The Collaborative Dance: Only Three Steps

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Abstract

In the past we taught our students how to draw, a highly individualized skill. With Building Information Modeling (BIM) a new paradigm has arrived. Drawings can now arise from the modeling of knowledge collected from partners in a collaborative process. The importance of personal skill is yielding to the primacy of collective knowledge. Tomorrow's students need collaborative sense. Yet while the need for collaborative sense is widely acknowledged, not enough is taught about how to actually satisfy that need.

Collaboration doesn't happen by accident. Because others must be included, collaboration requires the careful and deliberate building up of trust. Partnerships in industries other than design and construction provide us with insights into how to accomplish that end. Trust arises in three steps: formation, implementation, and evolution. The first step, formation, is a calculation. The calculus can include teaming agreements, the ConsensusDOCS 301 BIM Addendum, the BIM Execution Plan, and nondisclosure agreements. The second step, implementation, is about creating mutual understanding. It is here that the protocols established in the execution plan are tested. If successful, understanding grows. If unsuccessful, mistrust forms. The third step, evolution, is about bonding. A bonding trust is the evolutionary consequence of conditions where stable, ongoing relationships are allowed to develop.

Successful collaborations militate toward long-term partnering agreements. Such agreements are increasingly coupled with CM-at-Risk, Design-Build, and Integrated Project Delivery (IPD). This paper focuses upon the three steps and examines, as an academic case study, an integrated project delivery studio at Cal Poly, San Luis Obispo.

Keywords

Building Information Model (BIM), Design-Build, Integrated Project Delivery (IPD), Collaboration, ConsensusDOCS, BIM Addendum, BIM Execution Plan.

1. INTRODUCTION

A shared experience from our past may be that of drawing with a mechanical pencil on vellum or sketching with a B314 soft pencil on trace or skinny. The skill of hand-drawing is still valued but the need for that skill has diminished. It began to diminish in the 1980s with the rise of CAD products like Intergraph's Microstation. In the 1990s Autodesk's AutoCAD, enabled by more powerful personal computers, began its rise to prominence. Today those tools are giving way to BIM (Sabongi, 2010). We cannot know what graphic products will arrive in our future. But we do know that, unlike drawings, BIM is a repository of collective knowledge. Drawings can now arise from the modeling of collective knowledge tolled from partners in a collaborative process (Handler and Burdi, 2010). Thus, a trend is becoming clear: the importance of individualized skills is yielding to the primacy of collective knowledge.

BIM is not just a tool for collaboration, it is a management process. The term "Virtual Design and Construction" (VDC) is a better descriptor of that process. Regardless, the acronym BIM has come into common usage as the descriptor of both the software tool(s) and of the management process that enables the tool (ASC, 2010, p.1). In this paper, the acronym BIM refers to that underlying management process.

The building information model provides a platform for collaboration throughout a project's design and construction (AIA, 2007). Nevertheless, interposing that platform does not create collaboration automatically. It is important to understand what causes effective multi-disciplinary collaboration to occur (McCuen, 2009). Collaboration is an interpersonal activity. Moreover, it is an interpersonal activity founded upon trust. Trust must be grown, carefully and deliberately.

We can gain insight from examining strategic business alliances; an area where there is substantial agreement among both researchers and practitioners that the collaborative partnership has three steps: formation, implementation, and evolution (Lorange and Roos, 1992). There are analogous steps in the built environment. The first step is to impose an organizing structure. It is imposed in various ways, sometimes a contract, other times a teaming agreement, and still other times a set of shared, informal rules. The second step is where mutual understanding arises. It arises as the partners get to know each other and they start to understand and to predict each other's behavior. If mutual understanding becomes deep enough to form a bonding-type trust, collaboration becomes complete and we take the third and final step; we choose to integrate our knowledge. The payout for a collaborative partnership is the benefit that flows from knowledge integration (Jackson, 2011, p.322).

The old, adversarial design-bid-build mentality is like "trying to dance without any music – you can follow all the steps but somehow the rhythm is all off" (Jackson, 2011, p.325). Collaboration provides the music that makes you want to dance with your partner. This paper will examine the steps in the collaborative dance. In particular, it will examine those steps in the context of the BIM process. A case study examines partnerships within an Integrated Project Delivery (IPD) studio at California Polytechnic State University, in San Luis Obispo, California, during the spring quarter of 2010.

2. INTEGRATED PARTNERSHIP

The integrated partnership is a collaborative dance with three steps: formation, implementation, and evolution. Trust can grow with every step.

2.1. Formation

A partnership is founded upon promises and sustains itself if we make good on our promises. At the outset, everyone makes their own mental calculation: Will your actions be reliable enough for me to gain sufficient benefit from our partnership? This mental calculus not only grapples with whether the other party is competent enough to deliver on promises, but whether the other party is motivated enough to deliver (Child, et. al., 2005, p. 58). Contract language can be a good motivator. It may sound counter-intuitive that threats couched in contract language are the first step in developing trust. Nevertheless, construction projects are filled with uncertainty and risk, and good contracts establishes rules for our behavior under changing conditions and it apportions risks fairly between the partners. The quality of our relationships improves when our mutual expectations on uncertainty and risk are equally understood and expressed in writing.

Fear of the loss of business reputation is another good motivator. Recent market conditions pose

great challenges. With backlogs and margins down, firms are focusing upon efficiency and productivity (Schoppman, 2010). Simultaneously, they are casting a wider net by operating in new markets and niches (Schoppman, 2010). With ever increasing frequency, our contracting parties are strangers. When contracting parties are strangers, fear of the loss of business reputation is a very good motivator.

Potential partners want to learn something about each other before deciding to negotiate a contract. A prequalification process helps. But while helpful it is insufficient to tell us what we really want to know: we want to know about the culture, ethics, values and judgments of our potential partner. Only personal experience tells us what we really want to know. Yet we have no personal experience with strangers, of course. So there is an information period, prior to deciding to negotiate, where the potential partners try to get to know as much as they can about each other (Child, et. al., 2005, p. 59).

If the information gathering leaves the parties encouraged they will move into contract negotiations. Knowledge gained during the information period often informs the construction of the contract. Today, we can choose to incorporate the ConsensusDOCS 301 BIM Addendum into our terms and conditions (AGC, 2009). The BIM Addendum requires the partners to *"meet, confer and use their best efforts to agree upon the terms of or modifications to the BIM Execution Plan."* The BIM Execution Plan asserts, among other things, what models will be used, their content, the protocols for submission approval, how to incorporate additions and changes, what software should be use, how interoperability problems are solved, and to what extent we can rely on the model and it dimensional accuracy (AGC, 2009, p. 38).

Design-build partnerships must start before construction contracts documents are negotiated so that they are able to work together to generate the proposal that competes for the actual construction business. The primary means that they use to structure their relationships is the teaming agreement (DBIA, 2000). But before a teaming agreement is drafted, a good design-build team will first develop a teaming profile. The teaming profile is an assessment of the day-to-day workers, so called "worker partners", on the project. It focuses on compatibility, team alignment and cultural fit (Jackson, 2011, p.161). The teaming profile informs the execution of the formal teaming agreement. The teaming agreement establishes the roles, responsibilities and expected performance of the worker partners (Jackson, 2011, p. 161).

A teaming agreement is a good idea not just for design-build projects but for any type of project where a BIM is contemplated. Any informal set of rules is helpful.

An often overlooked area that has potential for upsetting relationships is intellectual property. Today, among other things, wrongful disclosures of means, methods and know-how are protected as trade secrets. This is highly significant because means, methods, and know-how are competitive advantages (Starzyk, 2010). The usual means of preventing disclosure is a license accompanied by a Nondisclosure Agreement (NDA). Yet NDAs are not entirely successful in preventing wrongful disclosure. Disclosure frequently occurs through agents, part-time employees, suppliers, or other third-parties whom come into contact with privileged information but are unaware of its secrecy. Regrettably, once information is disclosed through any means, even wrongful means, the law will no longer protect it. Licensing issues arise when subcontractors and suppliers contribute information into the BIM (Azhar et al., 2008). Thus, the very nature of a BIM tends to negate attempts at keeping trade secrets. Great mistrust arises from this reality.

2.2. Implementation

The implementation step is where personnel are assigned to the project, systems and materials are mobilized, and the work proceeds in earnest. It is here where we learn that the personnel have or have not the competencies that we expected; materials and systems work or work not as promised; trade secrets remain secret or are wrongfully disclosed; internal business cultures clash or not; personalities conflict or not; or values are or are not shared. Problems will occur whenever business partners are insensitive to each other's cultures, personalities, or values. When insensitivity persists, the likelihood of establishing a collaborative partnership is diminished and the best that can be hoped for is some form of guarded cooperation (Tung, 1993). Execution plans, teaming agreements, or informal rules memorialize what we know about each other up to that point in time, but they are also acts of trust. We still need to make good on our promises.

Even if we have a plan and make good on it, no plan can capture everything. Expectation will continue to change as unforeseen circumstances are encountered and risks either evaporate or come crashing down upon us. The BIM Execution Plan must evolve with the project. Technologies will change during the design and construction of any project and the plan must address that. Changes or additions to the governing contract must also be reflected in the plan (AGC, 2009, pp.33, 34).

Project control and reporting systems play a very significant role in success or failure (Child, et. al., 2005, p. 60). To make this clearer, consider a hypothetical where your BIM tools do not align with the business processes of one of your partners. That partner might be incapable of adapting within the time constraints of your project. At the very least she will lag behind your other partners. Every other partner would find that BIM adds to her quality of knowledge. It would not add to the quality of the knowledge of that one partner who was struggling to adapt her business processes. The opportunity to grow mutual understanding is denied to her.

There are many obstacles. But if things go well enough that we start to understand each other and predict each other's actions, the uncertainty present at the beginning of our partnership starts to recede. As uncertainty recedes during implementation, mutually understanding grows.

2.3. Evolution

Evolution is not so much a step as it is the quality of the dance. A successfully working partnership wins the confidence of upper management who tend to grant an increasing measure of autonomy and legitimate decision-making power to those people who are working day-to-day on the project (Lyles and Reger, 1993). Empowerment and forward momentum enable the evolutionary process to gain traction. Stable relationships develop between worker-partners. They begin to identify with each other's interests. Emotional ties and bonding can develop. It becomes less likely that unexpected circumstances, disappointed expectations or disputes will derail their partnership.

Whatever trust develops between the upper management partners (manager-partners) arises from the trust that first developed between the worker-partners. But trust is not a commodity; it is an interpersonal phenomenon (Child, et. al., 2005, p. 62). So any trust that develops between workers does not automatically impute to their managers. Workers must influence their managers to grow trust between manager-partners. The more satisfied workers that there are on the project, the more influence they will have. Moreover, workers with seniority and good reputations prior to the project assignment will have greater influence upon their managers than

will others. It behooves managers to minimize turnover of personnel during the course of any project, particularly key personnel. The more personnel that are fixed throughout the life of a project, the more likely that trust can evolve.

Trust, once developed, is fragile, however. A successful project can be followed by another project involving the same manager-partners but different worker-partners. A failed partnership between worker-partners on their second project may lead to withdrawal of trust by the manager-partners. More often, however, each project is followed by another project involving a different mix of designer, general contractor, and subcontractors. Relationships formed in a next project might undermine the relationships that we had worked so hard to establish in our previous project. The practice of awarding each job out to different partners is usually justified on costs grounds and this practice is embedded in the culture of construction. However, this practice tends to undermine trust. When it undermines it to the point that collaboration fails, and the lost opportunity cost of knowledge integration is taken into account, it may actually yield higher costs to award to the low-bidder.

Complete collaboration militates toward long-term partnering agreements. The reasoning behind this truism is suggested in a Southwest Asia proverb, which says *"The first time you share tea with a Balti, you are a stranger. The second time you take tea, you are an honored guest. The third time you share a cup of tea, you become family"* (Mortenson & Relin, 2006). A collaborative partnership is like a family because with a family there is trust. A partnership should be allowed to experience several projects because sufficient trust is difficult to achieve between strangers. Long-term partnering agreements are increasingly coupled with CM-at-Risk, Design-Build, and Integrated Project Delivery (IPD). They are uncommon in the low-bid environment of Design-Bid-Build. If partnerships are kept intact and deployed on successive projects, a bonding trust can form. A bonding trust can weather a wide gamut of difficulties, freeing collaboration to become complete.

3. ACADEMIC CASE STUDY

The College of Architecture and Environmental Design (CAED) at the California Polytechnic State University in San Luis Obispo, California offers a multi-disciplinary course for junior and senior level undergraduate students from four departments within the CAED: Architecture, Architectural Engineering, Construction Management, and Landscape Architecture. It is taught by faculty from the same four departments. The course is named the Integrated Project Delivery (IPD) Studio. Students enjoy short lectures and informal desk critiques, augmented by site visits, analytical exercises, case studies, and presentations of their work throughout the term. Guest lecturers are also engaged, who provide topical information within their areas of specialization. On average, approximately 60 students enroll every quarter.

In the spring quarter of 2010, the IPD Studio took on an infill project to benefit the City of New Orleans. The project was a national design competition sponsored by the U.S. Green Building Council's Emerging Green Builders. For this competition, student teams from across the nation were invited to plan and design a compact, energy efficient, ADA-compliant, hurricane resistant, LEED platinum, low cost housing unit. The IPD Studio entered the competition with eight student teams of six members each. Teams were formed as multi-disciplinary partnerships using a heuristic founded on individual preferences, preferences testing (Harrison & Bramson, 2002), distribution of skill sets, and the personal judgment of the faculty. The teams were tasked to arrive at an imaginative solution while maximizing the value of planning, design, engineering, and construction decisions. Potential solutions were measured by quantitative judging criteria. In

that manner, cost and schedule impacts were cast in contraposition to a wide spectrum of technical and social issues. Succeeding at this challenge would not have been possible without effective collaboration across the disciplines.

3.1. Team vs. Partnership

Individual teams were coached in team-building and partnering. Team coaching was supplemented by short group lectures. The objective was to foster critical thinking on group behavior by comparing and contrasting the characteristics of teams and partnerships. To that end, teams and partnership were identified, as follows:

Teams have:

- Interchangeable Members – Some teams have permanent members but the members of most teams are freely substituted or interchanged with other teams, such decision resting with a manager not on the team.
- Inequities – Despite working together on common problems, team members are rewarded or held accountable for performance in different ways, some members receiving or being held accountable more or less than others.
- Hierarchical Structure - Hiring, work assignment, evaluation, promotion, and termination are usually the responsibility of a manager not on the team. Occasionally a team is self-directed and autonomous but most teams are hierarchical; management direction flowing from the top down.
- Individual Competencies - people are assigned to teams to fill a role for which they bring certain competencies. An individual's success is a function of how well she fulfills her role as measured by the success of her team and the overall success of the venture.

Partnerships have:

- Charter Members – Membership is determined at the time that a partnership is formed. Subsequent removal of any member ordinarily terminates the partnership. A partner cannot even sell her share of the partnership without causing the dissolution of the partnership. In short, a partnership does not have interchangeable members.
- Determinable Shares - Members share equally in a partnership's assets, liabilities, profit, and loss, unless agreed otherwise at the time the partnership is formed. In every case the formula for distribution is fixed in advance and therefore determinable.
- Flat Structure - Unless agreed otherwise at the time of formation, each partner receives one vote. In every case the formula for distributing voting shares is fixed in advance.
- Compatibilities – Some partners choose each other for their mutual compatibility, others for their commercial utility, while still other partnerships are arranged by parent companies regardless of the wishes of the partners. Nevertheless, the partnership will likely exist for a common objective and a common objective is more likely to be achieved when the partners expected to achieve it are compatible.

Few working groups identify completely as team or partnership. Most have mixed attributes. Nevertheless, it is important to determine whether teaming characteristics or partnering characteristics are in the majority. Teams tend to be more cooperative, advancing individual goals while minimizing interference with the goals of other teammates. Partnerships, however, tend to be more collaborative, establishing common goals to facilitate the integration of their

collective knowledge. For the end of achieving knowledge integration it is more desirable for a group to identify as a partnership.

The IPD studio teams possessed a mix of identifiers; some as teams, others as partnerships. Membership and structure identified as partnerships. Membership was fixed at the outset. The groups neither expected that their members would change nor did any of the groups actually change. On structure; leadership emerged in some groups. By-and-large these spontaneous leaders were reluctant to describe themselves as leaders, however. In contrast, some groups had no obvious leader. A few groups explicitly declined to declare a leader. All things considered, structures were flat, an identifier of partnership. In contrast with membership and structure, equity and competency identified as teams. Grading criteria and policies supported different final grades for different students on the same team. In the end, team members neither received the same grades nor should they have had any expectation that they would. On competencies: department-aligned competencies drove the first cut at team formation. Moreover, the students themselves would, for example, look to their CM for estimating and scheduling while looking to their ARCE for approval of a particular design choice under hurricane conditions. In short, teams self-identified individual competencies. This is an characteristic of teams.

3.2. Survey

In a beginning-of-the-quarter questionnaire, students were asked, among other things, to respond to the following questions: What is a team? What are the characteristics of a good team? What is a partnership? What are the characteristics of a good partnership?

At the end-of-the-quarter, there were 27 responses (from a class of 48) to an exit survey posing, among other statements not germane to this case study, the following statements: my group had all of the characteristics of a good team; my group had all of the characteristics of a good partnership; it was easy to work with my other group members because we set clear rules from the beginning; I understand my other group members better now than I did at the beginning of the quarter; and I trust my other group members much more now than I did at the beginning of the quarter. To each statement, students were asked to choose from the following responses: strongly disagree; disagree; neither agrees nor disagrees; agree; strongly agree; or not applicable.

Also at the end-of-the-quarter there were 27 responses to the following questions: Which type of group behavior is most important in this course? Good teamwork or good partnering? Students were asked to choose from the following responses: good teamwork; teamwork and partnering are equally important; good partnering; and teamwork and partnering are the same thing.

Exit Survey results are attached in the Appendix.

3.3. Discussion

Student responses to the beginning-of-the-quarter questionnaire on teams and partnerships were notable not for their differences but for their similarities. By and large students contended that both teams and partnerships were groups of people who work together and who have common goals and responsibilities. Some students contended that teams and partnerships were the same thing.

To the end-of-the quarter statement; “Which type of group behavior is most important for this course? Good teamwork or good partnering?” none of the students replied that teamwork and partnering are the same thing. 59% of students replied that teamwork and partnering are equally important while 22% placed more importance on teamwork and 15% placed more importance on partnering. 4% (one student) did not answer.

48% of the class agreed or strongly agreed that their group had all of the characteristics of a good team. An identical number, 48% agreed or strongly agreed that their group had all of the characteristics of a good partnership. However, 19% of the class disagreed or strongly disagreed (and 30% remained indifferent) with the statement on partnerships, while 7% of the class disagreed or strongly disagree (and 41% remained indifferent) with the statement on teams. 4% (1 student) did not answer. Having established that students understood the distinction between teams and partnerships, it can be inferred that students thought that their groups were a little better at cooperating (teamwork) than they were at collaborating (partnering).

To the statement; "It was easy to work with my other group members because we set clear rules from the beginning" A plurality, 41% were indifferent, 37% agreed or strongly agreed, and 19% disagreed. Because some teams set few, if any, organizing rules, the negative responses infer a lack of basic structure on some teams. This underscores the importance of teaming agreements, signing-off on written rules, or on producing some other suitable structural device.

To the statement; "I understand my other group members better now than I did at the beginning of the quarter" a large majority, 89%, agreed or strongly agreed, while 7% disagreed and 4% (1 student) did not answer. One can infer from this that team members spent enough time working with each other to understand and to find some predictability in each other's behavior.

To the statement; "I trust my other group members much more now than I did at the beginning of the quarter" a plurality, 42% agreed or strongly agreed, 26% were indifferent, and 22% disagreed or strongly disagreed. This says that for about one-half of the class, trust levels did not change, the growth of trust was not apparent, or trust actually declined. Trust, however, is largely an evolutionary process that requires multiple engagements. It is difficult to gain sufficient traction on a single project. The negative responses to the statement support that contention.

3.4. Conclusions

At the beginning of the quarter students found few distinctions between teams and partnerships. This changed during the quarter, likely as a consequence of critical thinking about the characteristics of teams (cooperative) and partnerships (collaborative).

A majority of students felt that teamwork was at least as important as or more important than partnering. This suggests a preference for teaming (cooperation) as opposed to partnering (collaboration).

Students thought that their groups were a little better at teaming (cooperating) than they were at partnering (collaborating).

There may have been a lack of basic structure on some teams. That shortcoming would have adversely affected working relationships, underscoring the importance of teaming agreement, written rules, and other structural devices.

Students grew to understand each other better during the quarter. That says that they invested sufficient time working together to find some predictability in each other's behaviors. This supports the argument for keeping group membership fixed for the duration of the project.

For about one-half of the class, trust levels did not change, the growth of trust was not apparent, or trust actually declined. This supports the argument that trust is difficult to grow in a one-off project.

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5. APPENDIX

EXIT SURVEY **Question/Criteria:**	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Not Applicable	Unanswered
My group had all of the characteristics of a good team?	3.70%	3.70%	40.74%	22.22%	25.93%	0.00%	3.70%
My group had all of the characteristics of a good partnership?	3.70%	14.82%	29.63%	22.22%	25.93%	0.00%	3.70%
Question/Criteria:	Good teamwork	Teamwork and partnering are equally important	Good partnering	Teamwork and partnering are the same thing	Unanswered		
Which type of group behavior is most important in this course? Good teamwork or good partnering?	22.22%	59.26%	14.82%	0.00%	3.70%		
Question/Criteria:	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Not Applicable	Unanswered
It was easy to work with my other group members because we set clear rules from the beginning.	3.70%	14.82%	40.74%	29.63%	7.41%	0.00%	3.70%
I understand my other group members better now than I did at the beginning of the quarter.	0.00%	7.41%	0.00%	55.56%	33.33%	0.00%	3.70%
I trust my other group members much more now than I did at the beginning of the quarter.	14.82%	7.41%	25.93%	33.33%	18.52%	0.00%	0.00%

Population:

8	Architecture
11	Landscape Architecture
4	Architectural Engineering
4	Construction Management
27	TOTAL