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Implementing integrated delivery principles while addressing risk management obstacles

Douglas James Erickson
Northeastern University

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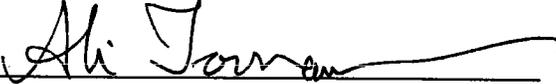
NORTHEASTERN UNIVERSITY

Thesis Title: Implementing Integrated Delivery Principles While Addressing Risk Management Obstacles

Author: Douglas J. Erickson

Department: Civil & Environmental Engineering

Approved for Thesis Requirement of the Master of Science Degree in Civil & Environmental Engineering



Thesis Advisor

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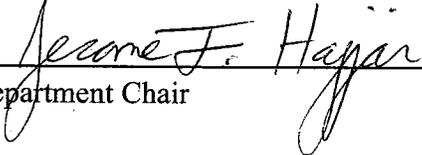


Thesis Reader

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Date

Thesis Reader

Date



Department Chair

6/1/2010
Date

Graduate School Notified of Acceptance:



Director of the Graduate School

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IMPLEMENTING INTEGRATED DELIVERY PRINCIPLES WHILE ADDRESSING
RISK MANAGEMENT OBSTACLES

A Thesis Presented

by

Douglas James Erickson

to

The Department of Civil & Environmental Engineering

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for the degree of

Master of Science

in

Civil Engineering

in the field of

Construction Engineering & Management

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It has been a privilege and extraordinary learning experience to discuss the topic of this thesis with distinguished members of the construction and insurance industry, including; Kevin Connolly of Connolly Architects, Laura Handler of Tocci Construction, Gregory Luth of GPLA Structural Engineers, and Jerry Sullivan and James Schwartz of Beazley Insurance. The inputs of these professionals have provided a great deal of knowledge and a unique perspective on this subject.

Finally, I would like to thank my wife, Tiffany, for the love, support, and motivation during my graduate studies. I am blessed with great family and friends that make accomplishments such as this one so fulfilling.

2. Abstract

New technologies are changing the way construction projects are delivered. Advances in technologies such as building information modeling (BIM) have challenged owners, designers, and construction teams to develop innovative means for procuring services required for the construction of a variety of projects. One of the delivery methods currently being used on building and infrastructure projects throughout the world, primarily in Australia, is a method known as Integrated Project Delivery (IPD). IPD is a project delivery approach that aims to harness inter-party collaboration to add project value. Two fundamental goals of IPD are to increase productivity and decrease waste born from costly inter-party disputes.

These goals are accomplished through a set of IPD principles established by the American Institute of Architects that focus on increasing meaningful collaboration between project participants. While many of these principles can be implemented through traditional delivery methods such as construction management-at-risk and design build, some of the more progressive elements of IPD are implemented through a new contracting method where the owner, design team, and construction team all enter into one multiparty agreement. This multiparty agreement attempts to increase collaboration even further through a shared “pain/gain” payment structure along with “no blame” contract clauses. The research provided herein distinguishes the difference between Process IPD – collaborative practices integrated through traditional delivery systems, and Pure IPD – which utilizes a multiparty agreement that includes shared pain/gain compensation and no blame contract clauses.

The implementation of Process IPD principles is an easier task than the implementation of Pure IPD principles. This thesis provides a qualitative road map for organizations looking to become more collaboratively oriented by first recognizing the value in Process IPD. The implementation of Pure IPD principles is more complex and difficult though, and this paper describes the legal and risk management obstacles that face organizations looking to deliver Pure IPD projects. While not offering definitive solutions to Pure IPD's legal and risk management obstacles, this thesis does provide an outline for future quantitative research aimed at addressing the Pure IPD legal and risk management obstacles.

3. Introduction to Construction Delivery, Risk Allocation, and Risk Management

Generally speaking, the construction of buildings and infrastructure require the work of a multitude of different parties. Owners organize and finance projects; architects and engineers provide professionally developed designs; construction managers and contractors procure and coordinate construction activities; and a bevy of subcontractors put together countless different materials that eventually form a finished project. This multitude of parties, in conjunction with typically unique construction projects, creates a complex set of challenges required to successfully complete the project.

3.1. Defining Delivery Methods

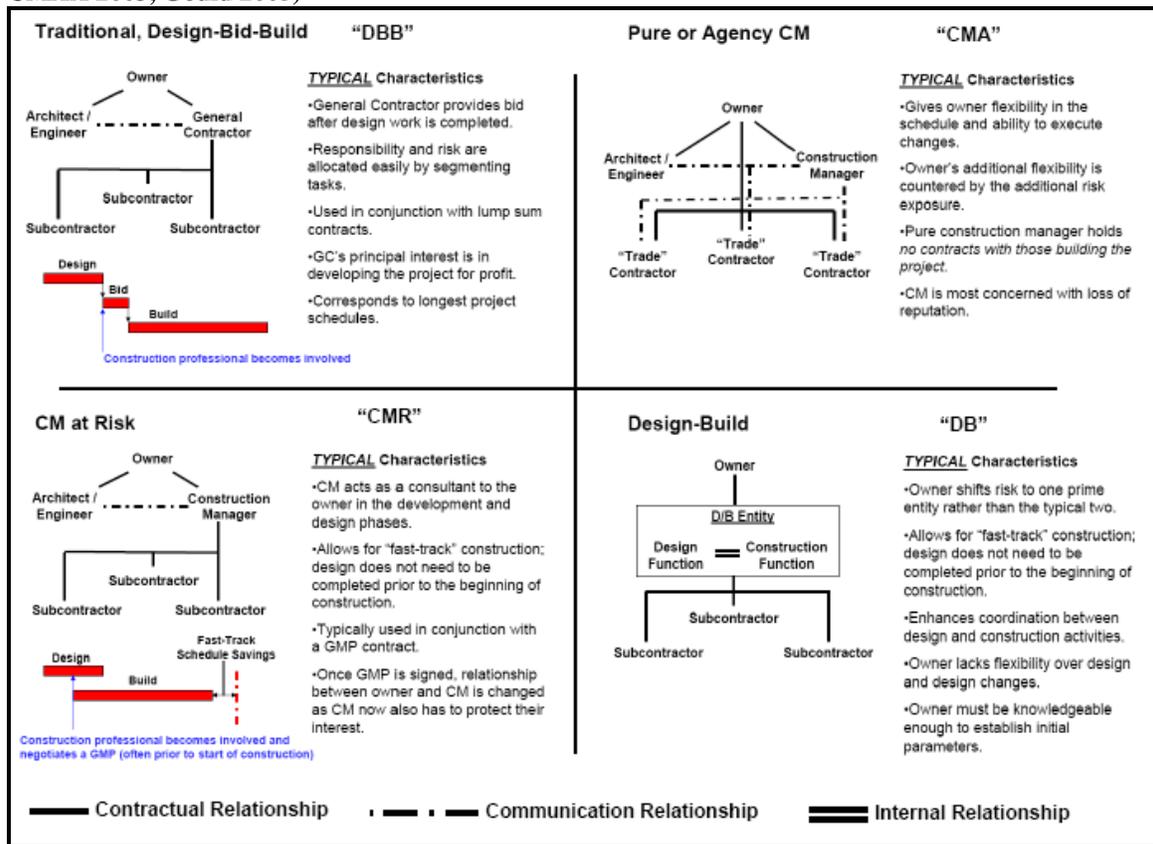
Delivery methods are simply defined by Frederick Gould as “*the approach used to organize the project team so as to manage the entire designing and building process.*” (Gould 2005) Owners typically want to accomplish a fairly common and straightforward set of goals through the delivery of their project – a quality built end product that is economically viable. Unfortunately, these goals are not always aligned with the organizational goals of design and construction teams. Delivery methods were created as a way to align specialized services to the needs of project owners while allocating a considerable amount of risk amongst the specialized service providers.

Throughout the years, different delivery methods have been created to give owners flexibility in achieving their goals based on the available resources and the complexity of the project. Figure 1 depicts the project structures for four of the more commonly

utilized delivery systems and some of the typical characteristics associated with each.

The solid lines indicate the contractual relationships between various project participants while the dashed lines indicate communicational relationships. These dashed lines show that, regardless of the presence of a contractual agreement, the construction and design teams are expected to communicate on a variety of topics during the project's development, including on matters such as requests for information, shop drawing submittals, and change orders.

Figure 1 - Selected Delivery System Structures and Characteristics (adapted from: Pena-Mora 2004, CMAA 2003, Gould 2005)



The traditional delivery method can be considered the "base" method of which all subsequent delivery methods came from. The matrix above attempts to show what characteristics each delivery method has that *may* give the owner an advantage in

achieving their goals in lieu of delivering the project through the conventional, design-bid-build method. It should be emphasized though, that one delivery method is not superior over any of the others. Rojas concluded this in his research on the construction of Pacific Northwest public schools using design-bid-build and construction manager-at-risk delivery systems (Rojas 2008). Rather, each delivery system is best fit for a certain set of project parameters and ownership resources unique to that project (Oyetunji et al. 2006, Rojas et al. 2008, Ibbs et al. 2003).

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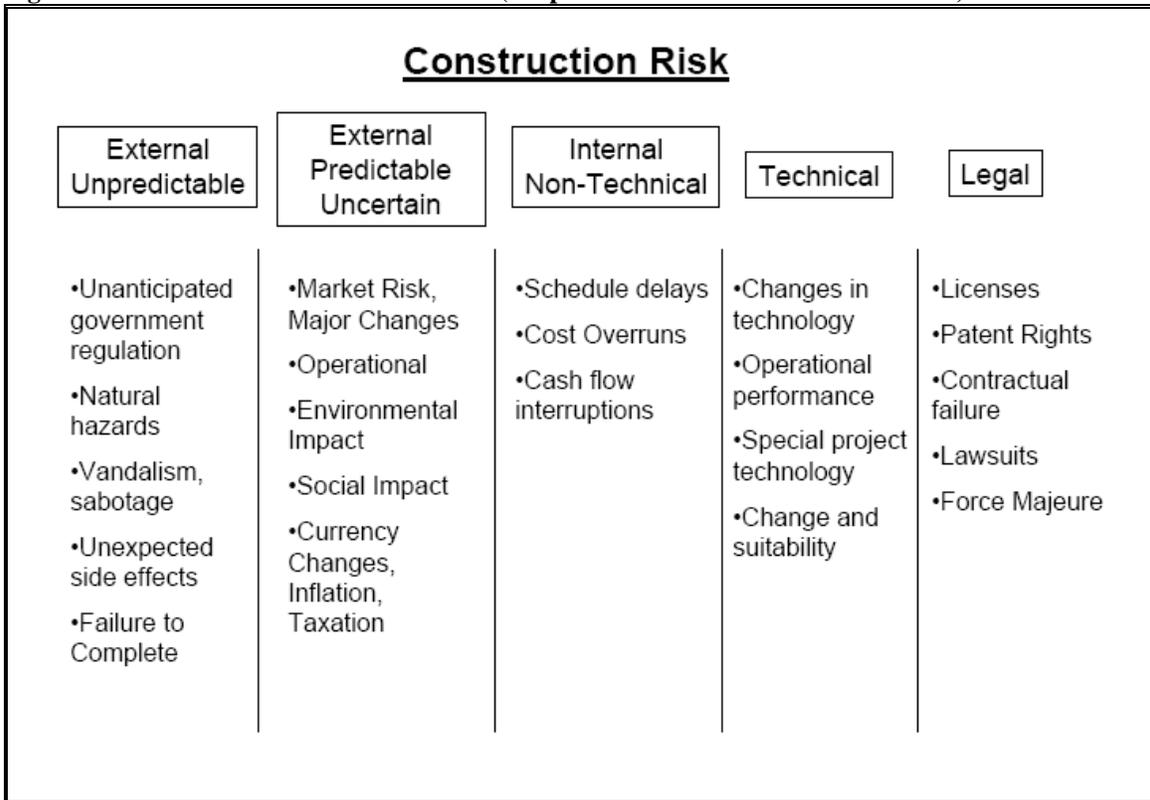
Throughout this thesis, the delivery methods described above will be discussed in conjunction with the standard American Institute of Architects (AIA) contracts developed for them. It should be noted that many other organizations, including the Associated General Contractors (AGC) and Masterspec, have developed similar sets of contracts for different delivery methods. There are subtle but significant differences between these contracts that often relate to how risk is managed and disputes are settled.

Analyzing the differences between the varying contract sponsorships is not the goal of this thesis. Since the AIA has a substantial amount of published literature and standard form contracts for IPD, the preceding AIA contract documents were a logical choice for reference throughout this report. The AGC has also released a series of documents describing IPD and have also released a standard form contract – “ConsensusDOCS 300: Tri-Party Collaborative Agreement.” (AGC website 2010)

3.2. *Risk Allocation and Management Within Project Delivery*

Integrated project delivery (IPD), one of the two underlying subjects of this thesis, is another form of project delivery. Before the characteristics of IPD are looked at in further detail, as was done within Figure 1 for other delivery systems, a fundamental understanding of delivery methods in conjunction with risk allocation and management needs to be established. Barrie and Paulson describe risk management in the construction industry as “*an organized effort to identify and quantitatively evaluate potential exposure, along with an advance plan designed to eliminate or mitigate the consequences of the risks.*” (Barrie and Paulson 1992) As shown in Figure 2, Barrie and Paulson further explain that risk encompasses all exposures – predictable and unpredictable, internally and externally held, and technical and non-technical.

Figure 2 – Construction Risk Identification (adapted from: Barrie and Paulson 1992)



Contractual relationships formed between the parties of a construction project allocate certain types of risk. Typically, the goal is to allocate risk to the party best suited to manage the particular risk and compensate that party accordingly for the risk they bear. Although the delivery methods differ in how and when services are provided, risk is often generally allocated in a very similar fashion as described below:

1. **Owner** – Responsible for project financing and giving design teams and contractors access to a site with known conditions (AIA Form A201-1997; Sections 2.2.1 and 2.2.3).
2. **Design Team** – Responsible for lawfully providing a safe and complete design scope as agreed upon with the Owner (AIA Form A201-1997; Sections 4.1.1 and 4.1.2).
3. **Constructor** – Responsible for constructing the project in accordance with the Design Team’s construction documents referenced within the Contractor’s agreement while adhering to governing laws during the construction of the project; such as OSHA regulation (AIA Form A201-1997; Sections 3.1.2, 3.1.3, and 3.3.1).

What this discussion has attempted to demonstrate is, while each delivery contributes different specialized services at different points and to differing degrees during the project timeline, at the end of the day the design team is responsible for design obligations and the construction team is responsible for construction means and methods. On this topic, AIA’s IPD Guide states, “*Traditional delivery and contracting approaches*

contemplate separate silos of responsibility...” (AIA IPD Guide 2007 – herein cited as “AIA Guide 2007” with page number reference)

While construction risk management encompasses all potential factors that expose the project and its participants to financial harm (see Figure 2), some risks can be partially transferred to insurers via insurance policies. Other risk, including risk pertaining to the contractor failing to complete his contractually prescribed work can be transferred to payment and performance bonds. This thesis will focus on the role of insurance in risk management on construction projects. Joseph H. Jones Jr., Esq., AIA provides the following description of construction insurance:

“Insurance exists to allow certain categories of risk to be transferred to the insurer. In return for payment of premiums, insurers agree to pay for damages that result from specific types of actions or failures to act by the insured.” (Sido 2006)

It is common for all project participants to carry a variety of insurance products. Figure 3 provides a summary of four of the more common insurance policies required of contracting parties to a construction project.

Figure 3 – Summary of Common Construction Industry Insurance Products (adapted from: Barrie and Paulson 1992, AIA 1997, and Shapiro 2010)

Summary of Common Construction Industry Insurance Products				
Insurance Product	Builder's Risk	Professional Liability	Commercial General Liability	Worker's Compensation & Employer's Liability
Procured By	Constructor	A/E	Constructor (and others)	All parties
Covered Risk	Typically covers losses due to fire, vandalism, lightning, wind, and similar forces. Coverage is held through construction, typically terminating at project completion.	Covers damages and claim expenses that arise from the holder's negligent act, error or omission in the performance of their professional services.	Covers liability imposed by law for negligent acts occurring in the conduct of business which result in bodily injury or damage to the property. <i>Can</i> cover post-construction damages resulting from defective work performed by subcontractors depending on jurisdiction.	Provides statutory benefits required by state law to an employee who is hurt or killed as a result of employment.

All of the insurance policies listed above provide coverage when damages arise as the result of a negligent based act by the insured. Insurance companies spend a great deal of money on legal counsel and experts to make certain their insured are at fault for a covered risk occurrence and whether or not that fault was the result of a negligent act. Further, this process also attempts to divide the damages if more than a single party is at fault and acted negligently. The issue of fault and negligence will become very important in the discussion of IPD and its mutual benefit and reward principle when associated with “no blame” contract clauses discussed later on.

While this subrogation and dispute process is often described as wasteful (as will be discussed in Chapter 6.4), it is important to recognize the benefits of the current construction insurance industry. First and foremost, performance data is continually being collected by insurers. This data primarily tracks two pieces of information – frequency of claim occurrence and severity of claim occurrence. From this data, insurers know how to set and adjust an insured's premium rate. The variability of this premium rate based on performance gives some organizations an advantage over others in competitive bidding situations.

Construction text books (Barrie and Paulson 1992) and journal articles (Rouse 1997) have quantitatively demonstrated the positive economic impact contractors with safe work records and corresponding low experience modification ratings (EMR) have. A low EMR can be credited with making a contractor more competitive when bidding for work. The same concept of performance and competitiveness also applies to design and engineering work. A 2002 survey performed by the AIA provided that liability insurance costs ranged from under 1 percent to more than 10 percent of gross billings (Sido 2006, AIA 2002), which can also affect how the design firm competes for work. These characteristics and statistics on construction insurance demonstrate why insurance products are often credited as helping distinguish good entities from bad ones.

The threat of this pricing disadvantage is also coupled with the lost time and effort typically exhausted by the insured in resolving the claim. Mr. Jones Jr. provides within Architect and Engineer Liability: Claims Against Design Professionals that insurance

should not be perceived as a “silver bullet” solution (Sido 2006). Insurance bears certain risk occurrences that cannot be avoided while maintaining an adequate amount of incentive for avoiding these occurrences.

Chapter 7.7 of this thesis will describe how these common risk allocation, management, and insurance practices are in conflict with elements of certain IPD principles. Before this is done, the lineage and fundamentals of IPD must first be presented.

4. Introduction to IPD

4.1. IPD Lineage from Lean Manufacturing

Integrated project delivery (IPD) was created to reduce waste in the construction industry through the collaboration of project participants and the integration of new technologies. Stealing a term from the manufacturing industry, there was a strong desire for construction processes to become more “lean” by reducing the financial waste associated with lower-than-desired construction productivity and costly inter-party project disputes.

In fact, some of the fundamental principles inherent of IPD can be traced back to origins in the manufacturing industry. William Lichtig, an attorney with McDonough Holland & Allen in Sacramento, CA traces IPD’s lineage to Japan’s Toyota Motor Company in the 1920s (Lichtig 2006). At that time, Toyota, much like today’s construction industry, was looking for ways to reduce waste, or in-other-words, become “lean.” So Toyota created the “Toyota Production System (TPS)”, a production philosophy that relied heavily upon, amongst other things, automation and just-in-time delivery. These innovations, along with the creation of a business culture that fostered collaboration and teamwork, helped Toyota obtain their production goals and become competitive with GM and Ford (Lichtig 2006).

For years, people have studied TPS for the lean principles it teaches. The question becomes, how can lean production principles created by a manufacturer of a relatively repetitive end product apply to leaner practices on predominately unique construction projects? Jeffrey Liker, the author of [The Toyota Way](#) summarizes the key lesson from

Toyota as, “*Lean is not about imitating the tools used by Toyota in a particular manufacturing process. Lean is about developing principles that are right for your organization and diligently practicing them to achieve high performance that continues to add value to customers and society.*” (Liker 2003)

This is precisely what the pioneers of IPD have done. They are taking business principles from successful manufacturing models, like TPS, to reduce wasteful processes in the construction industry. The Australian construction industry was one of the pioneers in implementing lean construction practices through IPD. The Victoria Government’s Project Alliancing Practitioners’ Guide (the Alliancing Guide) recalls the early conversations that lead to Project Alliancing delivery, a form of IPD:

“In the late 1980s a group representing a cross-section of government and private sector interests in the Australian construction industry concluded that claims and disputes had become endemic in the construction industry in the developed world and that there were no indication that the incidence of claims and disputes was decreasing.” (State of Victoria, Department of Treasury and Finance 2006, pg. 92 – herein cited as “Alliancing Guide 2006” with page number reference)

Shortly thereafter, a form of IPD, project alliancing, was being used in Western Australia to deliver major oil and gas expedition projects during the early 1990s. The utilization of this method grew from the private oil and gas sectors into the public infrastructure sector;

including a tunnel project procured by Sydney Water (Alliancing Guide 2006, pgs. 92-94).

4.2. *IPD in the United States*

In November 2007, the American Institute of Architects (AIA) helped take a significant step towards implementing IPD into the United States construction industry with the release of Integrated Project Delivery: A Guide (AIA Guide). AIA states that this guide “provides information and guidance on principles and techniques of (IPD) and explains how to utilize IPD methodologies in designing and constructing projects.” (AIA Guide 2007, pg. 1) AIA also defines IPD as:

“a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.” (AIA Guide 2007)

While the previously defined delivery methods focus heavily on role defining and risk allocation, IPD attempts to align each parties’ organizational goals with those fundamental project goals – quality and cost. To align these goals, a new set of contractual and communication relationships needed to be formed. This approach is built on principles of collaboration and the knowledge gained from lean business practices. AIA provides nine (9) principles of IPD that aim at delivering a project with enhanced collaboration and inter-party trust. These principles are:

1. Mutual respect and trust
2. Mutual benefit and reward
3. Collaborative innovation and decision making
4. Early involvement of key participants
5. Early goal definition
6. Intensified planning
7. Open communication
8. Appropriate technology
9. Organization and leadership (AIA Guide 2007, pgs. 5-6)

To implement these IPD principles, not only does the concept of differing organizational goals need to be broken, but a system needs to be created where all parties interests and risks are associated with the outcome of that project. Aligning organizational resources through inter-organizational collaboration becomes the cornerstone of integrated project delivery, as alluded to by Jeffrey Liker's analysis of lean production within Toyota Motor Company. This thesis will explore two project examples where collaboration aligned organizational goals with the projects' goals and reduced realized risk for the project participants. Review of a variety of industry publications yield numerous additional examples of projects where participants credited inter-organizational collaboration for the achievement of organizational and project goals, including: the Minnesota Twins' Target Field (Post 2010), the Curtis R. Priem Experimental and Performing Arts Center at Rensselaer Polytechnic Institute (Yoders 2009), and the Middle Tennessee Medical Center (Yoders 2009).

While this thesis will focus on lean construction through the AIA's IPD principles, it should be noted that other lean construction research efforts are ongoing, including the work done by Gregory Howell and Glenn Ballard of the Lean Construction Institute (LCI). The LCI is also taking principles from the Toyota Production System and working on different ways to apply those principles to construction. The LCI website describes lean construction as, "*a production management based project delivery system emphasizing the reliable and speedy delivery of value. It challenges the generally accepted belief that there is always a trade between time, cost and quality.*" (LCI website 2008)

4.3. *BIM and IPD – Independent and Fundamentally Different*

Now that a fundamental definition of IPD has been established, one caveat must be communicated - IPD and Building Information Modeling (BIM) are two different methods to foster collaboration. As described herein, IPD is a delivery method, an approach in which a project team is organized. BIM on the other hand, is a software innovation in which design and construction elements, along with other corresponding information, can all be stored and communicated within a parametric 3D model. While the two complement each other well, it should be understood that these two collaborative methods can exist independent of one another.

Dossick and Neff suggest that certain projects utilizing BIM technology also have organizational challenges that actually limit collaboration. They state, "*Whether a*

project is BIM enabled or not, organizational and cultural divisions between designers and builders and between contractors and subcontractors may stifle collaborative work and joint problem solving...” (Dossick and Neff 2010) IPD’s approach to organizing a project team attempts to harness BIM’s collaborative platform while highlighting existing incentives and providing new incentives for project participants to move past organizational divisions.

5. Thesis Research

5.1. *Research Methodology*

Now that the fundamentals of project delivery, construction risk, and IPD have been established, a more analytical look at the challenges facing IPD, particularly regarding risk allocation and management, can proceed. To perform this analysis, the author has relied upon three sources of knowledge:

- 1) interviews with a diverse set of industry professionals knowledgeable in IPD and/or construction risk management;
- 2) the author's industry experience (5+ years) in construction consulting; and
- 3) the rapidly developing landscape of IPD literature.

There were two primary goals utilized in choosing the professionals interviewed:

- 1) select professionals providing a range of services to the construction industry (i.e. – Architects/Engineers, builders, attorneys, and insurance providers); and
- 2) select professionals with a depth of knowledge in IPD and/or risk management.

All interviews were performed over the telephone and were recorded for the preservation and analysis of the information provided.

These interviewees shared valuable personal experiences, opinions, and recommended literature references, some of which will be included within this analysis hereafter.

Before the commencement of this analysis, the author is pleased to introduce the following professionals:

- **Kevin Connolly, AIA – President and Owner of Connolly Architects, Inc.** – Mr. Connolly is a licensed architect, owner, and president of Connolly Architects Inc. in Milwaukee, Wisconsin. Connolly Architects (CAI) has been providing strategic planning, design, and construction administration services throughout Wisconsin and beyond since 1983. Although small in size with less than 10 architects on staff, CAI has participated in several well recognized building projects in the Milwaukee area, including the Milwaukee Public Market, Leinenkugel Brewhouse, and the Oconomowoc Physician Center.

Mr. Connolly is also the current Regional Director of the AIA, representing the states of Wisconsin, Minnesota, South Dakota, and North Dakota. Through this position, Mr. Connolly also serves on the Integrated Project Delivery Initiatives Committee. Through his 26+ years of experience in addition to his involvement with the AIA, Mr. Connolly has become an advocate and educator of innovative construction technologies and management initiatives, including BIM and IPD.

- **Laura Handler, LEED AP – Virtual Construction Manager at Tocci Building Companies** – Ms. Handler is a LEED AP and virtual construction manager at Tocci Building Corporation in Woburn, Massachusetts. Tocci Building Corporation is a building and construction services firm that has been in business since 1922. What was once a small

masonry construction outfit is now arguably one of the most innovative construction firms in the country, in large part because of forward thinkers like Ms. Handler.

Tocci has been a leader in advocating and implementing lean construction, virtual design construction, and IPD. In May 2006, Tocci made an organizational commitment to utilize virtual design construction (VDC), or the virtual construction of a building on a computer platform prior to physical construction, on nearly every project they participate on. In 2008, Tocci participated with Autodesk and KlingStubbins in the delivery of the Autodesk AEC Headquarters project in Waltham, Massachusetts. This project was delivered using aggressive IPD principles, including a multi-party agreement put together by attorney Howard Ashcroft. Additional knowledge gained from this project will be discussed further in the subsequent chapters of this thesis.

Ms. Handler has also created a very informative and widely read internet blog titled “BimX”, which shares all sorts of information on BIM, VDC, and IPD.

- **Gregory Luth, Ph.D., S.E. – President and Chief Engineer at Gregory P. Luth & Associates** – Dr. Luth is the president and chief engineer of Gregory P. Luth & Associates (GPLA), a structural engineering firm in

Santa Clara, California. Dr. Luth has been practicing structural engineering for over 30 years and has participated on a broad array of construction projects. Some of Dr. Luth's recent projects include Disney's Grand Californian Hotel, the University of Southern California School of Cinematic Arts, and the Livermore Performing Arts Center in Livermore, California.

- **Jerry Sullivan, Beazley Insurance** – Mr. Sullivan has been in the insurance industry since 1995 and has experience with a variety of insurance products. Mr. Sullivan has made career stops with large professional liability providers such as AIG and Lexington Insurance. He is now the head of Beazley's architect and engineering professional liability business.
- **Jim Schwartz, Beazley Insurance** – Mr. Schwartz joined Beazley in March 2006 and is responsible for underwriting architectural and engineering risks. Prior to joining Beazley, Mr. Schwartz practiced as an attorney for 15 years, primarily representing architects and engineers in matters regarding professional liability and contract negotiations. Mr. Schwartz worked at the law offices of Donovan & Hatem, LLP in Boston, Massachusetts for 10 years prior to joining Beazley.

Beyond the information provided by these individuals, the recommendations to additional publications and knowledgeable people have been greatly beneficial in forming this research and analysis. In addition to utilizing the information provided by these individuals during their interviews, the published material recommended by these people will also be frequently referenced.

Finally, the author has also relied upon his five years of experience in the consulting industry to form this analysis and the corresponding recommendations. During these past five years, the author has worked at two different construction consulting firms that perform a large amount of work for insurers and attorneys. Much of the author's professional experience has been involved in dispute resolution projects regarding cost increases, design errors and omissions, schedule delays, construction defects, and safety incidents; basically all forms of realized construction risk. As has been previously presented, one of the goals of IPD is to eliminate the realization of these risks and the disputes that frequently follow. The author's experiences within this niche of the industry have given him a unique perspective on the inefficiencies of project delivery and insight into which risks IPD may be most likely to positively impact.

5.2. Research Goals

Through the means described above, the author aims at accomplishing the following:

1. Gauge the U.S. construction industry's interest in IPD.
2. Identify the key elements of Pure IPD and the risk management obstacles that face these elements.

3. Provide recommendations for implementing IPD principles and obtaining the goals of IPD as outlined by AIA.

6. U.S. Industry Interest in IPD

6.1. The Interest in Collaboration through BIM

There are numerous indicators that show there is a significant interest within the U.S construction industry for collaborative, leaner construction practices and, more specifically, IPD. One of the first indicators the author believes shows the industry's interest in IPD has nothing to do at all with the project delivery itself, but rather the rise in use of BIM software.

While the author cautioned against using BIM and IPD interchangeably in the background chapter, both BIM technology and IPD can be used to obtain the common goal of increased inter-party collaboration. McGraw Hill Construction's 2008 SmartMarket Report on Building Information Modeling states that, despite poor economic indicators, 62% of BIM users surveyed indicated that they will be using BIM on over 30% of their projects in 2009; compared to 45% in 2008. Industry wide, the report indicates that BIM is being used by 50% of architects, engineers, contractors, and owners at "moderate levels or higher." The top benefits listed within McGraw Hill's research point to similar benefits touted by supporters of IPD, including; easier coordination, improved productivity, improved communication, and improved quality control (McGraw Hill 2009).

Mr. Connolly and his architectural firm have been using 3D object based CAD, and in some instances, BIM, to provide higher quality and more efficient designs since 2003. Object based CAD allows CAI and other designers to attach information, such as material

specification information, to components of a CAD model. CAI has recognized the benefits of three-dimensional (3D) object based CAD and BIM during the design process along with BIM's ability to generate cost and schedule information prior to construction, and often prior to a construction team even being brought onto the project. As Connolly describes it:

“What first led us into IPD was that we were trying to push this BIM tool (around year 2003) to do stuff. We were doing 4D animations of the phasing of a project; we were developing cost estimates out of a model; but we were saying ‘what are we doing this for?’ We were just attaching unit costs to quantities, but we’re not really estimators. We needed a contractor to help us with this. Same with the scheduling; we could do this all day but we’re not the ultimate scheduler. So we said, this tool is great, but we can’t use it by ourselves.”

So, while BIM technology inherits collaborative properties, design teams are also looking for a way to collaboratively utilize the tool prior to construction. AIA's IPD principles are one way design teams such as CAI seek to more effectively utilize the collaborative attributes of BIM.

6.2. Interest in Improvement of Productivity and Reduction of Waste

Two of the more disconcerting characteristics of the current U.S. construction industry are productivity declines and the large amount of waste spent on resolving project disputes. The U.S. Bureau of Labor Statistics reports that since 1964, the construction

industry alone has had decreased productivity while all other non-farm industries have increased productivity by over 200% (Teicholz 2004). The AIA also acknowledges these figures and this problem within their IPD Guide and states new collaborative processes, like IPD, can help improve the industry's productivity (AIA Guide 2007, pg. 3).

Likewise, Dr. Paul Teicholz, former head of the Center for Integrated Facility Engineering (CIFE) at Stanford University, acknowledged the productivity problem and recommended utilization of the collaborative methods established at that time; such as design-build delivery and 3-D object based CAD (the precursor to BIM) (Teicholz 2004).

Regarding the waste inherent within construction disputes, the Dispute Review Board Foundation, a non-profit organization dedicated to the promotion of avoiding and resolving disputes, has settled more than \$90 billion in construction disputes since 2001 (Salmon 2009). James Salmon, former construction attorney and president of Collaborative Construction Resources, LLC, promotes collaborative agreements as a means of eliminating the hefty litigation costs tied to these disputes in an article published by the *Journal of Building Information Modeling* in Spring 2009.

6.3. *Interest through Action – Shovels in Ground and Built Projects*

Ms. Handler and her construction management firm, Tocci Construction, have seen first hand the rising level of interest in IPD. In early 2009, Tocci, KlingStubbins (architect), and Autodesk (owner) completed a 61,000 square foot office and museum in Waltham, Massachusetts aggressively implementing IPD principles. Ms. Handler currently estimates that approximately 80% of the clients they explain IPD to get excited about the

principles of the delivery method; including clients from both the public and private sectors. She also states that Tocci has several upcoming IPD projects in 2010. The Tocci website also provides a list of recognized IPD projects by other ownership, design, and construction teams besides Tocci, including projects such as: SSM Cardinal Glennon Children's Medical Center in St. Louis, MO; multiple Sutter Health Care projects in Northern California; and Barnes-Jewish St. Peters Hospital in St. Peters, MO (Tocci website 2010).

Chapter 7 of this report will describe in more detail the characteristics of IPD projects and establish a classification of two different levels of IPD. So while this chapter identifies the interest in IPD through projects identified as such by Tocci, the collaborative characteristics of many other projects may also signify the industry's interest in IPD, including the projects identified in Chapter 4.2.

6.4. Author Commentary – The Value in Collaborative Initiatives

The amount of attention IPD has garnered from the United States construction industry since the release of AIA's IPD Guide clearly indicates support for IPD principles and the project outcomes IPD attempts to provide. The author believes that the two most important outcomes the industry is looking for from IPD are: 1) the reduction of waste during design and construction through increased productivity (AIA C191-2009, AIA Guide 2007 pg. 3), and 2) the reduction of dispute costs during and after construction (AIA Guide 2007, pgs. 12-13; Project Alliancing Guide pg. 92). To improve the popularity of this delivery alternative, these attributes must become the focal point of all

implementation efforts. The latter of the two outcomes, reduction of dispute costs, is directly related to the management of risk on a given project.

An analogous problem and solution set can be found within the medical field. The Washington Post published a chart documenting the average hospital charges for treatment of a heart attack as being over \$50,000 (Brown 2009). This is a significant financial burden that is distributed between the individual (and family), their insurer, and the government (through Medicare and Medicaid). Consider these costs in comparison to the relatively inexpensive costs that most physicians agree help reduce the risk of a heart attack; including eating healthy, refraining from smoking, and exercising regularly.

The construction industry is fed up with their heart attacks -- costly project disputes. Litigation attorneys can routinely bill at rates well over \$300 per hour; while expert technical consultants frequently utilized on construction disputes can charge similar rates. Not to mention the lost time spent by the parties in dispute assisting in the resolution process and hindering their productivity on other, hopefully more amicable, projects. The opportunity costs in resolving this massive amount of disputed costs are efforts that could be expended on addressing an aging infrastructure, developing solutions to energy independence, and simply, adding quality to projects. The following two project examples attempt to demonstrate the negative effects of project disputes and realized risk on a construction project.

Project Examples No. 1 and 2

Two example projects demonstrating the potential negative effects of non-integrated, insufficiently collaborative project delivery will now be presented. The data provided herein is from real projects. Generic names and locations are used to provide an adequate level of confidentiality. The author was involved on a consulting basis on both projects after risk was realized during construction.

Example Project No. 1 involved the construction of a large diameter (>10') sanitary tunnel in and around a major U.S. city. The Tunnel Project was constructed by use of tunnel boring technology and the placement of segmental, precast concrete rings that were mechanically adjoined to create a large diameter ring. This process was repeated for over 20,000 linear feet to create the sanitary waste tunnel.

To protect the structural steel components of the tunnel from corrosive sewage gases, the engineered design was equipped with a corrosion protection liner. The liner was prescriptively specified as a PVC type material chemically bonded to the concrete by use of a proprietary binding agent. During installation of the liner system, multiple quality parameters were not being met despite exhaustive efforts by the construction contractor. Some of these quality issues included the appearance of air and water voids in the liner and general insufficient adhesion of the PVC like material to the concrete tunnel.

The problem eventually escalated into a multi-million dollar dispute. The contractor claimed that they exhausted millions of uncompensated dollars to construct and repair the

liner system that the contractor believed was inappropriately specified. Further, the contractor claimed that they voiced concerns about the liner system early on in tunnel's construction and unsuccessfully recommended the use of alternate liner systems. The design engineer and ownership group subsequently argued that the problems were the result of the contractor's ineffective construction means and methods.

Ultimately, each side spent a great deal of time and money to resolve this dispute through a contractually prescribed set of dispute resolution board (DRB) hearings. The parties collectively exhausted a great amount of money on expert consultants, lawyers, and organizational staff to come to a decision on whether the cause was a result of an inappropriate specification (design engineer responsibility) or ineffective construction means and methods (construction contractor responsibility). After the hearings, the DRB concluded that the specification was defective and incompatible with the tunnel system and the contractor was compensated accordingly, but at a modest percentage of what was originally requested.

Example Project No. 2 involved the construction of an approximately 10,000 seat football stadium in the U.S. During construction, the architect noticed that a set of precast concrete balconies were designed too large which resulted in sight lines being impeded for a number of stadium seats. The architect revised the balcony dimensions and submitted the changes for contractor pricing. After receiving the precast subcontractor's proposed costs, the at risk construction manager added miscellaneous costs and submitted a change order proposal for \$456,000.

Knowing that the contractor had little incentive to control costs to correct the architect's admitted error, the architect and their insured spent a great deal of money, time, and effort to review the contractor proposal and negotiate more reasonable costs. A revised balcony change order totaling \$356,000 was agreed to in principle two weeks after the original \$456,000 proposal was submitted by the contractor.

Both example projects attempt to display the waste inherent to realized construction risk on a commonly delivered construction project. The collaborative principles of IPD aim to be the industry's "diet and exercise" necessary to reduce risk and more effectively manage realized risk and thereby reduce some of the waste demonstrated by the Tunnel and Stadium example projects. The following chapter of this report provides a schematic roadmap towards IPD implementation, realization of reduced disputes and increased productivity, and the identification of some of the risk management issues facing "pure" IPD. The discussion will also look back at these two sample projects and consider how IPD principles may have reduced waste on each project.

7. IPD Implementation – Analysis and Recommendations

7.1. All IPD is Not Created Equal – Pure IPD vs. Process IPD

Consider the following question:

If collaboration between design teams, construction teams and owners is the cornerstone attribute of IPD, can't more traditional delivery methods, such as CM at Risk and Design-Build, be considered IPD to some degree?

The author's opinion, along with that of Mr. Connolly and Dr. Luth, is absolutely. The nine AIA principles can be applied to Construction Management At-Risk (CMR) (AIA Guide 2007, pg. 46) and Design-Build (DB) delivery systems (AIA Guide 2007, pgs. 47-48). The Design-Bid-Build (DBB) delivery, still the most prevalent delivery system in the U.S. construction industry, offers fewer opportunities for integration of IPD principles because it does not permit the early involvement of the construction team during project design (AIA Guide 2007, pg. 49).

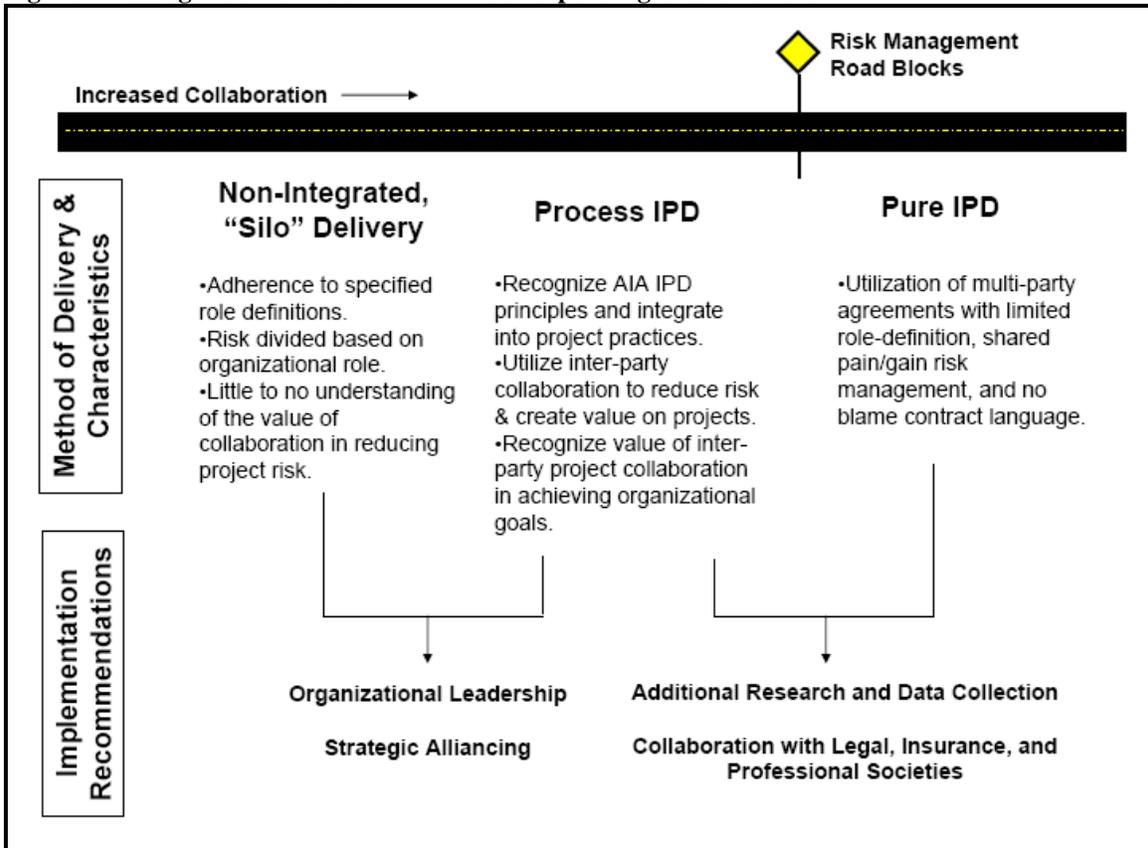
The key words in the opening question though, are "to some degree." Collaboration, while perhaps more vocally supported in recent years, is not a new concept in project delivery. CMR and DB delivery both seek collaborative input from construction teams prior to the completion of design, often for reasons such as improved constructability and fast-track scheduling (Rojas and Kell 2008). So while the IPD principles can, in part, exist in traditional delivery systems, some of the more "pure" elements of IPD are much less easily obtained. These more difficultly obtained elements primarily lie within 2 of the 9 AIA principles: mutual benefit and reward, and collaborative innovation and

decision making. These two principles are where contractual clauses regarding limited role definition, shared pain/gain compensation, and no blame can be applied to further incentivize collaboration. Ms. Handler described the importance of these “pure” IPD elements as follows:

“You can achieve some of those principles (the 9 AIA principles) with the traditional forms of contracting, but it is not the same as IPD. We (Tocci) very strongly, very firmly believe that IPD is a pure contract form. You can have things that are IPD like, on the path to IPD, without actually being IPD. Having a good designer and a good builder, (where) the builder has a preconstruction CM at Risk contract – that’s not the same thing. You are not going to see the same behaviors and the same values. Are you going to get value out of that? Absolutely! Can you get value without all 9 principles, or all 4 principles, (etc.)? Of course! Ultimately pure IPD requires those things. There is a reason each of them exist the way they do.”

The author believes that, as similar to most forms of project delivery, all IPD approaches are not created equal. It is important to distinguish different levels of IPD, define the underlying characteristics of the IPD levels, understand each level of IPD’s ability to affect realized risk and project productivity, and recognize the potential roadblocks to implementation. Figure 4 was created to communicate these distinctions and provide three categorical levels of IPD.

Figure 4 – Categorical Levels of IPD with Corresponding Characteristics



The categorizations and corresponding characteristics presented in Figure 4 were derived through the analysis of the following:

1. **Interviewee Responses** – From the comments provided herein by Luth, Connolly, and Handler, it is clear that there is not a consensus on how an IPD project is defined. Dr. Luth has never been involved in a project delivered via a multiparty agreement, yet believes GPLA has participated on numerous IPD projects based on their commitment to the Process IPD characteristics presented in Figure 4. Ms. Handler on the other hand maintains that IPD is a pure contract form with shared pain/gain compensation and no blame. Rather than choose a minimum criterion for a singularly defined IPD project, the author finds it prudent to establish

and distinguish different levels of collaboration corresponding to multiple categories of IPD. This approach allows industry organizations to determine what level of collaboration they feel comfortable with, and more importantly, how each level of collaboration affects project and organizational value. Further discussion on quantifying the value of these levels of collaboration will be presented in Chapter 7.8.

2. **Review of the AIA IPD Guide** – The analysis presented within the preceding bullet supports the AIA’s presentation of the IPD principles. While the AIA Guide discusses how multi-party agreements harness collaboration, the Guide also states that the 9 principles can be applied to CMR and DB delivered projects without some of the contractual clauses that distinguish the multiparty agreement. The Guide goes on to state, *“However, certain characteristics of a particular project or delivery model may affect the level of integration that can be achieved.”* (AIA Guide 2007, pg. 44) Figure 4 attempts to identify three levels of IPD integration and those characteristics that determine the categorization.

The first level established in Figure 4 is the non-integrated, silo delivered construction project where project participants have very defined roles and responsibilities at defined periods throughout the project’s schedule. DBB delivered projects would be categorized within this first level along with CMR and DB projects that, despite being structured to be conducive to integration of the IPD principles, did not effectively integrate them.

The second level established in Figure 4 is that of a Process IPD delivered project. Process IPD includes CMR and DB projects that *do effectively integrate* the attainable IPD principles. The AIA Guide describes in length various opportunities for the integration of IPD principles in both CMR and DB delivered projects (AIA Guide 2007 pgs. 46-49).

The third level of IPD, Pure IPD, more aggressively seeks inter-organizational collaboration through contractual incentives via multiparty agreements (MPA). The characteristics of these MPAs along with the IPD principles they seek to enhance will be discussed in more detail in Chapters 7.4 through 7.7. Before this discussion is presented, Chapters 7.2 and 7.3 will describe in more detail the collaborative benefits to Process IPD.

7.2. *From Non-Integrated Delivery to Process IPD – An Important First Step*

Chapter 3.2 of this thesis explained how risk is typically allocated through traditional forms of project delivery. Process IPD is simply the recognition that inter-party project collaboration does provide value to traditional forms of project delivery like DB and CMR. By combining resources and experiences during the planning phase of a project, it is reasonable to expect that more risks can be identified and appropriately managed (Oyetunji and Anderson 2006). Dr. Luth of GPLA describes this collaboration as follows:

“If both of those parties take it on themselves to identify the conflict, to find it, to identify it, and seek a resolution, then you’re twice as likely to have a resolution

to every problem. Now if one of those parties goes to sleep and misses something, there is still another chance of finding the problem.”

Further explaining why his structural engineering firm implements Process IPD, Dr. Luth states:

“We’ve always done IPD... we’ve never done anything else because I consider it to be the lowest risk way to do a job. So I do it (process IPD) as a way of risk management not as a way of profit. I spend a little more money doing the job, but I think overall it is worth it because I am reducing my risk.”

To compare it to an old idiom, Process IPD results in sort of an “I’ll scratch your back if you scratch mine” culture. While project risks are still allocated via traditional delivery and contracting methods, Process IPD participants recognize the value of adding collaborative resources to reduce project risk; even if it is beyond their contracted scope of services. These participants also comprehend that realized risk and conflicts can affect all project participants, regardless of which party is contractually obligated to that risk. The best way to avoid a conflict is to eliminate the realized risk that created it in the first place, even if it means expending organizational effort not necessarily compensated through the project contracts.

That is not to say that this organizational effort beyond the contemplation of the contract is not of intrinsic value though. Consider the tunnel project example presented in Chapter 6.4. Although the problems with the tunnel liner were ultimately determined to

be the fault of the design team's specification, the construction team expended a lot of capital and manpower to defend their position.

Further, by reducing conflict costs, it can be reasonably determined that reducing risk through collaborative Process IPD practices could also, among other things: 1) Decrease liability on the firm's balance sheet by reducing premiums, 2) Increase the firm's bidding advantage as a result of reduced premiums, 3) Increase competitive advantage through reputation as a low-risk organization (as presented in Chapter 3.2).

Project Example No. 3

A project that exemplifies the characteristics of Process IPD will now be presented. Dr. Luth's firm, GPLA Inc., acted as the structural engineer of record on the subject project which consisted of five buildings for the University of Southern California School of Cinematic Arts (USC SCA) in Los Angeles, California. The architect on the project was Urban Design Group and the general contractor was Hathaway Dinwiddie.

The USC SCA project relied heavily on building information modeling (BIM) to create a medium in which collaboration was fostered. By investing in teams capable of collaborating through BIM technologies, it was USC's expectation that all mechanical, electrical, plumbing, architectural, and structural elements be in the model and fully coordinated. The various design engineers and contractors collaborated and coordinated each project element on each floor, in detail, prior to construction.

The process described in the previous paragraph is quite different than the sequential overlay coordination process described by Tatum et al. (2001). This form of coordination, still common within the industry, involves trade contractors creating shop drawings from the design drawings that show where they intend to locate their equipment. These scaled transparent drawings from each trade contractor are then overlapped on a light table to identify conflicts (Riley et al. 2005). The general contractor typically presides over the coordination and helps resolve identified conflicts. If the conflicts between project elements are deemed too great to be addressed by the general contractor and trade contractors, additional information is often requested from the design team.

The Riley *et al.* (2005) research also attempts to quantify the cost of conflicts identified in the field as a result of inadequate coordination. The research states that, per conflict, costs can range between \$2,000 and \$30,000. The author has been involved as a consultant on two university laboratory projects where alleged damages from inadequate coordination resulted in numerous conflicts and corresponding damages ranging between \$100,000 and over \$1,000,000. Unlike the Riley research, these past project experiences of the author's also included damages related to schedule delay as a result of time lapsed while correcting the conflicts.

These unintended costs are what USC avoided through the project's intensified coordination process. As Dr. Luth generally described previously in this chapter, the design entities were eager to participate as they individually and collectively recognized

the value in providing the manpower to facilitate the intensified and collaborative coordination effort. At the end of the day, this collaborative coordination effort resulted in zero dollars of claims born from inadequate coordination. Further, these coordination and intensified planning efforts through BIM also decreased the scheduled structural steel duration from 391 days to 275 days. By decreasing this critical path activity by over 30%, the project participants also inherently reduced the risk of schedule related delay damages.

7.3. *Author Recommendations – Becoming a Process IPD Organization*

There are two subtle characteristics of Figure 4 that need to be emphasized at this point. The first is the significance of the linearity of the “roadmap”, or in other words, an organization must first learn to succeed at Process IPD before it can move towards implementation of Pure IPD principles. In their “Organizational Divisions in BIM-Enabled Commercial Construction” research, Dossick and Neff (2010) identify organizational and cultural divisions between project participants that can limit collaboration via BIM technology. They provide the following statement pertinent to this discussion on IPD, *“Suggestions of revised contracting practices to incentivize collaboration could solve some of these issues, but our research suggests that conflicts between scope and project will still remain. Throughout the network of project organizational structure, effective project-oriented leaders at all levels navigate the communication infrastructure to exchange information, encourage joint problem solving, and inspire collaboration in spite of conflicting obligations to scope and company.”* (Dossick and Neff 2010)

Dossick and Neff (2010) go on to state that future research could investigate what aspects of cross-company collaboration are likely to produce better buildings more efficiently. The research performed herein and the establishment of the characteristics of different IPD levels begins to provide answers. It is hypothesized herein that Process IPD champions like GPLA and CAI, who recognize the inherent value of inter-party collaboration, are the type of companies that are more likely to benefit from the contractual incentives provided within Pure IPD forms than those accustomed to non-integrated delivery. More research should be performed though to substantiate this statement by examining different organizations success on Process and Pure IPD projects.

The other subtle characteristic of Figure 4 is the omission of any risk management roadblocks on the path from non-integrated delivery to Process IPD. Companies like GPLA, CAI, Tocci Construction, and countless additional industry firms have been implementing Process IPD for years prior to the release of AIA's IPD Guide. In fact, characteristics of Process IPD, and even Pure IPD to some degree, resemble the components of construction partnering (Anvuur and Kumaraswamy 2007, Hauck et al. 2004). Throughout the history of the US construction industry, there have been successful projects that often reflect back upon the cooperation of those organizations participating on the project.

To increase the implementation of the IPD principles, the author suggests that the industry first reflect upon some of the proven, fundamental characteristics of successful,

collaboratively built projects. One fundamental characteristic that the author would like to highlight is the value of organizational leadership. Like most business initiatives, IPD principles are much more implementable when an organization's leadership is supportive of the initiative. Organizational leadership often has the resources and authority to cultivate business cultures and implement initiatives to achieve that culture (Dossick and Neff 2010).

While the AIA IPD Guide does list "organization and leadership" as one of the nine IPD principles, the Guide does not emphasize enough the importance of corporate leadership when establishing a framework for IPD implementation. The Project Alliancing Practitioners' Guide more appropriately highlights the importance of organizational leadership when pursuing project alliancing work (a form of IPD recognized by the AIA Guide) by providing a governance and management structure that contains an oversight "alliance leadership team (ALT)". The ALT is created to, in part, "*empower the alliance managers; champion support, vision, and principles; and harness best resources from participant organizations.*" (Alliancing Guide 2006, pgs. 12-14)

While it is true that the Alliancing Guide is more geared towards providing Pure IPD recommendations, it should be recognized that the actions suggested of the leadership team above are important actions for organizational leadership on all types of projects. All three of the design and construction professionals interviewed during this thesis research recognize the importance of actions similar to those listed by the Alliancing Guide while in pursuit of the IPD principles. Handler described the third generation

president of Tocci Construction, John Tocci, as always being interested in collaborative technology applications, including building information modeling and virtual design construction. Tocci Construction now models and integrates collaborative delivery principles into nearly every project they build.

Beyond implementing collaborative construction practices into his own firm, John Tocci also started the Associated General Contractors BIM Forum whose intent is to increase collaboration among all parties to a building project and to break down traditional silos between designers and constructors (Post 2009). The BIMForum now has over 1500 members from a diverse set of industry professionals, including designers, constructors, attorneys, educators, and technology providers.

GPLA's vision statements provide a glimpse into their commitment to progressive construction means:

"We are on a quest to revolutionize the way buildings are designed and built. We combine traditional values with state of the art technology." (GPLA website 2010)

While simple, vision statements like these show that Dr. Luth and the GPLA leadership are, on an executive level, committed to innovative means of delivering projects. As stated earlier, Dr. Luth does this by expending resources beyond what is contemplated by most of his design contracts for the management of organizational risk, the betterment of each individual project, and the long-term betterment of GPLA. This commitment to innovation and collaboration has landed GPLA praise in publications like the Journal of

Building Information Modeling (Smith 2009) and advertisement campaigns like Tekla's "From Design to Construction" sales campaign (2010 advertisement). Tekla is a structural BIM software platform utilized by GPLA and the other project participants on the USC SCA project.

Another recommendation that may help firms move towards Process IPD implementation is the more frequent utilization of strategic alliancing. A strategic alliance is defined as a long-term inter-organizational agreement for mutual benefit which is based on equivalence and high complementarity (Anvuur and Kumaraswamy 2007). Again, while important to IPD, this is not a new idea to the industry. Design-build project work is often pursued by a construction organization and a design organization that are familiar and comfortable collaboratively working with one another (AIA Guide 2007, pgs. 47-48). Larger ownership groups are also known for selecting the same design and construction teams when building projects like retail stores, restaurants, and hotels.

Successful strategic alliances amongst industry organizations often create many of the principles presented with the AIA IPD Guide, including: mutual respect and trust, collaborative decision making, and open communication (Hauck et al. 2004). There is frequently a respect and trust between these organizations that foster a relationship with less probability of conflict. Strategic alliances also recognize the benefits of sharing experience and expertise during the procurement and management of projects. As hypothesized previously within this chapter, the collaborative principles learned from

strategic alliancing will put industry firms in better position to benefit from participation in more contractually incentivized, Pure IPD project forms.

7.4. *From Process IPD to Pure IPD – A Challenging Transition*

The background chapters of this thesis made a point to emphasize the common practices of risk allocation and management in traditional forms of project delivery. Pure or Contract IPD handles risk allocation and management in a completely different way. Pure IPD also attempts to increase inter-party collaboration by contractually binding project participants' compensation to one another and the goals of the project (or incentivizing collaboration). While Process IPD attempts to provide organizational value through the reduction of *allocated risk*, Pure IPD attempts to provide organizational value through the reduction of *mutually shared risk*.

Referring back to Chapter 7.1, the more progressive elements of Pure IPD primarily lie within 2 of the 9 AIA IPD principles, mutual benefit and reward and collaborative innovation and decision making, where project participants utilize multi-party agreements with limited role definition, shared pain/gain compensation, and no blame contract clauses. These contract elements also create an intriguing set of risk management obstacles, as alluded to within Figure 4. Chapters 7.5 and 7.6 will describe the progressive elements of these principles along with the risk management road blocks that must be addressed before more extensive Pure IPD implementation can commence.

Before these elements are described in detail, the author would like to first explain the documentation basis for the following research. First, the State of Victoria's Alliancing Guide provides a detailed analysis of project alliancing and its characteristics, including discussion on shared pain/gain compensation and no blame. The AIA Guide recognizes project alliances as a multi-party contracting method along with single purpose entities (SPE), and relational contracts (AIA Guide 2007, pgs. 32-33). While all three of these multi-party arrangements require the owner, design team, and construction team to execute a single agreement, they do have their differences.

The AIA guide describes project alliances as, *“the owner guarantee(s) the direct costs of non-owner parties, but payment of profit, overhead and bonus depend on the project outcome... To reinforce Alliance teamwork, all significant decisions (are) made by facilitated consensus and the parties waive any claim between them, except for willful default.”* Conversely, relational contracts are described as *“similar to project alliances”* but differ as a result of relational contracting's *“approach to compensation, risk sharing and decision making... the parties may agree to limit their liability to each other, but it is not completely waived. If errors are made, conventional insurance is expected to respond.”* Single purpose entities are described as, *“temporary, but formal, legal structure(s) created to realize specific project(s) (like a limited liability company or other legal form).”* As a result of creating an independent legal entity, the AIA states additional issues regarding taxation, corporate formalities, management, and insurance need to be addressed (Entire paragraph - AIA Guide 2007, pgs. 33-34).

Between 2008 and 2009, the AIA released standard contract forms for multi-party agreements, including C191-2009 – “Standard Form Multi-Party Agreement for Integrated Project Delivery” and a series of agreements for the formation of different SPEs (C195–2008 – “Standard Form Single Purpose Entity Agreement for Integrated Project Delivery”, C196–2008 – “Standard Form of Agreement Between Single Purpose Entity and Owner for Integrated Project Delivery”, C197–2008 – “Standard Form of Agreement Between Single Purpose Entity and Non-Owner Member for Integrated Project Delivery”) (AIA website, 2010). Discussion throughout the remainder of this thesis will focus on the C191-2009 document, which integrates project alliancing concepts of shared pain/gain and no blame contract clauses (AIA C191-2009 FAQs). The integration of these concepts creates the characteristics indicative of the Pure IPD approach established within Figure 4.

7.5. *A Closer Look at the “Mutual Benefit and Reward” Principle*

This chapter will take a closer look at the shared pain/gain and no blame contract methods found within the Alliancing Guide and the C191-2009 agreement. These contracting methods were created to further incentivize the mutual benefit and reward principle. The AIA describes this principle as follows:

“All participants or team members benefit from IPD. Because the integrated process requires early involvement by more parties, IPD compensation structures recognize and reward early involvement. Compensation is based on the value added by an organization and it rewards ‘what’s best for the project’ behavior, such as by providing incentives tied to achieving project goals. Integrated

projects use innovative business models to support collaboration and efficiency.”

(AIA Guide 2007, pg. 5)

Dr. Luth voiced his opinion regarding value added based compensation during the interview. Describing a typical scenario where cost savings are uncovered by both a design and construction team on a traditionally delivered project, Dr. Luth states:

“The effort involved is more or less uniformly distributed. I send a guy to a meeting and he spends two hours at the meeting and the contractor spends two hours at the meeting. If they collectively save \$100,000, how does it get shared?

(Compensation should be shared more evenly than is customarily done) because we both invested the same amount of effort in uncovering those savings.”

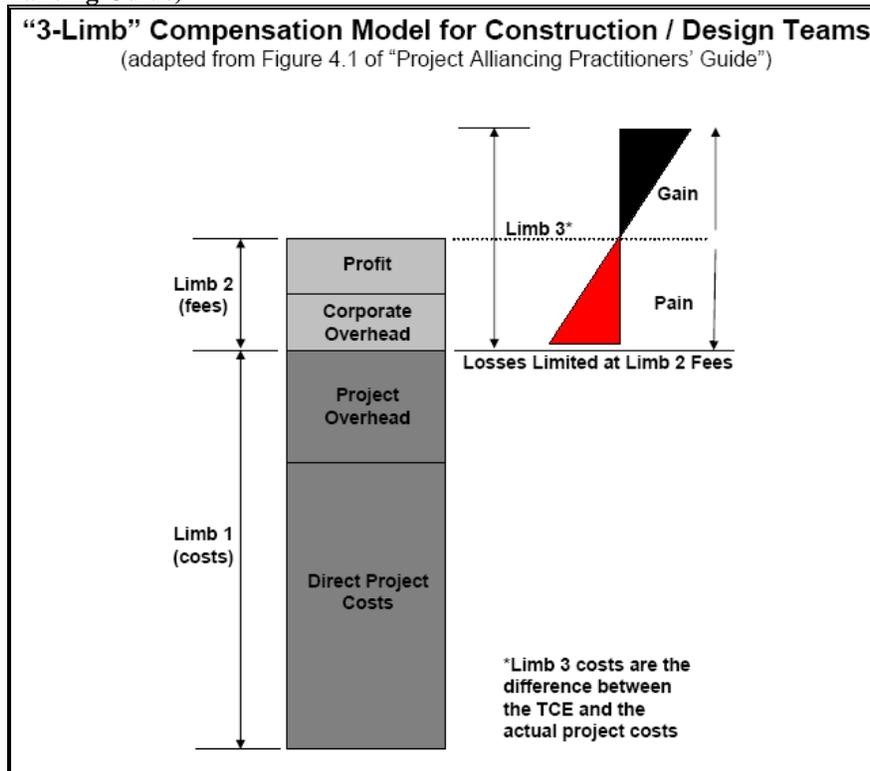
Current delivery and contracting methods often do not provide an equal compensation distribution between the owner, design team, and construction team for realized cost savings. The AIA mutual benefit and reward principle communicates the need for a more equitable means for compensating value added resulting from inter-party collaboration.

One method of obtaining this principle within a Pure IPD project is through a compensation model where profits and losses are shared between the project participants based on the team’s performance versus a mutually agreed upon target cost estimate (TCE) developed early on in the project’s development. If the total project costs fall below the TCE, the owner, construction team, and design team share in the financial gain. Conversely, if the total project costs are above the TCE, the project team shares a portion of the financial pain.

As outlined by the Alliancing Guide, compensation for the construction and design teams could follow a 3-limb compensation model as shown in Figure 5. The Alliancing Guide describes the different “limbs” of compensation as follows:

- **Limb 1** – *Expenditure on the work under the alliance (including mistakes, rework and wasted effort) and project specific overheads related to the work under the alliance are reimbursed at actual cost, subject to audit.*
- **Limb 2** – *A fee (the fee) to cover ‘normal’ profit and a contribution towards recovery of non-project-specific (i.e. corporate) overheads.*
- **Limb 3** – *An equitable pre-agreed share of the ‘pain’ or ‘gain’, depending on how actual outcomes compare with pre-agreed targets (in both cost and non-cost areas) (Alliancing Guide 2006, pgs. 27-38).*

Figure 5 – “3-Limb” Compensation Model for Construction / Design Teams (adapted from Figure 4.1 of the Alliancing Guide)



The limb 3 costs are the difference between the TCE and the actual costs, or the “pain/gain” limb of this compensation model. On the pain end of the limb 3 costs, downside risk for the construction and design teams as presented by the Alliancing Guide is capped at 100% of the Limb 2 costs. Therefore, if the TCE is exceeded, the Limb 2 costs are collected from both design and construction teams; in an effort to share the “pain” of not meeting the project’s cost goal. Figure 6 below contains a hypothetical example showing a high level summary of the TCE for a notional ~\$100M infrastructure project (adapted from The Alliancing Guide Tables 4.1 and 4.2).

Figure 6 – Target Cost Estimate for Notional ~\$100m Infrastructure Project and Limb 2 Fee Calculation (adapted from The Alliancing Guide Tables 4.1 and 4.2)

	Cost Item	Costs Incurred Pre-TCE Agreement	Costs Incurred Post-TCE Agreement	Combined
Owner	Staff	\$ 250,000	\$ 1,000,000	\$ 1,250,000
	Consultants	\$ 450,000	\$ 750,000	\$ 1,200,000
	Other directly incurred costs	\$ 200,000	\$ 1,150,000	\$ 1,350,000
	Expenses	\$ 100,000	\$ 350,000	\$ 450,000
	Risks/unallocated contingency	\$ -	\$ 1,247,000	\$ 1,247,000
Construction Organization	Salaried personnel	\$ 1,000,000	\$ 3,600,000	\$ 4,600,000
	Construction Plant	\$ -	\$ 12,000,000	\$ 12,000,000
	On site wages	\$ -	\$ 13,000,000	\$ 13,000,000
	Materials	\$ -	\$ 17,000,000	\$ 17,000,000
	External hired equipment	\$ -	\$ 7,900,000	\$ 7,900,000
	Subcontract	\$ 600,000	\$ 11,000,000	\$ 11,600,000
	Site amenities and facilities	\$ 650,000	\$ 3,000,000	\$ 3,650,000
	Other project-specific overheads	\$ 300,000	\$ 2,500,000	\$ 2,800,000
	Provisions for specifics risks	\$ -	\$ 5,000,000	\$ 5,000,000
Design Organization	Salaried personnel	\$ 1,000,000	\$ 3,500,000	\$ 4,500,000
	Contract staff	\$ -	\$ 550,000	\$ 550,000
	Subconsultants	\$ -	\$ 400,000	\$ 400,000
	Expenses/other costs	\$ 450,000	\$ 550,000	\$ 1,000,000
Owner Costs + Construction & Design Limb 1 Totals		\$ 5,000,000	\$ 84,497,000	\$ 89,497,000
		Construction & Design Limb 2 Fee\$ (*See note below)		\$ 10,493,750
		Mutually Agreed Upon Target Cost		\$ 99,990,750
<p>The Alliancing Guide describes the Limb 2 costs as "a fee that reflects (the construction and design organization's) 'normal' business margin for corporate overheads and normal profit, consistent with scope and context of the alliance..." (The Alliancing Guide 2006, pg. 31) This example adapted from the guide outlines the following hypothetical fee percentages for the construction and design organization.</p>				
		Limb 1 Costs	Fee %	Total Limb 2 Costs for Each Organization
Construction Organization	Total of Limb 1 Costs from Above	\$ 77,500,000	12.5%	\$ 9,687,500
Design Organization	Total of Limb 1 Costs from Above	\$ 6,450,000	12.5%	\$ 806,250
		Total Limb 2 Costs (at-Risk)		\$ 10,493,750

It must be emphasized that the Limb 2 cost distribution shown in this example are completely hypothetical. Limb 2 costs can be established on a fixed basis or a percentage basis and also can be at-risk at different ratios. The Alliancing Guide states, "A typical approach is for pain/gain to be shared in direct proportion to the respective (non-owner organization) Limb 2 fees. However, where it is agreed that this arrangement does not properly reflect the relative contributions to/influence on the leadership, performance, outcomes, and overall success of the alliance, the sharing ratios should be revised

accordingly.” (The Alliancing Guide 2006, pg. 36) In this example, a total of over \$10m is at-risk between the design and construction teams.

The purpose section of the AIA’s C191-2009 form provides the following commentary that reflects a similar compensation basis as described for alliancing:

“The Architect, Contractor and other Parties are reimbursed only for their direct and indirect costs incurred in the design and construction of the Project. Profits can be earned in two ways: achievement of goals during the course of the Project (“Goal Achievement Compensation”), and shared cost savings realized at the end of the Project (“Incentive Compensation”). The Owner pays pre-established Goal Achievement Compensation amounts to all Non-Owner Parties if and only if the goals are met. Failure to achieve the goal, regardless of fault, results in the forfeiture by all Non-Owner Parties of the Goal Achievement Compensation pre-established for that Project Goal. Similarly, failure to design and construct the Project for a total cost less than the pre-established “Target Cost,” regardless of fault, results in the forfeiture of any Incentive Compensation payment to all Non-Owner Parties.” (AIA C191-2009)

While the communication of the compensation model is modified by AIA within the C191-2009 by using terms such as goal achievement and incentive compensation, the idea of shared pain/gain is just as recognizable. As was discussed for project alliancing, there are many ways to structure and calculate the distribution of organizational compensation and financial exposure amongst the Pure IPD project participants. The

AIA form allows the users of the document to tailor these details accordingly within Article 4 – “Compensation”. Article 5 of the C191-2009 form outline the basis for the establishment of the target cost amendment, the adjustment of the target costs, and the re-affirmation to sharing in the responsibility in maintaining the target cost during project implementation. Paragraph 5.4.6 contains:

“Recovery Plans called for under this Section 5.4 shall be developed without consideration of which Party or Parties is (are) responsible for the failure to maintain the Target Cost.” (AIA C191-2009, Article 5)

The other important attribute in this compensation structure within a Pure IPD, multiparty agreement is the “no blame” characteristic inherent to the agreement and alluded to within Paragraph 5.4.6 provided above. By bounding the parties together within a single agreement and making the parties waive rights to claims and subrogation, each entity is unable to seek compensation as a result of another entity’s negligence. The only exception comes when the damages can be attributed to acts of willful misconduct (The Alliancing Guide, pg. 2). The C191-2009 agreement describes this no-blame concept within the purpose section previously cited and within Article 8 – “Risk Sharing”. Like the Alliancing Guide, Article 8 requires the parties to waive all claims against each other, including claims for consequential damages (except for instances of willful misconduct) (AIA C191-2009, Article 8).

This is a significance difference when compared to the common practices within traditionally delivered projects. Many construction disputes arise out of one party

claiming that the negligence of another party created the damages lawfully being sought after. This inherent characteristic of many traditional delivery methods can contribute to organizations exhausting efforts towards the preservation of organizational interests at the expense of the betterment of the project (AIA Guide 2007, pg. 8). As stated within the previous chapter, one of Pure IPD's goals through mutual benefit and reward, 3-limb compensation, and no blame is to eliminate this self preservationist attitude amongst project participants by creating incentives to align organizational goals with the project goals and to more equitably compensate all the organizations for their work in achieving these goals. By creating these aligned project goals, it can be reasonably discerned that the project has a better breadth and depth of resources for many problems that may be encountered through the life cycle of the construction project. By providing a more equitable compensation structure, design teams like GPLA have more incentive to exhaust additional resources to accomplish these goals.

7.6. *A Closer Look at the “Collaborative Innovation and Decision Making” Principle*

The AIA describes the collaborative innovation and decision making principle as follows:

Innovation is stimulated when ideas are freely exchanged among all participants.

*In an integrated project, **ideas are judged on their merits, not on the author's***

***role or status.** Key decisions are evaluated by the project team and, to the*

greatest practical extent, made unanimously.” (AIA Guide, pg. 5)

As discussed in the previous chapter, not only are project goals contractually aligned within Pure IPD through shared pain/gain compensation and no-blame, but so are resources. So, on a key design decision, not only will the design team have input, but so will the construction team, and vice-versa. While the combination of these resources will most probably diminish inherent risks, as was described in the discussion on Process IPD, it also creates a potential liability problem should a loss occur on a Pure IPD project. By collaborating on design decisions, the construction team may also be assuming non-traditional professional liability. By collaborating on construction decisions, the design team may be assuming risk related to construction productivity, quality, and safety.

It is important to understand how this is fundamentally different than what is experienced on a Process IPD project. Process IPD projects allocate responsibilities and risks amongst the different project participants, regardless of the level of collaboration used to make the project decisions. On a Pure IPD project, a traditionally allocated design decision could be made by the construction organization with the consequences of such decisions being born by all those listed within the multi-party agreement (via no blame and shared pain/gain – assuming the decision was not made through willful misconduct).

For instance, consider the hypothetical and summary level example where a flashing detail for a set of windows is not provided within a set of construction documents. The project schedule is tight and the design team resources are being exhausted elsewhere, so a member of the construction team calls the designer and verbally gets an “okay” to implement a flashing detail conceived from the construction member’s experiences. The

constructor details the flashing for inclusion within the design documents and the detail is constructed. During the warranty period of construction, residents of the condominium begin complaining about leaky windows, and it is recognized that the detail, though conceptually agreed upon on the phone with the architect, was detailed inappropriately for the given openings. The implementation of the “collaborative innovation and decision making” principle backfires on the architect, as they now have to share in the responsibility of the delegate design decision and the corresponding repair costs. The potential risk management implications of a situation like this will be further explored in Chapter 7.7.

7.7. Risk Management Obstacles Facing Pure IPD

The principles and elements of Pure IPD described within chapters 7.4 through 7.6 currently inherent risk management obstacles that hinder more frequent consideration and utilization of this delivery method. There are questions as to whether the shared pain/gain, no blame, and collaborative decision making fit, or even ever will, into the present day legal and insurance frameworks existing in the United States (Novitski 2008). Two of these risk management obstacles that will be presented herein are: 1) Unintended consequences of collaborative design as it relates to the health and safety of the general public; and 2) The lack of insurance products for use on no-blame, multiparty agreements.

David Hatem of Boston's Donovan & Hatem LLP, asks the following questions pertinent to the discussion regarding potential problems with collaborative design practices within Pure IPD:

“In the more specific context of design delegation, the principle registration/licensure issue relates to: (1) the qualifications of the person performing the design; and (2) who, in the context of distributed and delegated design, is in responsible charge of that design as well as the coordination and integration of the design with other, overall components of the project design. Does the distribution and delegation of design responsibility result in adequate protection of public health, safety, or welfare? In the context of collaborative design, can or should more than one person or entity be responsible for the entirety of the project design?” (Hatem 2008)

The Freakonomics book series by Stephen Dubner and Steven Levitt does a great job of illustrating how positively perceived ideas can create unintended, and often unforeseen, consequences (Dubner & Levitt 2005). In one of the numerous examples Dubner and Levitt present, a daycare center imposed a \$3 per child, per incident fine on parents who were excessively tardy in picking up their children at the end of the day. The goal of this fine was to simply deter the parents from being tardy. What the daycare found though, was that this actually resulted in more tardy incidents! The Freakonomics authors state that the unintended, unforeseen consequence came to fruition because, *“For just a few dollars each day, parents could buy off their guilt (for being tardy). Furthermore, the*

small size of the fine sent a signal to the parents that late pickups weren't such a big problem." (Dubner & Levitt 2005)

This example, along with the subtitle to Freakonomics, "*the hidden side of everything*", aptly describes the concerns presented within Mr. Hatem's paper. While it is reasonable to expect that inter-party collaboration results in productivity improvements and conflict waste reduction, could there not be unintended, unforeseen consequences that appear later on? Hatem's contemplation on design delegation and the protection and safety of the public is particularly interesting. By eliminating traditional roles and allocated risks via a Pure IPD multiparty agreement, could this delivery system be reducing the licensed and certified design professional's responsibility in designing a safe end product? This is one type of important question that must be considered and addressed by industry supporters of Pure IPD.

Besides addressing design authority as it relates to the public's safety, Pure IPD must also determine if and how insurance products work with multi-party agreements and no-blame contract clauses. As presented in this thesis within Chapter 3.2, insurance products only respond when damages arise as the result of negligence based acts by the insured (Sido 2006). Australian attorney Rehana Box, familiar with Project Alliancing IPD, provides the following commentary on no-blame contracting and professional liability insurance in a May 2002 article for the *Australian and New Zealand Institute of Insurance and Finance Journal*:

“Essentially, under a ‘no blame’ culture none of the parties will be liable to any other party for any act of default or negligence, other than possibly a willful default... A conventional professional indemnity policy will only respond where the insured has incurred a liability to another party in respect to its negligence. Under the ‘no blame’ regime of alliance contracting, the negligent party has no liability to the other alliance partners.” (Box 2002)

The same insurance obstacles still exist for Pure IPD in the United States. Jim Schwartz of Beazley Insurance voiced similar concerns about traditional insurance products and no blame contracting:

“Your traditional PLI (professional liability insurance) is strictly a third party liability policy. It provides coverage for claims against the insured from third parties. It’s not first party coverage. If an architect doesn’t recognize the profit that was expected from the project, it can’t rely upon its PLI insurance to cover it.”

Mr. Schwartz’s colleague at Beazley, James Sullivan, goes on to say:

“Insurance companies (have) negligence based triggers; which means that there has to be a negligent act on the part of the designer. Just the fact that there is a mistake in the drawings doesn’t necessarily mean that the architect (or engineer) was negligent. This is the whole standard of care issue – how another like architect or engineer would have done that drawing. In the scenarios under IPD, like Jim said, it’s not negligence based, it’s just fault based. There’s a mistake, we have a pot of money and the pot of money is going to pay to fix the mistake.

There is no remedy to say, 'Well was it negligence? Was it not negligence?' it just pays. There are issues there because the policies are not constructed to handle that type of scenario."

Since the 2007 release of the IPD Guide, the AIA has also recognized the conflict between traditional insurance products and Pure IPD principles such as no blame and collaborative decision making (AIA Guide 2007, pg. 18). The C191-2009 – “Standard Form Multi-Party Agreement for Integrated Project Delivery” contains language indicating that the conflict still exists. Instead of outlining a specific set of traditional polices required on the project, the document recognizes the need for a more innovative approach:

“The Parties shall retain an insurance consultant to provide advice and assistance with respect to integrated products such as Owner or Contractor-Controlled Insurance Programs or with respect to the individual insurance requirements for the Parties and other Project participants.” (AIA C191-2009)

Taking a step back from the details of legal obligations and insurance coverage, the industry should take time to consider why these obstacles are important. If the goal and expectation for IPD is to reduce risk through collaboration, why is insurance coverage even needed? The obvious answer is that insurance would still be needed to protect the Pure IPD project participants from catastrophic losses resulting from unforeseen risk. No amount of collaboration can avoid all risks, and some of these risks may potentially be severe. Toyota’s 2009/2010 United States recall of over 2.3 million vehicles (Cronin-

Fisk 2010) is a great example of how even the most highly touted business principles (“The Toyota Production System, see Chapter 4.1) inherently carry some degree of risk.

But even more specifically, industry practitioners must pay attention to the details of any and all forms of IPD when considering the risk. For instance, it is reasonable to postulate that the three-limb pain/gain compensation model actually puts a significant amount of additional risk on the ownership organization than it does on either the design or construction organizations. The design and construction organizations’ risks are capped at the sum of profit and corporate overhead. If no blame clauses exist, further economic losses would therefore be born solely by the owner. Referring back to the question regarding the need for insurance products, in this case it would be to protect a certain level of ownership assets during the construction of an individual project.

Project Example No. 4

Despite the risk management obstacles discussed within Chapter 7.7, Pure IPD principles delivered through multiparty agreements are being implemented on U.S. construction projects (See Chapter 6.3). Project Example No. 4 takes a look at the construction of the Autodesk headquarters in Waltham, Massachusetts delivered through the implementation of Pure IPD characteristics, including the use of a multiparty agreement that contained a shared pain/gain compensation structure, limited project participant role definition, and contained no-blame contract clauses. The owner of the project, Autodesk, requested joint proposals from architectural and construction management teams and eventually entered into the multiparty agreement with Kling Stubbins (architectural organization) and Tocci

Construction (construction organization). Handler stated that the multiparty agreement pre-dated the AIA's multiparty form agreement and was therefore custom drafted by attorney Howard Ashcraft of Hanson Bridgett LLP (Handler interview 2009).

Autodesk's white paper on the project states that the limited role definition "*gave the architects early access to the expertise they needed from the builder about constructability and how design decisions would impact schedule.*" (Autodesk 2009)

Tocci Construction's involvement from the project's inception allowed the construction team to benefit from an increased ability to understand both the program requirements and the design intent. John Tocci stated, "*With IPD supported by Autodesk BIM solutions, we are intimately involved in the design and in virtually constructing the building before we even set foot on the job site. This is invaluable to us.*" (Autodesk 2009)

Regarding construction risk, the white paper quotes John Tocci's explanation on how the Pure IPD project reduced risk on the project. He states, "*A more conventional project keeps the stakeholders in silos. Every company has its own, clearly defined risks. Even when we want to collaborate, we have to jump through some hoops – errors and omission insurance, liability concerns, and notification requirements. If you take half of the effort that goes into managing those risks and instead choose to work in a more collaborative fashion – as in IPD – you can quickly solve or eliminate a lot of problems.*" (Autodesk 2009)

The Autodesk whitepaper, along with other publications (“BIM+IPD - 3 Success Stories”, Yoders 2009; New England Real Estate Journal Project of the Month, 2009) highlight many other achievements reached on the project as a result of the collaboration harnessed through the multiparty agreement. Some of the final project metrics speak to the success of this delivery and contracting method, including:

- Zero percent non-discretionary change orders (change orders not resulting from contemplated owner scope additions);
- Zero lost time safety incidents;
- Zero dispute costs and zero claims;
- Project was completed on time despite an aggressive 8 month combined design *and* construction schedule. (Tocci website 2010, and Yoders 2009)

This example of Pure IPD attempts to demonstrate the added value the project participants experienced as a result of utilizing a multiparty contract agreement with mutually shared resources and risk.

Revisiting the Project Examples

A qualitative analysis of the presented project examples will now be performed to hypothesize if and where progressively collaborative IPD principles may have provided value to lesser collaboratively delivered projects. First, consider the tunnel project example. On this project, the contractor voiced concerns early on and warned the design team about the utilization of the prescribed tunnel lining system. It may have been possible to avoid the dispute if, during the procurement stage, the owner selected a design and construction team that was in agreement on the best method to line the tunnel. This

may have resulted in the project team utilizing a more effective tunnel lining system; especially if the selected design team was unable to find a contractor that supported the prescribed chemical adhesive system.

Even if the wrong lining system was still chosen by a design and construction team, the dispute costs that resulted may have been avoided if the project was procured via a multiparty agreement with shared pain/gain compensation and no-blame clauses. If these Pure IPD elements were in place, the parties would have likely developed a resolution more quickly instead of expending the capital and manpower effort on defending their allocated risks.

Similar hypothetical considerations can be made on the stadium project. It can be reasonably hypothesized that more substantive involvement opportunities during the design development (utilizing Process IPD elements) may have resulted in the balcony sizing issue being discovered and addressed prior to balcony installation. Similar to the tunnel project example, the time and money expended while negotiating a price for the balcony change may have also been eliminated if a multiparty agreement with shared/pain gain and no-blame was utilized on the stadium project.

It is a more interesting and complex thought exercise is to compare project examples 3 and 4, the USC SCA project and the Autodesk project. From the metrics data presented on both projects herein, both projects appear to be successful on numerous fronts (although the author will note that Phase II of the USC SCA project is in the latter stages

of construction and final cost figures were not obtained). The owners appear to be pleased with the project outcomes, cost escalation and claims appear to be low, and schedule milestones appear to have been met. While this is as small of a comparable sample size as possible, it is reasonable to hypothesize about whether the level of value added by Pure IPD projects is great enough over Process IPD projects to expend efforts to overcome the risk management obstacles presented in this chapter. This hypothesis is discussed further in the following chapter.

7.8. *Author Recommendation for Future Research*

While it is beyond the scope of this thesis to offer a definitive solution to the risk management obstacles facing Pure IPD, a fundamental scientific approach to addressing these obstacles can be established based on the information presented within this thesis. The first thing that should be done is to establish a hypothesis and goal as it relates to implementing both Process and Pure IPD. The following hypothesis is provided as an example:

Process IPD can reduce realized risk and project disputes below what would be expected from traditional, non-integrated delivered projects. Introducing Pure IPD principles would reduce these risk parameters even further.

The above hypothesis should also include quantitative risk performance expectations for both Process and Pure IPD. A similar hypothesis could also be identified for evaluation of IPD versus productivity expectations and overall project performance. Together, risk avoidance, productivity, and other project performance parameters (i.e., project quality,

safety performance) can be compared between varying levels of collaborative delivery systems (non-integrated, Process IPD, and Pure IPD) to see if a sufficient increase in performance parameters exists to justify pursuing solutions to the risk management obstacles discussed in Chapter 7.7.

To test this qualitatively developed hypothesis, researchers must decide what data should be compiled to test the expectation driven hypothesis. There are two different general types of parameters that need to be established. The first is a parameter that provides a “Delivery System Score” (DSS); or how collaborative the project’s delivery system actually is. This score should be established based on evaluation of the delivery system itself, and not the quantitative outcomes of the project. The DSS should include the evaluation of the following delivery characteristics:

1. **How and When Specialized Services are Procured** – Early, substantive involvement of both the design and construction teams is paramount in integrated delivery (AIA Guide 2007, pg. 3, 5, 46). Attention should be paid to when contracts are signed, what levels of pre-construction services are provided by each organization, and what types of contracts are signed (e.g., Design-Bid-Build, CM-at-Risk, Design-Build, Multi-party).
2. **What Means of Collaboration are Planned and How is Collaboration Being Compensated** – Evaluate how the project participants intend on fostering collaboration; whether it be through pre-construction constructability reviews, virtual design construction initiatives, intensified trade coordination through the use of BIM or other approaches.

Compensation for the planned collaborative means should also be considered. As was discussed with Dr. Luth, compensation to project participants is not always proportional to the value added through collaboration. The IPD score should consider how organizations are compensated for their collaborative efforts versus the value these efforts add to the project.

3. **How Conflicts and Disputes are Intended on being Resolved** – This evaluation would include both the evaluation of the project participants past propensity to be involved in project disputes along with the project’s contractual plan for resolving conflict. Project participants that have positive alliancing history and organizational leadership committed to inter-party collaboration would score well. Further, projects with contractually prescribed leadership teams responsible for oversight and dispute resolution would also be indicative of integrated practices. Ultimately, contractual language including no-blame and shared pain/gain would identify the most progressive of projects.

Figure 7 contains a sample DSS scale ranging between 0 and 4. Considering the aforementioned delivery evaluation and this sample scoring framework, “non-integrated” DBB projects would have a DSS between 0 and 1, Process IPD projects would score between 1 and 3, and Pure IPD projects would score between 3 and 4. The DSS should be set up in a way that allows varying scores between these levels of integrated delivery. Therefore, the actual score given to a project should be rounded to the tenths decimal

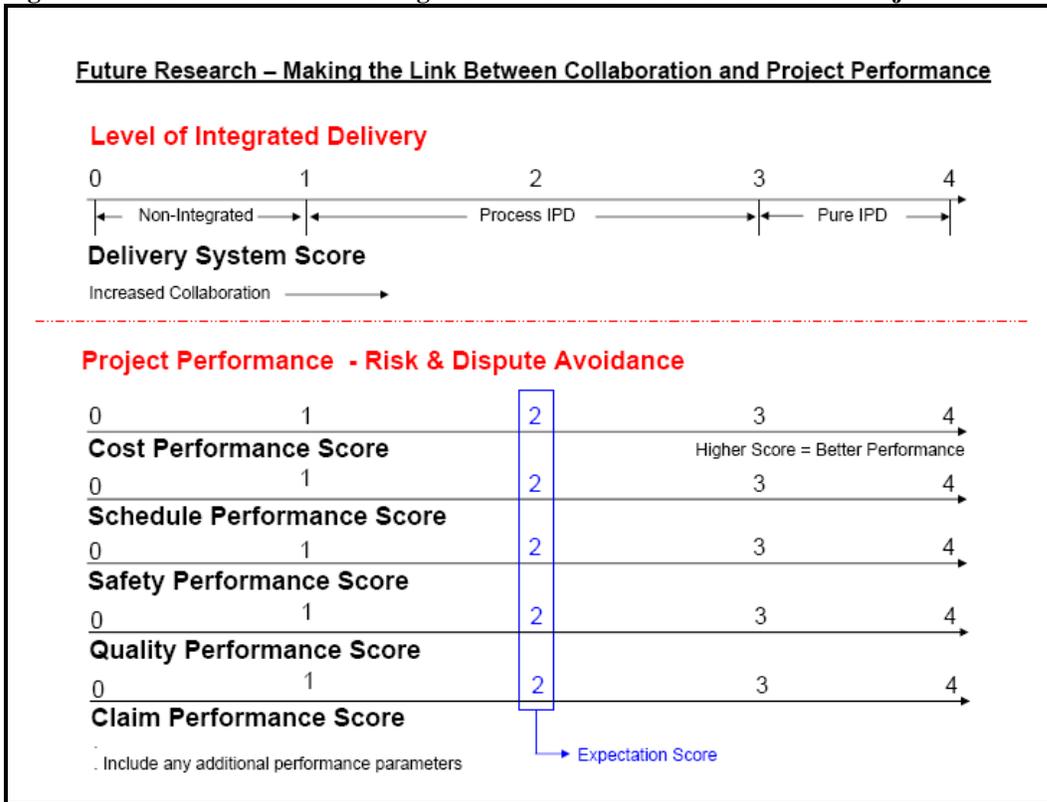
based on a detailed scoring criteria (e.g., 0.2, 2.4, 3.7). The following provides examples of project delivery characteristics that would score within certain DSS ranges, without establishing the scoring criteria specifics, based on the evaluation parameters discussed above:

1. **Score of 0 to 1** – A score in this range would be for DBB projects, where the construction team provides no pre-construction services. DBB projects can have varying scores within this range based on the level of collaboration provided by the design team during construction. For instance, a project delivery structure that includes little-to-no design team construction administrative services should be scored lower than a project delivery structure that does contemplate the design team participating in construction administration and compensates the design team accordingly.
2. **Score of 1 to 3** – This is the largest scoring range and corresponds to Process IPD projects. Figure 4 (Chapter 7) provides three Process IPD characteristics that can be implemented on a particular project to a wide degree of variation. This larger DSS range is set up to recognize the wide variability in implementing these Process IPD characteristics. For instance, a construction team on CMR project may recognize the value added through the AIA IPD principles of early goal definition and intensified planning while performing their pre-construction services. But that might be the extent of that project's collaborative delivery plan. This type of project would score between 1 and 2 on this sample DSS scale.

Other projects, such as the USC Cinematic School project described in Chapter 7.2, may be delivered with greater integration of the AIA IPD principles by project participants much more aware of the principles' value on CMR and DB projects. Projects like the USC project, where parties were chosen based on their ability to collaborate prior to and during construction while utilizing BIM technology and other collaborative innovations, would score between 2 and 3 on this sample DSS scale.

3. **Score of 3 to 4** – A score of 3 to 4 would be given to Pure IPD projects utilizing multi-party agreements with shared pain/gain compensation structure and no blame contract language. Scores closer to 4 could be given to projects with participants experienced in collaborative construction. Attention should also be given to how the project participants resolve disputes given the lack of legal recourse built into multi-party agreements. Higher scores could be given to projects with leadership teams overseeing the project; much like how alliance leadership teams are utilized in project alliancing (Chapter 7.3).

Figure 7 – Future Research – Making the Link between Collaboration and Project Performance



After each project is designated an IPD score, parameters established to evaluate realized risk, project disputes and overall project performance must be analyzed. Those interviewed within this thesis, Luth, Sullivan, and Schwartz, all echoed the common sentiment that more data needed to be collected in order to understand how these collaborative principles and contract methods actually affect project outcomes. The “Project Performance Scores (PPS)”, also shown within Figure 7, attempts to communicate the need for this data. Again, the scoring system should be set up by the researchers, but should consider the following basic parameters:

1. **Cost Performance** – Conflict and disputes often occur when a project’s budget (TCE, GMP, lump sum) is not met. Attention to how costs are

evaluated versus expectations should be analyzed along with if, how and why amendments to the planned budget are made.

2. **Schedule Performance** – Similar to planned costs, conflicts and disputes often occur when a project’s schedule is not met.
3. **Safety Performance** – Safety data is regularly kept on construction projects and the affect of collaborative practices on project safety should be analyzed.
4. **Quality of Finished Project** – Review of technical, physical attributes of the project should be evaluated to see if these attributes fall short, meet, or exceed the owner’s expectations. Disputes can arise when these quality expectations are not met.
5. **Frequency and Severity of Claims** – An analysis commonly performed by insurance companies when underwriting and adjusting policies (Sido 2006). It is important to understand how much of the project’s realized risks actually evolve into project claims and disputes.

Figure 7 also contains a sample scoring scale for the PPS ranging from 0 to 4. A score of 2 would be the “expectation score” for each parameter, with lower scores indicating worse than expected performance and higher scores indicating better than expected performance. Care should be given to the establishment of the scoring scale’s extremes (0 and 4) as well. These extremes could be established at the 5% probability level for the given parameter.

Once delivery system scores and various project performance scores (e.g., cost, schedule, safety) are established, the data can be plotted on a simple x-y scatter plot to see if there is an appreciable inclining relationship between DSS and any given individual PPS. A positive regression slope would show that the implementation of progressively collaborative delivery did improve the evaluated project performance parameter. A negative regression slope would therefore show the opposite; or that progressively collaborative delivery resulted in that parameter performing worse. Figure 8a shows two sets of hypothetical research data plots with Data Set 1 showing a more appreciable increase in cost performance than Data Set 2. Notice that each DSS range was equally represented - four projects for each x-axis integer range were put into the hypothetical data set. Figure 8b further describes the data being plotted in Figure 8a.

Figure 8a – Hypothetical Example – Collaborative Delivery v. Cost Performance Plot

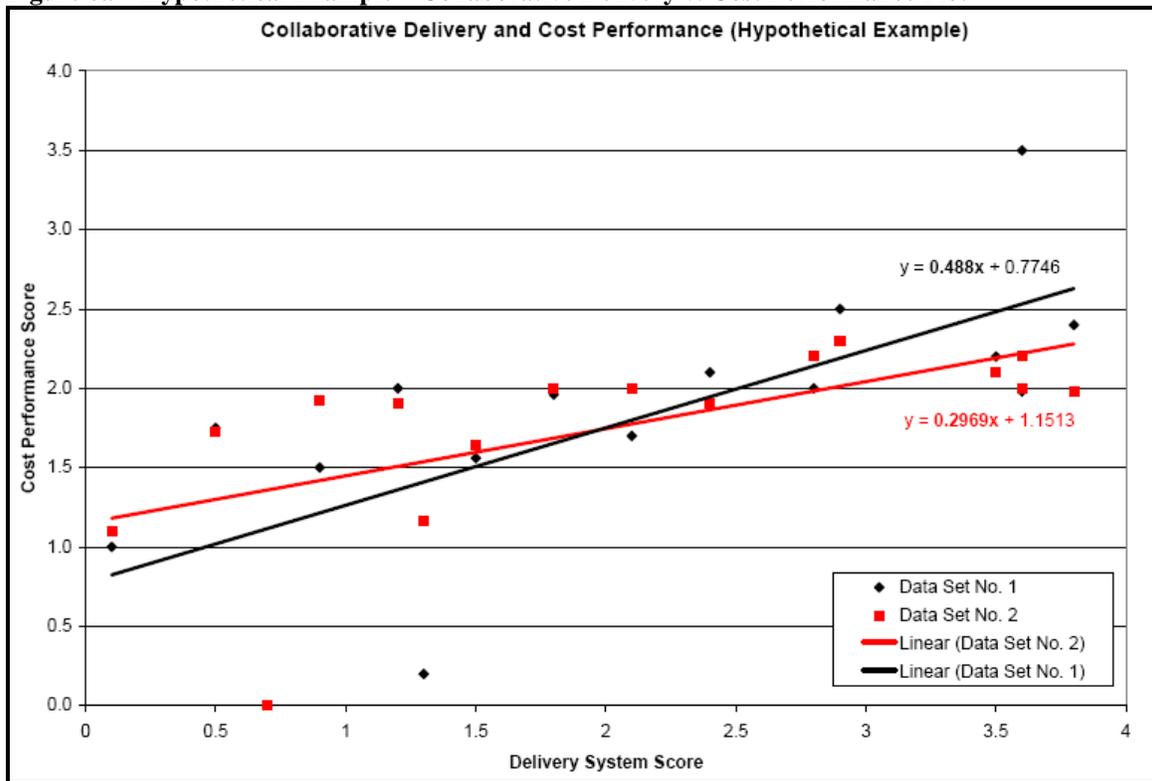


Figure 8b – Hypothetical Example – Collaborative Delivery v. Cost Performance Data Description

Hypothetical Data Set No. 1						
Project No.	Delivery System Score	Expected Project Costs	Final Project Costs	Cost Differential	Percentage Cost Increase (Decrease)	Cost Performance Score
1	0.1	\$ 1,000,000	\$ 1,050,000	\$ 50,000	5.0%	1.0
2	0.5	\$ 1,000,000	\$ 1,012,500	\$ 12,500	1.3%	1.8
3	0.7	\$ 1,000,000	\$ 1,113,000	\$ 113,000	11.3%	0.0
4	0.9	\$ 1,000,000	\$ 1,025,000	\$ 25,000	2.5%	1.5
5	1.2	\$ 1,000,000	\$ 1,000,000	\$ -	0.0%	2.0
6	1.3	\$ 1,000,000	\$ 1,090,000	\$ 90,000	9.0%	0.2
7	1.5	\$ 1,000,000	\$ 1,022,000	\$ 22,000	2.2%	1.6
8	1.8	\$ 1,000,000	\$ 1,002,000	\$ 2,000	0.2%	2.0
9	2.1	\$ 1,000,000	\$ 1,015,000	\$ 15,000	1.5%	1.7
10	2.4	\$ 1,000,000	\$ 995,000	\$ (5,000)	-0.5%	2.1
11	2.8	\$ 1,000,000	\$ 1,000,000	\$ -	0.0%	2.0
12	2.9	\$ 1,000,000	\$ 975,000	\$ (25,000)	-2.5%	2.5
13	3.5	\$ 1,000,000	\$ 990,000	\$ (10,000)	-1.0%	2.2
14	3.6	\$ 1,000,000	\$ 925,000	\$ (75,000)	-7.5%	3.5
15	3.6	\$ 1,000,000	\$ 1,001,000	\$ 1,000	0.1%	2.0
16	3.8	\$ 1,000,000	\$ 980,000	\$ (20,000)	-2.0%	2.4

Hypothetical Data Set No. 2						
Project No.	Delivery System Score	Expected Project Costs	Final Project Costs	Cost Differential	Percentage Cost Increase (Decrease)	Claim Performance Score
17	0.1	\$ 1,000,000	\$ 1,045,000	\$ 45,000	4.5%	1.1
18	0.5	\$ 1,000,000	\$ 1,013,500	\$ 13,500	1.4%	1.7
19	0.7	\$ 1,000,000	\$ 1,016,000	\$ 16,000	1.6%	0.0
20	0.9	\$ 1,000,000	\$ 1,004,000	\$ 4,000	0.4%	1.9
21	1.2	\$ 1,000,000	\$ 1,005,000	\$ 5,000	0.5%	1.9
22	1.3	\$ 1,000,000	\$ 1,042,000	\$ 42,000	4.2%	1.2
23	1.5	\$ 1,000,000	\$ 1,018,000	\$ 18,000	1.8%	1.6
24	1.8	\$ 1,000,000	\$ 1,000,000	\$ -	0.0%	2.0
25	2.1	\$ 1,000,000	\$ 1,000,000	\$ -	0.0%	2.0
26	2.4	\$ 1,000,000	\$ 1,005,000	\$ 5,000	0.5%	1.9
27	2.8	\$ 1,000,000	\$ 990,000	\$ (10,000)	-1.0%	2.2
28	2.9	\$ 1,000,000	\$ 985,000	\$ (15,000)	-1.5%	2.3
29	3.5	\$ 1,000,000	\$ 995,000	\$ (5,000)	-0.5%	2.1
30	3.6	\$ 1,000,000	\$ 1,000,000	\$ -	0.0%	2.0
31	3.6	\$ 1,000,000	\$ 990,000	\$ (10,000)	-1.0%	2.2
32	3.8	\$ 1,000,000	\$ 1,001,000	\$ 1,000	0.1%	2.0

Description of Hypothetical Data

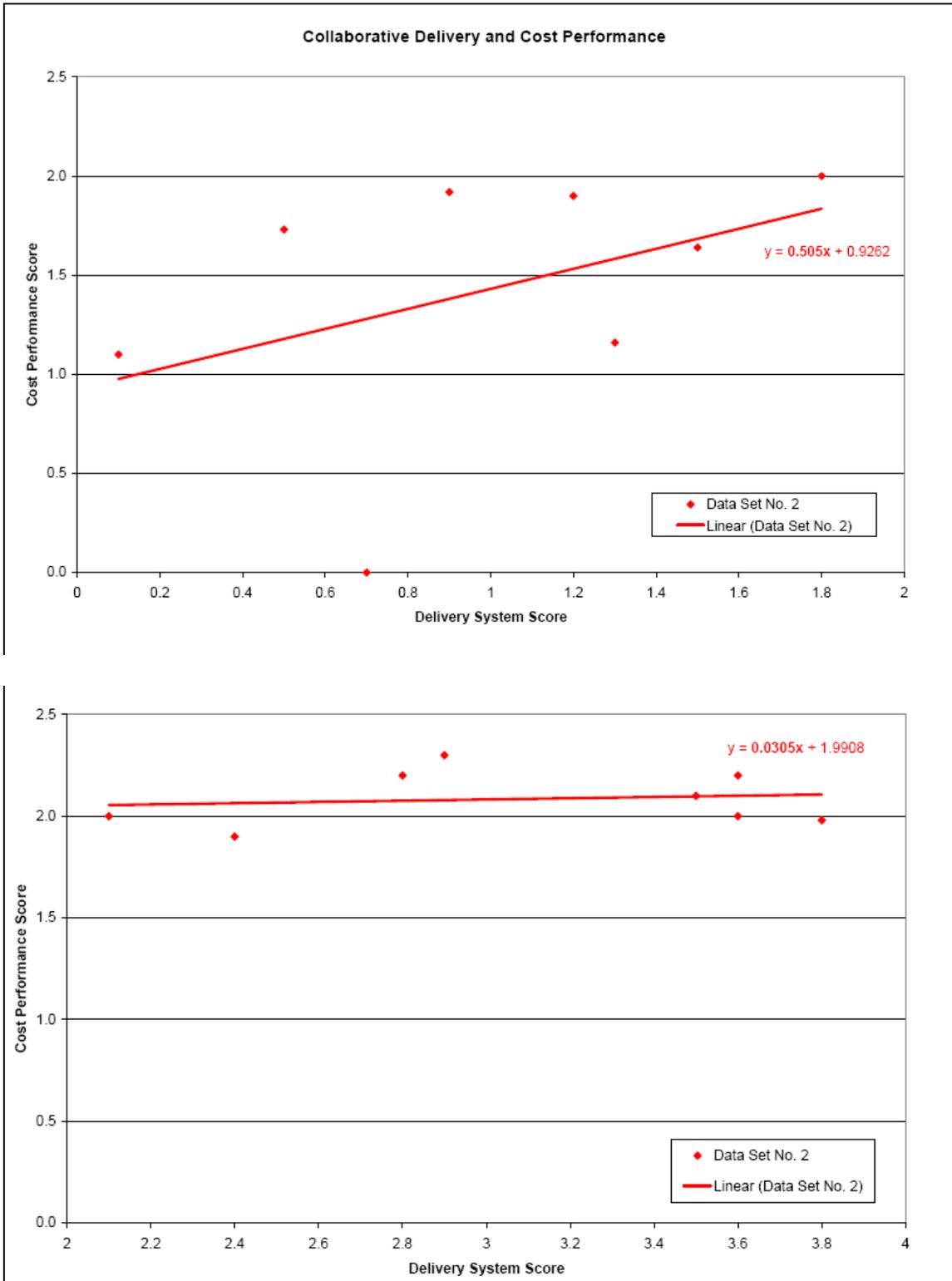
The data provided above and plotted herein is a *hypothetical* example of the future research being proposed. In each data set, four projects are given delivery system scores (DSS) between each integer range. Each hypothetical project has a hypothetical expected project cost of \$1 million. Final project costs were then selected for each project and a cost differential percentage was calculated.

In this example, the cost performance score was based on the expectation that \$0 of cost increase would occur. Therefore, a project that had final construction costs of \$1 million were awarded a score of 2. On the extremes, final costs of +10% or -10% were awarded scores of 0 and 4 respectively. All intermediate final costs were scored based on the linear interpolation between these extremes and the 0 to 4 scoring scale.

Researchers could also decide to combine different individual PPS scores (e.g., cost, schedule, safety) to see how the overall project performance is affected. For example, it is possible that the cost performance score does appreciably increase while the schedule performance relationship may not. Combining these parameters might be valuable in evaluating the overall effectiveness of IPD principles in adding project value.

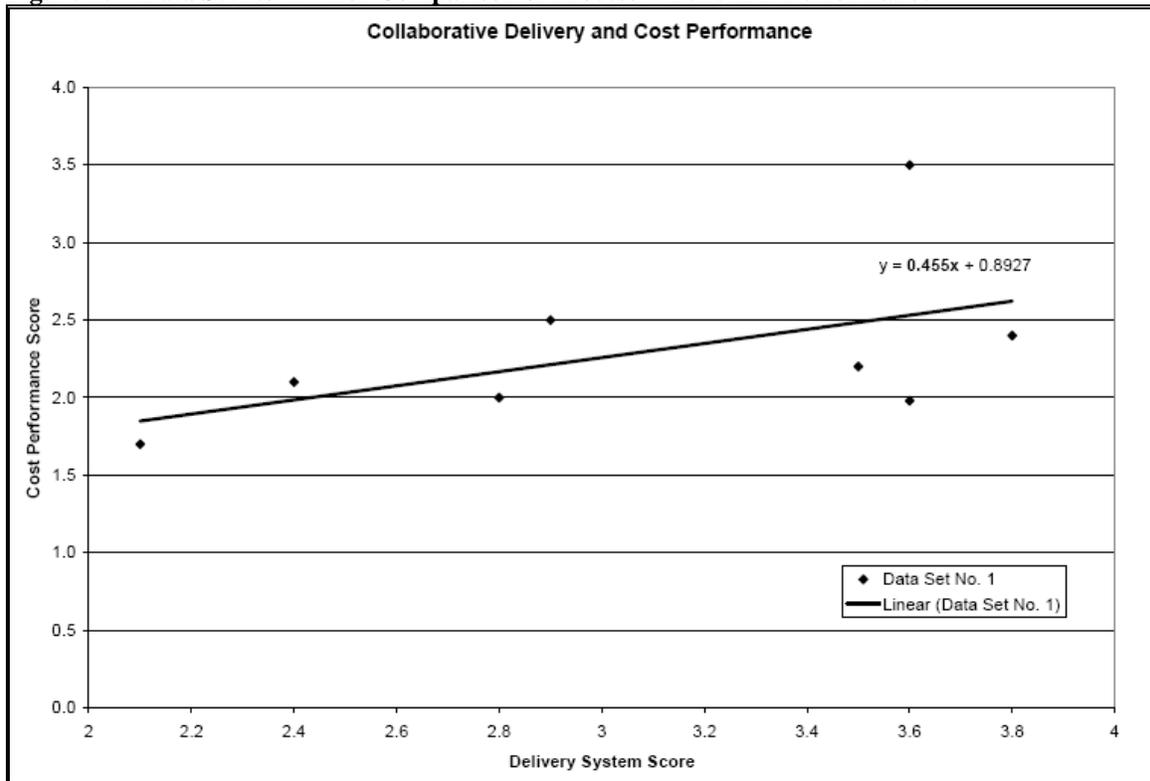
Further, the regression analysis described herein could isolate data over various DSS ranges. For instance, there is likely value in comparing DSS data between 2 and 4 to see if there is an appreciable performance increase between aggressive Process IPD projects (DSS between 2 and 3) and Pure IPD projects (DSS between 3 and 4). Figure 9 shows the hypothetical Data Set 2 shown in Figure 9 split between DSS scores (top plot for DSS between 0 and 2, bottom plot between 2 and 4). This comparison of hypothetical data shows that the trend in cost performance increases at a much lesser rate between the higher DSS projects than the lower DSS projects.

Figure 9 – Data Set No. 2 – Data Split for Comparison of Process v. Pure IPD Performance



Comparatively, Figure 10 plots the Data Set No. 1 for projects with DSS between 2 and 4. The more appreciable increase in cost performance shown in Figure 10 may lead to the conclusion that additional resources be expended to solve the legal and risk management challenges facing Pure IPD where the performance data shown within Data Set No. 2 may not. By providing the industry with more reliable and comprehensively analyzed data, the hypothesis described at the beginning of this chapter, and those similar to it, can be confirmed or denied.

Figure 10 – Data Set No. 1 – For Comparison of Process v. Pure IPD Performance



Implementation of a research project similar to that described herein could be difficult. The availability of data, validity of the scoring criteria, and the subjectivity of the analysis used to derive scores will all provide the research team with a significant amount

of challenge. The author does not have sufficient data to apply a like criterion to the 4 project examples discussed within this thesis. For example, final cost data is not available for the USC SCA project and no executed contracts have been reviewed for any of the projects.

Researchers should also consider consulting a diverse set of industry professionals when developing a like analysis. Ownership groups, design teams, constructors, specialty trades, professional associations, insurance providers, attorneys, and specialty consultants should all have a role in the future of the industry and the way innovative processes (e.g. IPD) are implemented. The breadth of knowledge presented through the interviewing of the five diverse industry professionals within this research speaks to the importance of collaborative problem solving in addressing the IPD risk management obstacles. Finally, while developing the criteria for research, those advancing the research should also be those who are verse in the risk management obstacles to IPD. They should also be willing and able to help overcome these risk management obstacles - should the research findings support that effort.

8. Summary of Findings

This thesis has identified and discussed the principles of IPD, the U.S. industry's interest in IPD and collaborative construction, the different levels of IPD, and the risk management obstacles facing these different levels. By distinguishing a difference between the characteristics of Process IPD and Pure IPD, industry organizations can identify their ability and willingness to pursue different types of IPD work.

This thesis also presents recommendations for future research through the analysis of project performance parameters against various levels of integrated delivery. This type of analysis will help identify an appropriate level of effort to expend on the risk management obstacles facing Pure IPD. By providing additional data that supports the positive effects of collaborative delivery principles in reducing realized risk and conflict, researchers and industry advocates will have more data to present to those interested in helping overcome the current risk management obstacles.

Finally, the breadth of knowledge provided on the topics of IPD and risk management by those interviewed provide future researchers with an understanding that the most effective solution set lies amongst a diverse set of industry players. The construction industry relies upon the inputs of many different types of professionals. The obstacles facing Pure IPD affect a variety of these professionals. Therefore, a truly collaborative approach to addressing these obstacles should continue.

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