

07.07.08

Integrated Project Delivery: First Principles for Owners and Teams

Outcomes of the 3xPT Strategy Group
Integrated Project Delivery Workshop, July 2007

3xPTStrategyGroup

Introduction

Global competition, enhanced and more numerous project performance requirements, and disruptive technologies—those going above and beyond continuous innovation—are putting pressure on established project delivery models. Integrated project delivery (IPD) holds the promise to integrate project organization and processes to create facilities that perform better and are designed, built, and operated more efficiently while fully leveraging new technologies.

Acknowledging these forces and trends, the 3xPT Strategy Group conducted a workshop on IPD in July, 2007. The workshop defined guidelines for integrated project delivery approaches and improved industry outcomes, looking through the lens of four project delivery models (design-bid-build, design-build, construction management at risk, and project alliance).

The workshop explored approaches to integration within both existing and new delivery constructs. Four cross-functional teams composed of owners, architects, contractors, subcontractors, consultants, attorneys, and insurers explored and defined integration options to generate new ideas and insights. Each team identified characteristics of IPD within the context of each of the four delivery models.

In follow-up work sessions of the 3xPT Strategy Group, characteristics of IPD identified during the workshop were sifted and refined to arrive at a set of “first principles” of IPD applicable to all delivery constructs. This paper sets forth those first principles, organized in five key areas: process and organization, scope, performance metrics, tools and methods, and contractual agreements.

The 3xPT Strategy Group thanks workshop facilitator Martin Fischer of Stanford University’s Center for Integrated Facility Engineering and all workshop participants. This document is offered as a guide for owners and project teams to use in deploying IPD to the maximum extent possible on a particular project. It is our belief that industry can implement all principles outlined herein immediately to achieve better results through integration, regardless of delivery model.

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About the 3xPT Strategy Group

3xPTStrategyGroup

The 3xPT Strategy Group is a collaboration of the Construction Users Roundtable (CURT), the Associated General Contractors of America (AGC), and the American Institute of Architects (AIA), formed in 2006 to become a credible voice representing the three organizations on matters regarding industry transformation. The 3xPT's vision is a transformed and sustainable construction industry, where each project is designed, developed and delivered to optimize value across its lifecycle.

First Principles: An Overview

Each of the workshop's four multidisciplinary teams considered a range of specific characteristics of IPD through the lens of a particular delivery model (design-bid-build, design-build, construction management at risk, and project alliance; see Appendix A for the workshop assignment) and documented their conclusions. In follow-up working sessions, all workshop-identified characteristics were reviewed, refined, and distilled by the 3xPT Strategy Group into the following set of First Principles, which are applicable to all delivery models. The principles are arranged into five categorical groupings, each explored in more detail in the following sections.

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1 Process and Organization

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- 1.1 Owners should lead by example, with a strong commitment to integration and accountability

The owner's leadership is particularly critical for a successful integrated project delivery (IPD) process. A more concentrated and concerted design phase—which includes more disciplines, including key subcontractors that can generate and evaluate substantial alternatives quickly—is a principal advantage of IPD. Owners set the stage for this concentrated performance through strong, accountable leadership in the timely and thorough setting of performance criteria, reviews of design solutions, responses to questions, and decisions.

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- 1.2 Assemble the right team early, based on qualifications, and identify resulting knowledge gaps

At the end of projects that used IPD owners often comment that they are happy with the final result (e.g., a better facility obtained with fewer changes, minimal or no budget increases, and less schedule creep), but that their own team was challenged because it had to provide more feedback and make more decisions in a shorter time than they are used to from projects that use traditional delivery models.

Assembling the right IPD team is one of the first and most important project tasks of the owner. Together with the main designer and builder, the owner should select the initial IPD team members and plan for the timing and process of team growth as design proceeds and the number of disciplines and performance criteria grow and become more detailed. As with any delivery method, the owner's representatives to the team must be able to provide accurate feedback to the rest of the IPD team and to maintain ongoing internal stakeholder buy-in so that decisions can be informed on a timely basis and actions taken accordingly. Other team members should be selected with consideration to specific strengths and experience with the project type so that they can foresee as many of the unknown circumstances as possible and propose and contribute to measures that mitigate the potential impact of these unknowns, including the identification of possible additional team members to fill knowledge gaps.

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- 1.3 Strive for collaboration to drive all processes, whereby interests are aligned with skills best suited to the objectives

In most cases, IPD members will pay more attention to early project designs and decisions when they know that they are on the project and will need to live with the input they provide in the early stages.

Project goals can help dictate who needs to be involved when and with what commitment and make clear what expertise is required when. Since projects with IPD are more likely to be fully successful when they start with an early and strong collaboration (as this sets the tone, excitement, energy, and example for the rest of the project), careful joint consideration of project goals, performance metrics, and their target values serve well in aligning the interests of the owner and the strengths and talents of IPD team members.

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- 1.4 Quantify and allocate risks and rewards through careful planning and fair principles of distribution

Additionally this creation phase of the project team must include an approach to aligning and allocating risks and rewards to support project goals and—where possible—to quantify the risks. These discussions will determine whether all key parties are culturally aligned to embark on the project using the IPD approach—if firms and individuals are not confident to commit to the performance levels required by the project, the performance requirements may be unrealistic or additional team members or tasks may need to be added. In fact, this intensive and critical first project phase will highlight whether the right team is indeed in place for the project.

At the beginning and throughout the project, the IPD team members must be clear about how they will contribute to the information and decision basis of the project. They also need to articulate what information they require from other team members to propose design solutions, provide feedback, and make the commitments needed to advance the project in a timely manner. This dialog is critical to make sure that everyone's efforts are maximally effective. Communications are critical to the collaborative process.

In most cases where IPD is contemplated, some of the traditional design phases should be restructured or combined. After team selection and goal setting, the conceptual or schematic design phase will develop the project farther than today's methods because more disciplines are involved with more commitment and intensity. After a successful schematic design phase, the design development phase should be relatively short as its main purpose is to confirm feasibility of execution—including constructability and maintainability—of the proposed design. The construction documents phase and shop drawing (shop modeling where possible) efforts should be combined for the main construction systems. With their likely early involvement, key subcontractors should have sufficient information after the design development phase to create the shop drawings for their systems; a separate construction documents phase should not be needed to develop this level of detail.

Design phases may be longer under IPD because the IPD team will develop design solutions more fully than typical, and the required design team is larger and includes more disciplines. The expectations of the IPD team for completeness and the level of coordination of the design are higher given this approach. However, it is possible that the design phase might be shorter if the IPD team can identify strong solutions more quickly and thereby avoid the rework and delays resulting from today's slow and incomplete design reviews. The construction documents phase and shop drawing effort under the IPD process should be shorter since the design should be well-coordinated after the DD phase and the key stakeholders in the owner's organization should have reviewed and bought into the design solution that is being detailed, fabricated, and built.

Much of the project information that supports the analysis, visualization, communication, and decision-making during the IPD process is best represented and shared in building information models (BIMs). BIM enables virtual design and construction (VDC), which is the most effective tool available today to support an integrated organization of project team members. BIM and VDC enable all stakeholders to see the project clearly as it develops, reuse information as much as possible, and make the commitments about the project design and its expected performance needed for a project decision. Most likely, team members will create a constellation of related models that enable each discipline to use the tools and create data that work best for the design, analysis, detailing, and fabrication of its systems and share coordination details. Determining what constitutes a complete design by discipline and by project phase should also include agreement on the extent and format of the information in each BIM. Furthermore a process to synchronize the BIMs must be established and followed carefully.

Some IPD teams have had success in colocating IPD team members for one or several project phases. For example, colocated mechanical, electrical, plumbing, and fire protection subcontractors have been able to detail projects much more productively and effectively in 3D than teams using a traditional organization and 2D coordination methods. It may be advantageous to colocate teams on larger projects to more easily accommodate design and coordination of their larger systems.

1.7 Integrate project thinking through innovative processes like scenario-based planning, 4D modeling, and just-in-time delivery

With a better-coordinated project design, the IPD team should be able to leverage technology that optimizes off-site labor and production which, in turn, should increase quality and help overcome the workforce challenges that are prevalent on many projects today. The IPD team should also be able to determine which elements of the design can be standardized and which elements are suitable for modularization. Finally BIM data can support the use of 4D models to iron out sequencing issues before they become costly and allow pull-driven fabrication and just-in-time delivery of information, materials, parts, assemblies, and required equipment and resources.

2 Scope

(Project Scope, Scope of Work, Service Offerings)

2.1 Develop a clear, mutual definition of project scope and project goals

For example, the owner of a building project typically selects the design of a building based on a conceptual solution and a preliminary cost estimate without proper inclusion of other facility lifecycle criteria like energy performance, construction schedule duration, etc. that are added to the initial design later, often at great cost and without taking advantage of possible synergies between building systems and between disciplines collaborating in a design phase.

In contrast to traditional project delivery where disciplines are brought into a project sequentially and the scope is therefore defined sequentially as well, IPD starts with a careful and holistic definition of the project scope and the scope of work or service offerings of the IPD team. IPD affords the opportunity to engage a multidisciplinary project team from the start of a project and it allows better and quicker definition of the project scope for all important performance metrics. Therefore, the project scope definition is derived from

- the performance metrics for the facility
- the performance metrics for the IPD team
- an initial plan for the methods that will be used to assess these performance metrics and the frequency of their measurement

Based on these expectations, the IPD team can be formed to ensure that the appropriate and proactive expertise is available to assess the performance of a facility and to develop and recognize promising design solutions. In collaboration with the owner and acknowledging performance criteria, the IPD team can then define the service scope of the whole team and the services scope of all parties and the related compensation.

In general IPD team members must perform at higher levels than in their traditional roles. The IPD team is expected to develop a design that is coordinated, that can be built without significant change orders arising from field coordination issues, and that can be maintained and operated as desired by the owner. Today many of these problems are discovered as the project progresses, often leading to costly and time-consuming rework or functional failures after project completion.

2.2 Identify project-critical specialty contractors and subcontractors; get them involved early

On projects with a short design-construction schedule or with high performance requirements for the key systems of the facility, it may make sense to engage the key subcontractors from the very start of the project to obtain access to their detailing, fabrication, and construction expertise and minimize the risk of costly redesign in later project phases.

2.3 Identify a process and model coordinator

If a separate process and model coordinator is engaged, the service scope and expected performance of the coordinator must be defined carefully in concert with all IPD team members. Furthermore, procedures for sharing information between the IPD team members and the process and model coordinator must be established and adhered to early in the project. Such procedures are also necessary when a representative from a core discipline on the IPD team assumes the coordinator role. However, since the coordinator is already part of the team, there are usually fewer performance issues with respect to model coordination.

In many projects the owner and IPD team will represent the facility design with BIMs to help visualize design solutions, create a common and continuous information basis for all team members, test the facility virtually, and provide a shared starting point for the many discipline-specific, computer-based analyses the team members will carry out. If BIM is deployed on the project to represent the key project information for several members of the IPD team and over several project phases, a process and model coordinator should be appointed. This coordinator can be someone who is already on the IPD team (e.g., a representative from the lead design firm, the general contractor, or a key subcontractor), or a separate entity can be engaged to perform process and model coordination.

3 Performance Metrics

3.1 Define performance framework and identify specific performance measures based on owner/project goals.

3.2 Identify the specific team member accountable for each activity; consider collective vs. individual responsibility for appropriate metrics

Selecting the IPD team, defining the performance framework for the IPD team, and defining the performance metrics for the project are possibly the three most important tasks of an owner. Performance metrics should be established transparently and be able to be measured clearly. They should allow the owner and other IPD team members to determine when a task or phase is done, what compensation is due, how well the project is going, support learning from project to project, and assign who will be responsible—singularly or jointly—to meet each performance goal. The metrics should also allow the disciplines to make trade-offs in the design of the various systems of a project and support the management of a project by making it clear what information is required to support the necessary analyses and decisions.

Metrics should be established that reflect agreed-upon project objectives and include the performance of the whole facility and, if appropriate, its major systems. Schedule metrics may include deadlines for major milestones and individual phase tasks.

Overall project performance goals might include project capacity, desired energy performance, the expected seismic performance of the structure and the architectural and MEP systems, first cost and lifecycle cost budgets, egress time goals, and target opening date. Such performance goals are defined on many traditional projects but are particularly important in the IPD process in that while owner driven they are ultimately established by the entire IPD team, creating a higher degree of commitment and buy-in. All metrics should be made visible to all key project stakeholders so the design can be executed with proper balance to each.

Establishing metrics and the respective target values fosters constructive communication and early project collaboration within the IPD team. It is particularly critical that the IPD team and the owner mutually agree on the project budget and schedule targets and identify the major outside influences that could affect the budget and schedule. Then the IPD team can agree on who will carry the risk for the impact of each of these outside influences so that the owner and the IPD team can include appropriate contingencies in their budgets and schedules.

Finally the IPD team should acknowledge that the skills necessary to achieve project goals may not be available within the team itself. If so, identification of the required skill sets and budgeting for the development of these skill sets must be included in the project plan.

4 Tools and Methods

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- 4.1 Leverage technology; optimize use of tools to minimize risks

 - 4.2 Ensure technological competency of team members; develop a shared understanding of base platforms

 - 4.3 Define a digital information protocol charter at the project's inception

 - 4.4 Require open information sharing

Since today's digital design and collaboration form the backbone of an integrated process, technological competency of the IPD members is a must. Potential team members must demonstrate their experience and expertise with the technologies necessary to carry out the project at the level of quality, speed, and cost performance required by the project goals. Since the IPD process develops more and better information earlier in the project than traditional project delivery models, an appropriate technology protocol must be established and adhered to from the start of the project. To support the completion of the design the technology protocol must not only establish the format of representation of the information for each discipline but also define the ownership, access, and responsibility with respect to project information, in particular with respect to shared BIMs. It must also establish a culture of open information sharing. This is particularly important in that the sharing of incomplete information is required; the completion of a design can only happen through the collaboration of the IPD team or a subteam as it continuously exchanges project information. Finally the information management protocol establishes who controls and is accountable for what information when so that the responsibility for information mirrors the responsibility for project performance metrics and helps make the IPD process more transparent.

5 Contractual Agreements

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- 5.1 Use contractual terms that drive collaboration to the maximum extent possible; appropriately allocating risk and reward

Integrated contractual agreements are emerging to allocate risks and rewards appropriately for the IPD process. The principles outlined in this document provide a foundation for a fresh approach to contractual terms and new norms that can evolve today's contractual language and drive collaboration. They should help an owner and the IPD team apply IPD methods to the maximum extent possible within a particular project delivery framework, be it design-bid-build, construction management at risk, design-build, or a fully integrated project delivery process.

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- 5.2 Consider value-based compensation with outcome-based incentives and disincentives aligned across the team

The contractual agreements must establish the basis for value-based compensation—the project team should be able to demonstrate the value against the performance criteria of the project—and an alignment of outcome-based incentives and disincentives across the IPD team. It should also provide the framework for a collaborative management of risks and contingency and enable the IPD team to move money and other resources across organizational boundaries to enable globally effective design solutions and innovations.

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- 5.3 Consider collaborative management of project contingencies

Finally owners and IPD teams should work closely with insurance companies and agencies so that insurance products and approaches may evolve to reflect the changed performance of projects that leverage the IPD process.

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- 5.4 Work with insurance companies and agencies to develop new risk management approaches and insurance products

Appendix A

Workshop Assignments

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3xPT Integrated Project Delivery Workshop Objectives and Assignment

To define guidelines for new, less wasteful business enterprises – driven by integrated project delivery concepts – for four project delivery models to help move the design and construction industry towards improved outcomes.

The building industry is reaching consensus that integrated project delivery methods will be increasingly important in the future. All the players in the building process are searching for innovative ideas to reach integration, yet relatively few projects will, in the near term, be able to follow completely new delivery approaches such as project alliance, and will be delivered in various better-known paradigms such as Design-Bid-Build, CM, or Design-Build.

This workshop has been designed to explore opportunities for integration within both existing and new delivery constructs. Cross-functional teams comprised of owners, architects, contractors, subcontractors, consultants, attorneys and insurers will explore and define integration options within four delivery approaches to generate new ideas and insights into how to advance towards integrated project delivery even under established delivery methods. It is our hope that this exploration will yield a collection of innovative concepts that the industry can implement immediately to achieve better results through integration.

Project

Higher education classroom and laboratory facility, 150,000 sf, \$40 million budget, 2 year deadline, urban setting, complex agency approval processes

Delivery models

Design-Bid-Build, Design-Build, CM at risk (CMr / CM/GC), Alliance
[every participant will be assigned to a specific workgroup team; each team will be assigned a particular delivery model for consideration]

Your assignment: How can it be better?

Even within existing models of project delivery, there is room for improvement. The “integration and optimization slider” may be moved to the right, processes improved, outcomes enhanced. This is your task: how can this delivery model be implemented and modified to improve outcomes?

Assignment, Part One: Vivid Vision and Annotated Timeline Diagram for Integrated Project Delivery

- Building on the definitions of the project delivery methods by the AIA California Council develop a vivid vision for maximally integrated project delivery under the constraints of your delivery method. Create an annotated timeline diagram of the adjusted, more integrated delivery method to highlight the differences to the traditional implementation of the delivery method. Include key differences for the various project stakeholders. This vision and timeline will provide the framework and target for the consideration of the 20 key topics.

Assignment, Part Two: 20 Key Topics

- On the following pages, we have identified five categories of topics, each with a specific set of points of consideration. Questions under each will give you an idea of what each point is about. From that list, we have identified 20 “must complete” points of consideration—this is the minimum goal for the work of your team. In light of the objectives of the workshop and your specific delivery model, document the innovative concepts generated by your workgroup as they relate to each point.

Your workgroup leader (or appointed alternate) must document the work of your team as you go in a powerpoint template provided onsite; feel free to use the flipcharts in each room to supplement your thinking. Sketches on 8-1/2 x 11 can be scanned by workgroup facilitators if you'd like to include them in your record.

The work of your team will be synthesized into a working document to be shared with the industry at large, to offer models for improved practices regardless of delivery approach / contract model.

As you work, always consider:

The process of team assemblage, its sequence, character, makeup, especially in relation to the flow of the project

Team member behavior, especially in relationship to considerations of risk and reward

Building information models and the use of technology

Access to and sharing of project information, including BIM, especially in relation to the flow of the project

Prefabrication of building systems and components

Barriers to improved practices within that delivery model

Firm or tentative decisions and commitments made by specific team members or the whole team

The key differences to today's way of working

Firm or tentative decisions and commitments made by specific team members or the whole team

The key differences to today's way of working

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Integrated Project Delivery Workshop

Hotel Allegro, Chicago

Topics for Consideration by Workgroups

This page contains a summary of all the topics. The following pages elaborate on the topics through questions that may serve as points of departure for consideration and discussion by the workgroups.

At minimum, your workgroup must report on the 20 highlighted key topics in light of your specific delivery model. Should your workgroup have additional time, feel free to tackle other topics as desired. Use the PowerPoint template provided by workshop organizers to document your work. Workgroup facilitators can assist with photos of flips or scans of 8-1/2 x 11.

1) **Scope: Project Scope, Scope of Work, Service Offerings**

- a) Project Scope
- b) **Service Scopes**
- c) Instruments of Service
- d) Subcontracts
- e) **Changes**

2) **Performance Metrics**

- a) **Outcome/Overall Performance Metrics**
- b) **Process/Management Metrics**
- c) Measurement
- d) **Project Risks**

3) **Process/Organization**

- a) **Roles**
- b) **Risk Management/Distribution**
- c) **Design**
- d) **Collaboration/Coordination**
- e) Material Procurement
- f) **Fabrication**
- g) **Construction/Field Assembly**
- h) Staffing/Education and Experience of Project Staff
- i) **Selection Process and Criteria**
- j) Quality Control/Inspection

4) **Tools/Methods**

- a) **Technology Protocol**
- b) **Information Management**
- c) **Information Handover/As-built Documentation**
- d) Information Security/Confidentiality

5) **Contractual Agreements**

- a) **Contract Model**
- b) **Licensing**
- c) **Standard of Care**
- d) **Compensation**
- e) **Risk/Insurance**
- f) Termination/Withdrawal
- g) Dispute Resolution
- h) Confidentiality
- i) Assignment

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1) Scope of the Project and Services

What is the scope of the project? What is the scope of work for a company?

1a) Project Scope

- What is the project about, what should the project accomplish/provide? How is completion and success of the project measured? What performance criteria must be part of the scope description?
 - capacity (e.g., # of examination rooms or # of patients processed per day)
 - user expectations (acoustic, (day) lighting, travel distance internal to a building)
 - delivery time
 - quality/durability
 - budget
 - etc.
- What is the scope of services required for the project (e.g., just design services, deliver the physical building, manage the building lifecycle, etc.)?
- How is the scope defined/described? What is a good (poor) scope description?

1b) Service Scopes

- What does each company do and deliver on the project?
- When are the services delivered?
- What are the performance criteria for each service/company?
- How, when, and how often is the performance tracked?
- How many design versions will be produced?
- What is included in a design version (just architectural scope, all design disciplines, full building definition plus construction schedule, etc.)?

1c) Instruments of Service

- How is the service delivered?
- What instruments are used to deliver the service?
- Who can use the deliverables? Who owns the deliverables? How can others use the deliverables?

1d) Subcontracts

- What other key parties should/must be involved?
- What expertise or capacity are critical in addition to the expertise and capacity available from the main project participants?
- When and how is that expertise and capacity brought into the project?
- How are these subs engaged in the project? What performance expectations are made explicit? How is the performance tracked?

1e) Changes

- What changes are part of the scope or should be expected by the participants?
- How are changes in scope, schedule, organization handled?
- What are likely sources of changes?
- What changes have detrimental impact? Are there changes with positive impact?
- How can changes be minimized?

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2) Performance Metrics

What are the expectations for the project? How do the participants know the project has been successful? How can a company show that its work added value?

2a) Outcome/Overall Performance Metrics

- What are overall project outcome/performance metrics?
- What are the cost-related performance metrics for the work (e.g., initial cost, lifecycle cost, target cost? How are the budget/costs established?
- Who owns cost contingencies (who, how much, for what)?
- What are schedule performance metrics (e.g., duration, milestones)?
- What are the sustainability and life cycle goals for the project?
- What do the users expect from the facility?
- Etc.

2b) Process/Management Metrics

- What are appropriate process/management metrics (e.g., response and decision latency, budget item reliability, plan percent complete, RFIs, rework, etc.)?

2c) Measurement

- How are the metrics and target values established and predicted?
- How is the actual performance measured or observed?
- What are the consequences of good/bad performance?

2d) Project Risks

- What are the most significant project risks?
- What is the potential impact of these risks on project success? How are the impacts predicted and measured?

3) Process/Organization

Who will do what when with whom?

3a) Roles

- Which parties (stakeholders) get involved when?
- What responsibilities does each party have? What commitments is each party expected to make in the various project phases (see below)?

3b) Risk Management/Distribution

- How are the risks managed?
- Who assumes which risks when? How?
- Are all the risks pooled and managed as pooled risks, or is there a “divide and conquer” approach to risk management?

3c) Design

- What is the scope of design?
- Who creates the design?
- Who reviews the design?
- Who approves the design?
- Is there a core team? Who is in it? Why?
- What are the major design phases?
- What decisions (should) get made in each phase?
- What constitutes a complete design for each phase? How is completion measured?
- How is the performance of the design team measured?

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3d) Collaboration/Coordination

- How is the collaboration between stakeholders organized?
- Which stakeholders are coordinating what when with whom? How often? With what coordination methods?
- How are the coordination activities planned?

3e) Material Procurement

- What is the scope of procurement (e.g., including detailed design or not)?
- What is the basis for procurement (SD, DD, CD, shop drawings)?
- How is the procurement schedule coordinated with the design and construction or field assembly schedule?
- How is the performance of the procurement team measured?

3f) Fabrication

- How much of the project scope is fabricated vs. built in the field? What disciplines' scopes are fabricated?
- Are there specific targets for fabrication?
- What is the basis of fabrication?
- What is the scope of fabricators (just fabrication, plus detailing, plus field assembly)?
- How soon after detailing are parts and subassemblies fabricated?
- How long before field assembly are parts and subassemblies fabricated?
- How are the fabricators involved in design and in field assembly planning?
- How is the performance of the fabricators measured?

3g) Construction/Field Assembly

- How is construction managed (e.g., by activities, workflow, areas, (sub)systems), disciplines, crews, milestones?
- What are performance targets for the construction phase?
- How is the construction strategy developed? By whom?
- Who decides on the construction methods used? When?

3h) Staffing/Education and Experience of Project Staff

- What are important capabilities the project team members must possess? Skills? Experience?
- How are skills, experience tracked?
- What are different levels of competencies that are important for the project team?
- How is the commitment of each team member to an integrated work method tracked?

3i) Selection Process

- How are team members (companies, individuals selected)?
- What "must have" and "nice to have" criteria are used?

3j) Quality Control

- What is role of QC? Who does it? When? How?
- Is QC a separate activity or built into the work methods used for design, procurement, fabrication, and field assembly?

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4) Tools/Methods

What work methods, including IT, will the project team use?

4a) Technology Protocol

- Are there 'must-have' tools? Must-master tools?
- What commitments are made/needed with respect to tool use and following information protocols (see questions below)?
- What personal and organizational expertise is needed for these tools?

4b) Information Management

- How is information represented?
- How is information shared?
- How is information updated?
- What is the role of digital models (building information models)?
- How is the quality of information ascertained?
- Who owns what information when?

4c) Information Handover/As-built Documentation

- What information is handed over after each phase? What are logical hand-over points?
- In what format is information handed over?
- Who controls, warrants the quality (accuracy, completeness) of the information handed over? How is quality of information handover checked?

4d) Information Security/Confidentiality

- Who manages information security (for each company, for the project as a whole, by issue, by discipline, project phase, by project sub-scopes)?
- How does each party establish what information is confidential?
- How are information confidentiality and collaboration reconciled?

5) Contractual Agreements

What contracts and business deals, arrangements, and agreements will support the project scope, goals, and work of the various companies as outlined above?

5a) Contract Model

5b) Licensing

5c) Standard of Care

5d) Compensation

5e) Risk/Insurance

5f) Termination/Withdrawal

5g) Dispute Resolution

5h) Confidentiality

5i) Assignment

Appendix B

Invited Workshop Participants

Owners	Harold Helland, Abbott David Hood, U.S. General Services Administration Mike O'Neill, Johnson & Johnson Craig Russell, Disney
Contractors	Jim Dome, AIA, Barton Malow Design/Construction John Linenberg, Walbridge Aldinger Daniel N. Russell, Sundt Construction Inc. Thomas Sweeney, J. H. Findorff & Son Inc.
Designers	Forrest R. Lott, AIA, Lott & Barber Architects H. Thomas McDuffie, AIA, RIBA, Jacobs, Architecture & Engineering Practice Jeff Millett, AIA, KlingStubbins Doug Parris, AIA, NBBJ
Engineers	Joseph G. Burns, FAIA, Thornton-Tomasetti Group Jim Jacobi, PE, Walter P. Moore and Associates Inc. Jon Magnusson, Magnusson Klemencic Paul Stoller, Atelier 10
Subcontractors	Pete Garcia, University Mechanical Gary Hunter, J. F. Ahern Company Mike Mackintosh, Bel-Aire Mechanical Inc. Dave Morris, University Mechanical Tom K. Sorley, Rosendin Electric Inc.
Attorneys	Will Lichtig, McDonough Holland & Allen PC Richard H. Lowe, Duane Morris LLP Pat O'Connor, Faegre & Benson LLP Tom Owens, NBBJ
Professional Liability	Douglas K. Hamilton, AIG/Midwestern Risk Specialist Inc. Lorna Parsons, Hon. AIA, Victor O. Schinnerer & Company Inc. Paul D. Rowe Jr., Esq., XL Design Professional John Willard, CPCU, Zurich NA
General Liability	Michael Ahern, CNA Tom Boudreau, AIG Terry R. Tennant, ARM, Allied Risk Solutions Jacobus P. Vrolijk, Zurich Construction
Surety	Drew Brach, Marsh USA Inc. Mary Alice McNamara, Travelers Bond & Financial Products John A. Rowedder, Travelers Bond & Financial Products
3xPT	Ricardo Aparicio, AIA, Esq., General Electric Company Charles G. Hardy, U.S. General Services Administration William P. Tibbitt, Johnson & Johnson Phillip G. Bernstein, FAIA, Autodesk Building Solutions Barbara M. Price, FAIA, Jacobs, Architecture & Engineering Practice Jim Suehiro, AIA, NBBJ Mike Kenig, Holder Construction Company J. Doug Pruitt, Sundt Construction Inc. John Tocci, Tocci Building Corp. Markku Allison, AIA, The American Institute of Architects Chris Monek, Associated General Contractors Gregory L. Sizemore, Esq., Construction Users Roundtable Jan Reinhardt, Turner Construction Company Bradley R. Milton, AIA, RDG Planning & Design Lisa Adkins, AIA, LEED AP, Gensler
Facilitator	Martin Fischer, Center for Integrated Facility Engineering, Stanford University