict how the initial conditions will change to the final conditions using the natural laws.
- Once the initial conditions are set, the final conditions are also set due to natural laws. In other words, the natural laws dictate how the initial conditions will change to the final conditions.
- There is no possibility to impact, influence, or control the event to result in an outcome that is not related to the initial conditions once the initial conditions are set. All event outcomes are singular, predictable and regulated by natural laws.

The above progression of deductive logic to identify that no one party has influence or control over another party, has been analyzed by Jacob Kashiwagi (2007). Kashiwagi showed that there was no documentation that showed conclusive evidence or logic that one party can have influence, impact or control over another party (Kashiwagi, 2010; Kashiwagi, 2008; Kashiwagi, 2007). Major events in society that support Kashiwagi's concept include the failure of prohibition, the high cost and negative impacts of the ongoing drug war, the lack of effectiveness of prisons to rehabilitate criminals, the lack of success of welfare programs to change individuals, the failure of one country's attempt to change another country's government structure through war (Vietnam War and Iraq War.) In all cases, the attempt to control an entity or group of entities to a desired outcome proved costly with the expectations being unfulfilled (White, 2010; Szalavitz, 2009; Langan and Levin, 2002; Gregory, 2006; Greer, 2009; Caulkins et. al., 1997).

The authors, therefore, propose that a system that uses management, direction and control as a means to mitigate risk may be ineffective. Therefore, if owners/buyers of construction are attempting to compensate for the lack of expertise in contractor's project managers by using direction and control, the result may be increased risk. The methodology to show the potential validity of this concept will be deductive in nature, using logic which can be readily observed, and case study testing. When one party attempts to manage, direct, and control another party, the second party usually becomes more reactive and, therefore, has a higher risk. If the testing shows potential merit of the concept, more research may be required.

## **7. Development of the Concept of No "Control"**

According to the proposed deductive logic based on observation, the centerpiece of the proposed new system is the concept that the buyer:

- Has no effective control over a contractor or vendor.
- Cannot utilize a contract to efficiently and effectively control the contractor to meet their expectations.

- If the owner is a decision maker, and attempts to manages, direct, and control the contractor, the expertise to deliver construction is a requirement of the buyer. This assumes that the owner is a better expert than the expert vendor, thus increasing the risk of the project.
- If owners are attempting to manage, direct and control, the system becomes riskier due to the lack of precedence that control can be effectively used to mitigate risk. In other words, if an owner attempts to control a contractor the project is perceived as a riskier project. If the project was not initially perceived as risky, there would be no need to control the contractor.

An alternative method to control risk will be utilized in a new risk management system. The new system will use the opposite of the "control" concept. The new concept will use concepts that are not found in traditional models. The new concepts include (Kashiwagi, 2011; Kashiwagi, 2009; Child, 2010; Meyer, et. al., 2010):

- The owner's control will be replaced by the alignment of expertise. The owner will select and employ an expert contractor. An expert contractor should have minimal risk in delivering construction.
- The expert contractor will prove that they can do the project based on past experience, performance metrics and the ability to see into the future project before it is done.
- The expert contractor will compete with other experts to do the work.
- The expert contractor will plan out the project from beginning to end, before the project is started.
- The contractor will control the project. They will identify the delivered scope. The contractor will identify what is out of the scope, and that will be identified as risk to the project.
- An expert contractor has no risk within their defined scope.
- The contractor shall have a risk mitigation plan to mitigate the risk that they do not control.

- The contractor will be the offeror of the contract, and the owner/buyer will be the acceptor of the offer.
- If the contractor does not clearly define their scope, schedule, risk and risk mitigation, and track their risk and resulting cost and time deviations, the contractor's proposal is not acceptable as an expert and their contract is. They are not an expert, and the owner should not accept the proposal.
- The contractor will identify all deviations to the project, the source of the deviations, and mitigate the risk at the lowest cost during the project.

The use of control by the owner over a contractor through a contract will not be used. The contract will be written by the contractor to identify how the expert will deliver the project. The contractor will be the offeror of the contract, and the owner or buyer will be the acceptor of the contract. The owner will assume that the competing contractors are experts. If they are not an expert, the owner's delivery system will not allow the hiring of the non-expert contractor. This new approach also identifies risk as "what is outside the scope of the contract." By definition, an expert should have no risk in doing their expertise, within an offered scope. Their only risk is outside of their control, scope or where the owner's intent and project information is not clear. An expert contractor, who writes their scope, should not volunteer to do anything that they cannot do. Therefore, by deductive logic, the expert contractor should not have risk in the scope of a project which they determine. This identifies the new structure as having the following characteristics:

- The owner uses a selection process which identifies expert contractors who can deliver construction.
- The owner identifies the best value contractor who can deliver an acceptable product at the lowest price to the owner.
- The owner will identify the best value expert contractor as one who makes them the most comfortable that they are delivering a product which the owner can accept, who can identify the project risk and how they will mitigate the risk of a project which is outside of their

control, and can do it for the lowest price within their budget.

The new structure will be tested by case study. The success of the tests would be defined by the following:

- The new system will measure project deviation.
- The clients will be satisfied with the delivered construction.
- The risk created by the expert contractor is negligible.
- If project deviations occur, the deviations will most likely be caused by the owner (outside the control of the expert contractor.)
- If the owner attempts to exert control, the risk of the project will increase.
- If the contractor creates project deviations and customer dissatisfaction, the deductive concepts of no control are probably not accurate.

The results of the case studies will identify if there is potentially a new risk system. If the proposed system based on the new concepts produces positive results, the system and the concepts can be further analyzed. These concepts force the research into a new area that research has not heavily investigated. The solution is a radical departure from conventional construction management research. Concepts that are not well published include:

- Expert contractors have no risk.
- Risk does not come from projects, but from owners hiring contractors who are not experts in defining the scope and not mitigating risk that they do not control.
- Owners using decision making, management, direction, and control to minimize risk will increase the risk of the project. First, if they need to utilize control, they have hired a non-expert who has high risk. Then they are exacerbating the risk by trying to manage, direct and control.
- Decision making increases risk. When the initial conditions are understood, they predict the final conditions. When decision making is used, the initial conditions are not understood, and the final outcome is in doubt.

- Contractors should be responsible to mitigate risk they do not control, but are not financially responsible for the risk.
- Risk is caused by the owner's delivery system, unforeseen events due to a lack of information and non-experts and thus can be attributed to the owner.
- Contracts cannot mitigate risk.
- Contracts are used to control the contractor. Contracts are a source of risk due to the perception that the owner can successfully use it to control and direct the contractor.

Deductively, if a buyer makes decisions, directs, and controls a contractor, the buyer is increasing the risk of project failure. If the contractor is an expert, and observes and can accurately identify the initial conditions of the event (buyer expectation, environmental conditions, budget, time, quality), and can identify the final conditions and how to get from the initial conditions to the final conditions, they minimize the risk of the buyer/client. If the owner is the expert, and is directing the contractor, the risk of project failure increases because by default, the contractor is a non-expert and requires direction. If a contractor is an expert, by definition they can identify the following:

- Initial project conditions (owner expectation, resources, and environmental constraints).
- Final conditions.
- How to get from the initial conditions to the final conditions.
- The scope of the project (which brings no risk to the contractor) and what is outside of the scope of the project, which is the financial responsibility of the owner/buyer.
- Minimize the risk of those who they do not control or risk caused by a lack of information.

Project risk is being defined as items which are not in the scope of the project. Project risk cannot be transferred to the contractor because it is not in the scope of the project. The expert contractor can mitigate risk, but they cannot be financially responsible for risk that they do not control. Therefore, project risk cannot be transferred from the owner to the contractor. Therefore, contractors only have risk when they cannot

see their project from beginning to end cannot clearly define their scope and cannot proactively mitigate risk that they do not control. Risk is caused by the inability to see into the future. Risk is, therefore, related to the level of expertise and experience of the contractor. If they are not expert, they increase the project risk.

Risk is, therefore, minimized by employing the most expert contractor, having them identify the scope of the project, and having the owner accept the scope of work as defined by the contractor. The proposal is that risk is not caused by the complexity level of a project, but risk is defined by the lack of experience and expertise of personnel who are participants of a project. Personnel with more experience (performed like projects in the past) and expertise (ability to observe and accurately perceive the initial conditions and natural laws) will have less risk. Risk, therefore, is more personnel related and not project related.

## **8. Dominance**

The term dominance is defined as (Kashiwagi, 2012):

- Simple.
- Obvious.
- It is a no brainer.
- Predicts the future outcome.
- Results in minimal risk.
- Brings consensus among people, and minimizes decision making.

When dominance is maximized, decision making is minimized. When the need for decision making is maximized, the conditions are complex, and participants must use their own experience and expertise to determine future actions. By using deductive reasoning, risk increases when decision making is maximized. Experts who have expertise and experience, minimize decision making, can accurately identify initial conditions and can accurately predict the changing of conditions into the future. The clearer the expert's vision of the future project, the simpler they can communicate and plan for the project. Experts plan the project from beginning to end. Experts also minimize the risk that they do not control or identify areas where they lack information. In these instances, the contractor

has risk, and must make a decision (using their experience and expertise), to set a tentative plan.

Therefore, experts explain things in clear, dominant and simple terms that are easily understood by everyone. Experts can bring consensus in a group with their dominant perceptions, explanations and proposals. They minimize the decision making of all the other participants by making things simple, by connecting the dots between the present and the future. When they make things dominant, it relieves all other participants of decision making to predict the future outcome. This deductive reasoning results in the following proposals:

- Experts minimize the need for decisions if they can see into the future.
- Decision making is done when someone cannot see into the future and they must choose between multiple options.
- The degree of decision making is relative to the vision or blindness of the person. The visionary who can see into the future, does not depend as much on decision making. If someone cannot see, they depend heavily on decision making.
- Decision making increases risk.
- Risk is when someone cannot see into the future and cannot predict the outcome.
- Risk and decision making are related. People who are more dependent on decision making, have higher risk.
- The new environment will increase dominance, simplicity and transparency, and thereby, minimize decision making and risk.

The new environment will minimize decision making by forcing everyone to look into the future and preplan. When people pre-plan they minimize decision making and risk and see the future more clearly.

### 9. Industry Structure

Figure 1 is the industry structure model. It identifies the price based and the best value environments. The major difference between the two quadrants is that in the price based quadrant, the buyer or client determines the requirement and the solution, and minimizes risk by managing, directing, and controlling the contractor. In

this environment, the client is responsible to mitigate the risk.

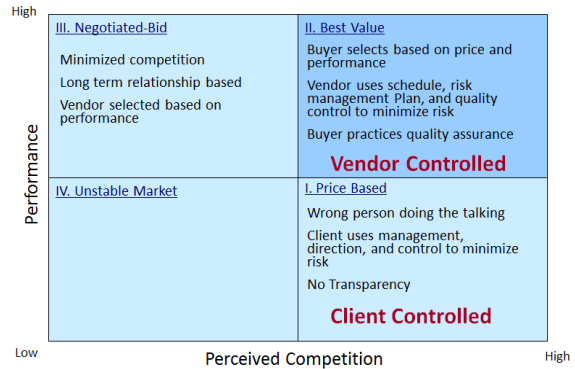


Fig. 1. Industry Structure (Kashiwagi, 2012)

In the best value environment, the client identifies the best value contractor, but the contractor identifies what they will deliver and how they will deliver it. The contractor does the risk management and the quality control, and the buyer does the quality assurance (ensures that the contractor is doing what they proposed they would do including risk management and quality control.) The contractor also defines the scope of the work and "what is in" the scope, and "what is out." The contractor must ensure that what is not in scope is clearly defined, and does not cause risk to the scope of the project. An expert contractor will not have risk in their defined scope.

The expert contractor, therefore, accomplishes the following:

- Must compete to identify their company as the best value.
- Identifies what is in and what is out of the project.
- Has a detailed project schedule.
- Identifies the activities in the schedule that they do not control or which they do not have sufficient information. These are risk activities. These are not in their scope, but they will work to mitigate these risks.
- Identify how they will mitigate the risk in a risk mitigation plan.
- Identify how they will track the risk, measure the risk and report the risk to the owner/buyer.

These actions reinforce the concepts that:



- An expert contractor has no financial risk. They are not financially responsible for accomplishing a task that the client has not given sufficient or accurate information.
- A best value contractor is the offeror and the buyer is the acceptor of the offer.
- The expert contractor is in the best position to identify what will be done.
- A contract does not have to be all inclusive, but merely identifies what the contractor will provide in the project.
- An expert contractor minimizes the project risk.
- The contract is the contractor's offer and how they will mitigate risk.

## **10. System Solution**

The deductive logic proposes that the price based environment, or the traditional method of project delivery is a major source of project risk. As defined above, the price based environment has the following characteristics:

- The wrong party is doing the talking (the party with less expertise.)
- Buyer/owner controls the contractor and the project.
- The owner uses their own expertise, experience and decision making to identify the construction project scope, cost, time duration, and quality.
- The owner and their representatives use management, direction and control to mitigate project risk.
- The number of participants to deliver the project increases.
- The risk increases as communications, meetings and directions increase.
- As management, direction and control increases, contractor's personnel become more reactive.
- The contract becomes a more vital part of the project, as the client attempts to control the contractor.

The authors propose that in the current environments where construction is being delivered, the buyers control the environment, and are managing, directing, and controlling the contractors to minimize risk. The authors propose that if the control of the projects was transferred to the expert contractors, and if the sources of deviation were identified and measured, the following results would occur:

- The clients and buyers would be identified as the major source of risk and deviations.
- The buyers of construction would be very satisfied with the performance of the contractors.
- The contractors would become more proactive and would not be the source of risk.

## **11. Creation of the Best Value Environment and Test Results**

The authors have been developing and testing the new risk management model, the best value Performance Information Procurement System (PIPS) for the past 18 years at Arizona State University. The best value PIPS was designed with the characteristics of the new “no control” alignment model. PIPS testing has the following results (PBSRG, 2012):

- Over 1000 tests.
- Industry funding of \$12M to conduct the tests.
- Delivering of \$4.4B of services.
- BV PIPS is copyrighted and licensed to 26 different research clients (most licensed technology developed at Arizona State University (ASU) by AZ Tech, the innovation group at ASU.)
- Vendors increase their profit margin by 5%. (State of Hawaii report, 2002; University of Minnesota Report, 2011).
- Minimize management transactions by as much as 90%.
- 50% of the time the awarded best value is the lowest cost.
- Customer satisfaction is at 98%.

- Testing has been conducted outside of construction, and results show that the same problems in delivering construction exist in other industries.

Best value PIPS is characterized by the following unique characteristics:

- Identifies the contractor as the expert, the offeror of the proposal, and the client as the acceptor of the offer.
- Transfers the control of the project from the buyer to the contractor.
- Minimizes the need to manage, direct and control the contractor.
- Minimizes decision making of all parties.
- The contractor identifies the scope of the project and how it will be accomplished.
- The contractor tracks all project deviations and the source of the deviations (risk.)
- Forces the contractor to have a detailed plan, and to improve quality by minimizing project deviations.

Over the past 18 years, multiple clients (Motorola, Honeywell, McDonnell Douglas, International Rectifier, IBM, Neogard, State of Hawaii, United Airlines, Federal Aviation Administration, U.S. Coast Guard, U.S. Air Force, U.S. Corps of Engineers, U.S. Army Medical Command, University of Minnesota, Tremco, State of Idaho, State of Oklahoma, State of Alaska, Rijkswaterstaat (Dutch infrastructure agency), University of Alberta and Brunfield) have participated in tests to change the environment from an "owner controlled" price based environment, to a "contractor controlled" best value environment (PBSRG, 2012; Kashiwagi, 2012). Two efforts, the University of Minnesota and related tests in the state of Minnesota, and a Large Government Organization (LGO) used the best value PIPS environment to mitigate risk. Both clients ran repeated project tests over a number of years and were able to document the contractor project performance, the project deviations, and the source of the deviations.

The results of tests run in the state of Minnesota by the University of Minnesota and others are shown below in Table 2. Note the following results (PBSRG, 2012):

- The client and their representatives were responsible for 95% of all project cost and time deviations.
- Client satisfaction of the contractor quality was 100% and the average rating for performance of the contractor was 9.5.
- Over 50% of the time, the best value was the lowest cost.

It is also important to note that the best value PIPS system was being continually improved during the testing. The project testing was done on design-bid-build projects, design-build projects, and multiple prime contractor projects. The LGO tests were different from the University of Minnesota tests due to the following:

- The LGO did not use PIPS for the selection phase, but only for the risk management phase. The selection was run more in an owner controlled price based manner, even though other factors than price were considered. The buyer was non-transparent, negotiated the contractor's price, and heavily considered price in the awards, which is not the best value PIPS process.
- The LGO used the clarification phase after award, by having the contractor conduct a site survey, and hold a clarification meeting.
- The risk documentation was kept on more projects for a longer period of time giving longitudinal information

The LGO application was called the Performance Information Risk Management System (PIRMS). Even though the selection phase was not used, the results mirror the results of the State of Minnesota (Table 3):

- Over time, as the new system was implemented, the project deviation (cost and time) decreased.
- The use of the risk management plan (RMP) which identified the scope and the risk that the vendor did not control resulted in lower project deviations.
- The major project deviations were caused the buyer/clients.
- The contractors caused very little risk.

The buyer's users were very satisfied with the contractors' performance (Table 4.)

Table 2. University of Minnesota Results

Criteria	Rating
Number of Projects	326
Awarded Cost	\$296M
Percent of Projects where BV had lowest cost	53.00%
Overall Change Order Rate	15.80%
Due to client	14.30%
Due to designer	00.60%
Due to contractor	00.00%
Due to unforeseen	00.90%
Overall Delay Rate	42.90%
Due to client	31.20%
Due to designer	04.10%
Due to contractor	02.20%
Due to unforeseen	05.40%
Average contractor Performance Rating	9.6/10
Number of completed project ratings	206

Table 3. LGO WRR/RMP Performance Metrics of Completed Projects

PROJECT OVERVIEW	Estimated		
	Without WRR	With WRR	With WRR and RMP
# of Projects	130	265	72
<b>AVERAGE PROJECT</b>			
Awarded Cost (\$M)	\$1.92	\$1.31	\$1.33
% of Projects on Time (%)	28	32	40
% of Projects on Budget (%)	40	48	65
% Over Awarded Budget (%)	7.02	6.87	3.73
% due to owner (%)	4.77	4.77	3.48
% due to contractor (%)	0.02	0.06	0.00
% due to unforeseen (%)	2.23	2.03	0.26
% Delayed	39.1	37.29	29.11
% due to owner (%)	25.0	26.07	29.14
% due to contractor (%)	3.58	2.21	-2.61
% due to unforeseen (%)	10.52	9.01	2.58

Table 4. Owner's Satisfaction with Contractor

CONTRACTOR	A	B	C	D	E
Number of Projects	68	121	51	51	24
<b>AVERAGE PROJECT</b>					
Awarded Cost (\$M)	.78	1.08	2.31	1.65	1.29
<b>% Over Awarded Budget (%)</b>	<b>8.25</b>	<b>6.29</b>	<b>5.83</b>	<b>2.46</b>	<b>0.82</b>
% due to owner (%)	7.29	4.92	3.27	1.30	-0.12
% due to contractor (%)	0.32	-0.09	0.00	0.00	0.12
% due to unforeseen (%)	0.63	1.45	2.56	1.16	0.82
<b>% Delayed (%)</b>	<b>42.00</b>	<b>45.88</b>	<b>22.34</b>	<b>33.38</b>	<b>21.86</b>
% due to owner (%)	32.29	34.15	19.49	28.05	11.98
% due to contractor (%)	3.85	1.62	-2.08	0.82	0.94
% due to unforeseen (%)	5.86	10.11	4.92	4.50	8.94
Owner Satisfaction (1-10)	9.6	9.1	9.3	9.5	9.5

The LGO started testing PIRMS in 2006. The initial objectives were (Kashiwagi, 2009):

- Make the environment transparent.
- Transfer the control of the projects to the vendors.
- Educate the LGO personnel on how to use the system to minimize their efforts.
- Educate the contractors on how to use the system to maximize their profit and minimize project cost and transactions (meetings, communications, and problems).

By 2010, four out of the six areas of the LGO, were using the best value approach. Half of the contractors were using the best value approach in their own organizations. Table 5 and Figure 2 show the improvement in the understanding of the change in paradigm. However, in 2010, a change occurred at the LGO. The visionary who understood the concepts of the best value approach retired, and the personnel who replaced him did not have the same understanding or capability of being a visionary. Starting in the beginning of 2010 the LGO management decided to do the following:

- Control the information, no longer making all information available to all contractors. It became a "need to know" approach.
- Stop education to the LGO personnel on how to change their paradigm and use the best value

approach in all their work functions. They did not understand that unless the LGO policy was consistent with the best value approach of "no-control" and the LGO personnel could implement a paradigm across all their job functions, there would not have sufficient motivation to change and thereby be comfortable with the best value risk management approach.

- Stop educating the contractors in the best value
- Manage, direct and control the entire system at the headquarter's level and make it a "top down" approach.

The LGO attempted to automate the best value risk management system. They attempted to turn the risk management system into an automated performance information system that they could control. They were attempting to keep the performance and project deviation information, but not use the paradigm of "no control" of the best value model. Comparing the difference between projects with the best value risk management approach and the traditional process, the best value risk management approach increases in value from 2009-2010, then decreases in 2011 when the organization attempted to control the system and the information. The authors propose that the change is not implementing an information system, but changing their paradigm to move to a "no-control" paradigm.

Table 5. Best Value Conference Attendees

Best Value Conference Attendees	Year 06'-07'	Year 08'- 9'
Entity	# of Representatives	
IDIQ Contractors	23	79
Clients	9	37
Certification Program	Year 06'-07'	Year 08'-09'
Certified Best Value Contractors	0/7	2/7
Awareness & Best Value Education/Training	Year 06'-07'	Year 08'-09'
Contractors Requesting Education/Training	2/7	5/7

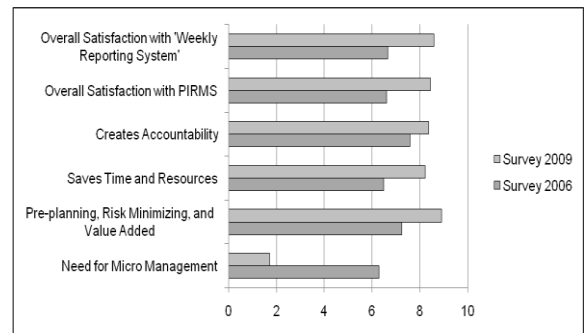


Fig. 2. Comparison of Survey Results from 2006 and 2009

Table 6 shows the impact of the decision to change back into the control mode. The overall deviation rate has increased and there is no difference between using a Risk Management Plan and not using it. It shows signs of contractors becoming more reactive. Table 6 also reinforces the reactive behavior of the contractors. The contractors can take control of the project by starting a weekly risk report (WRR) as soon as they are awarded a project. The WRR goes to all project participants once a week. The WRR does the following:

Table 6. Contractor Performance RMP Analysis by Year Completed

PROJECT OVERVIEW	Without RMP	With RMP	Without RMP	With RMP	Without RMP	With RMP
YEAR	3	3	4	4	5	5
# of Projects	82	36	29	102	30	108
AVERAGE PROJECT						
Actual Project cost (\$M)	1.5	1.0	2.6	1.5	2.0	2.1
% Over Budget	6.50	2.48	4.18	4.19	4.76	5.74
% due to owner (%)	5.32	1.79	2.57	3.72	4.71	4.79
% due to contractor (%)	0.07	0.00	0.00	0.18	0.00	-0.03
% due to unforeseen (%)	1.11	0.69	1.61	0.29	0.05	0.97
% Delayed	43.88	5.17	44.39	34.84	46.38	53.43
% due to owner (%)	29.53	10.11	27.86	33.59	42.31	38.16
% due to contractor (%)	5.14	-6.90	3.17	-1.01	-0.11	5.35
% due to unforeseen (%)	9.21	1.96	13.36	2.26	4.19	9.93

Table 7. Delivery of the WRR

- Establishes the contractor's project milestone schedule.
- Identifies any deviations to the contractor's schedule and the source of the deviations.
- It motivates all the rest of the participants in the project to be accountable to do their task at the right time. If they do not, they are identified as the source of risk with an accompanying cost and time to the project.
- Informs all project participants on the status of their project, and who may be a source of risk by not performing their task.

By creating the WRR at the time of award, the contractor can ensure that the notice to proceed (NTP) is accomplished by the contracting office in a timely manner due to the accurate and repeated documentation of the contractor. If the contracting office was not processing them in a timely manner, and the lengthy time could impact the contractor's schedules and costs. Even though the WRR was not required until the NTP, by creating the WRR at the time of award, the contractors kept the users and all interested parties notified if the contracting office is not proceeding with a timely NTP. The WRR goes to all interested parties, and they can easily see why their project is not on time if the NTP is not processed in a timely manner. By tracking the time of creation of the WRR, the attitude of the contractors and users can be identified. Table 7 shows that only a small percentage of WRR were done before the NTP in 2009/2010. The majority of the WRR are created 1.5 months after the NTP (when the WRR is legally required to be created by the contractor). This shows that the client and vendors were not diligent in doing their responsibilities. The potential impact of the LGO to not continue the education to change the paradigm and training of the clients and vendors resulted in the contractors not acting in their own best interest.

WRR CREATION DATA	
	2009/2010
# of Projects	226
# of Projects start with Weekly	64
% of Projects start with Weekly	28%
Average Length of Time a Project was Without a Weekly (weeks)	6.43

The performance of the contractors in the system by notice to proceed date is shown in Table 8. The following conclusions can be drawn from the data:

- The majority of the project deviations are caused by the client.
- As the client gets accustomed to the new paradigm, the deviation rates continue to fall.

## 12. Other Results of Best Value Approaching Test

The best value approach was tested by the Dutch agency Rijkswaterstaat who is responsible for water and ground infrastructure. They tested the best value PIPS environment on a \$1B test in 2008-2012. The process minimized the government procurement and transaction costs by 50%. The participating contractors also identified savings in competing and securing tenders (50-75%). The project results have been that deviations can be identified back to the owner, most projects finished a year ahead of schedule, and the system accurately identified that the vendors were not the source of risk in the delivery of construction. The Rijkswaterstaat is now using the best value risk management approach to reorganize their internal structure to mitigate risk, transactions, and cost (Brandsen, 2011; Witteveen, 2011). The Rijkswaterstaat also recently won the 2012 Dutch Sourcing Award (DSA) for public procurement and overall for public and private procurement achievement for their success with the best value PIPS delivery system. The NEVI, the Dutch professional industry procurement group has been licensed by Arizona State University to educate and certify all Dutch practitioners. This achievement is unparalleled in university research

developed systems and concepts in the delivery of construction services.

Table 8. Contractor’s Performance by Year of Notice to Proceed (NTP)

NTP YEAR	1	2	3	4
# of Projects	108	127	109	72
<b>AVERAGE PROJECT</b>				
Awarded Cost (\$M)	1.6	1.4	1.3	1.0
Total % Over Budget (%)	6.30	5.92	3.63	3.25
% due to owner (%)	4.73	5.54	2.90	2.17
% due to contractor (%)	0.00	-0.17	0.00	0.31
% due to unforeseen (%)	1.46	0.41	0.78	0.72
Total % Delayed (%)	48.44	45.56	28.33	20.82
% due to owner (%)	40.29	39.68	22.12	11.59
% due to contractor (%)	1.74	-0.09	1.11	-0.54
% due to unforeseen (%)	6.40	5.47	5.10	7.93

The Brunfield Company from Malaysia is one of the largest and most successful development/contracting groups in Asia. They are implementing the best value risk mitigating environment in their entire supply chain. What makes the effort significant is that Brunfield is one of the most successful entities in delivering construction performance, often minimizing delivery time and cost by 33%, while also minimizing defects (Kashiwagi, 2011). The Brunfield Company currently has a research grant to implement the best value approach not only in their own supply chain, but with all contractors, subcontractors, and vendors who do business with them.

The State of Oklahoma has been testing the best value risk management approach for the last three years on both construction and services projects. Their results are shown in Table 9. The following are significant characteristics:

- Did not have internal expertise, but depended on the external vendors' expertise.
- Minimized protest behavior. Encountered three protests and easily won all three.
- High customer satisfaction.
- Lower costs than anticipated.
- Better quality and performance than anticipated.
- Issues were caused by the owner's representatives.

Table 9. State of Oklahoma Results

Oklahoma Best Value Project Information	
# of Best-Value Procurements	20
Estimated Value of Best-Value Procurements	\$100M
Protest Success Rate (# of protest won / # of protests)	3/3
# of Different Services	13
% Where Identified Best-Value was Lowest Cost	71%
Project Performance	
# of Completed Projects	8
Average Customer Satisfaction	9.5 (out of 10)
Cost Savings	\$29M
% On-time	100%
% On-budget	100%

The State of Oklahoma did not confine their testing to construction projects. It included the following projects (PBSRG, 2012; Kashiwagi, 2012):

- Commercial Off the Shelf (COTS) Tax Software
- Enhancement of Workforce Job Website
- Electronic Document Management for Construction Documents.
- Computer to Plate Printer
- State wide light bulb and lighting fixture contract
- Emergency hazardous Waste Removal contract
- Construction Commissioning Services
- State Mental Health Services
- Performance Measurement of Federal Grants
- New Construction and Renovation projects
- Combination Juvenile Center and Services (cancelled due to political issues)

The State of Oklahoma used the positive results to change their construction procurement law to allow the new risk management environment of the best value PIPS structure. The state is also encouraging all procurement agents in the state to get educated and trained in the new process. They are also implementing the certification program that the Dutch are using.

### **13. Conclusion and Future Recommendation**

The researchers propose that project risk is a function of the following:

- An owner is making decisions and creating expectations.
- An owner's delivery environment where the wrong party is doing the decision making, management, direction and control.
- The owner is attempting to pass the risk of a project to a contractor.
- The owner is under the illusion that they can minimize project risk by directing and controlling a contractor.
- Owners/buyers are attempting to direct and control expert vendors to meet inaccurate expectations.
- The contractors in response become reactive and will not be financially responsible for risk.

The owner's delivery system creates risk by attempting to use decision making and control to minimize risk. The owner does not realize that risk is caused by a lack of expertise. By attempting to manage, direct and control, the owner is encouraging the contractors to be more reactive, thus increasing the owner's risk and delivering lower quality. The owners are essentially minimizing the usage of the contractor's expertise.

The researchers propose a new delivery model that utilized:

- No control by the owner/buyer.
- Alignment of expertise.
- Hiring an expert contractor by ensuring the expert can accurately identify the initial conditions, identify how to go from initial

conditions to final conditions, and can identify and mitigate risk that they do not control.

- Transferring project control to the expert.
- Determination of scope by the contractor.
- Identification of risk as only factors that are outside of the control of the contractor.
- Minimization of decision making, deferring to the expert contractor to identify solutions.

A model was built using the above characteristics. The model is the best value Performance Information Procurement System (PIPS) or the Performance Information Risk Management System (PIRMS). PIPS/PIRMS was used to minimize risk, minimize project cost, time and quality deviations. The testing of the new risk management and project management model resulted in:

- Identification that the owner/buyer and their representatives as the biggest source of risk.
- Minimization of project risk.
- A change of paradigm, from a management based approach to a leadership based approach.
- Both owners and contractors required education.

The new risk management model has the following characteristics:

- Minimized communication and decision making in the selection process and during the project.
- The best value vendor identifies the scope and writes the contract.
- The vendor is the offeror and the client/buyer is the acceptor of the offer.
- The best value vendor is identified through competition of performance and price.
- The best value vendor must clearly identify their project capability, their price, their scope, project risk and risk mitigation.
- The contract is written by the contractor, and includes all owner legal requirements, the scope of the work, the schedule, quality control and risk mitigation. It also includes the weekly risk report.

The testing of the new risk model by the LGO and the University of Minnesota had the following results:

- The clients have been satisfied.
- The contractors get high customer satisfaction ratings.
- The major source of project risk and deviation is the client.
- The new risk model is a paradigm shift and requires the client/buyers and the contractors to be educated in the new paradigm. The contractors become better with practice.
- The new model is a transfer of control to the contractors. The amount of management, direction and control transactions is reduced to as much as 90%.

The testing of the new risk model in the Netherlands by the Rijkswaterstaat on a \$1B infrastructure fast track project had the following results:

- Projects tendered twice as fast.
- Costs for both contractors and Rijkswaterstaat were reduced by 50%.
- The Rijkswaterstaat won the prestigious 2012 DPA for both the private sector and the public sector for their testing of the new risk model.
- Projects finished a year ahead of initial schedule completion dates.
- The NEVI (ISM and NIGP counterpart in the Netherlands) licensed to educate and certify professionals delivering services in the Netherlands in 2012.

The State of Oklahoma ran 20 projects (\$100M) on construction and non-construction projects. The results included 100% customer satisfaction, no vendor caused deviations, cost savings of \$29M and the mitigation of all risk caused by protests. Three of the projects were protested; however the protests were successfully overcome by the transparent measurements of the selection system.

These preliminary results are sufficient to warrant future research and testing of the “no control” risk management model. Testing is ongoing in Canada, Malaysia, Netherlands, and U.S. Future publications will cover the details of the new risk model and the test results.

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