



ANALYSIS #4 DESIGN-BUILD PRODUCTIVITY



C-5 Fuel Cell Facility

167th Airlift Wing

Martinsburg, WV

Kyle Goodyear

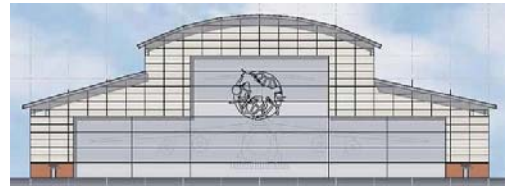
Construction Management

April 7, 2010

Dr. Magent

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



ANALYSIS 4: DESIGN-BUILD PRODUCTIVITY

BACKGROUND INFORMATION

The use of the design-build delivery method for construction has become more common over the years and there have been many advantages found by using this collaborative system. One of these advantages, as discussed in various classes in the AE curriculum, is that productivity in the field is improved due to a reduced number of Requests for Information and Change Orders. Since the contractor and the various engineers are working together in the design stages, fewer questions are left to be answered when it becomes time for the drawings on paper to become a building in the ground. It has been proven time and again that employing a design-build approach decreases the overall schedule of a project, primarily because construction often begins before the design stage is complete. A question to be answered is, does this approach create better efficiency for the designers and construction managers?

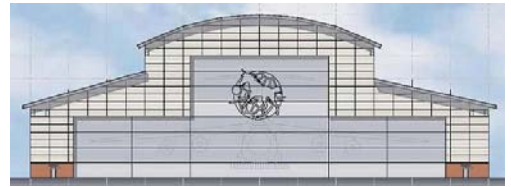
Productivity in the field is fairly simple to measure, whether it is how many cubic yards of concrete were placed in a day, or how many windows were installed in a week. However, quantifying productivity in the office requires further investigation. To analyze this topic, it is necessary to obtain information from industry members who have been involved with both the traditional delivery method of design-bid-build as well as the design-build delivery method. This information can primarily be acquired from construction professionals who have worked under both methods. It is also worthwhile to examine this topic from the owner's perspective, specifically an owner who has been involved with both delivery methods. Fortunately, as mentioned in previous documents for this thesis assignment, there are already two hangars on the base of the 167th Airlift Wing which are similar to the Fuel Cell Facility, one which was constructed using a traditional design-bid-build approach and one that was done under a design-build approach. The Contracting Officer for the Fuel Cell Facility project held the same role in each of the other two hangar construction projects, and is therefore a qualified individual to speak on the subject.

GOAL OF ANALYSIS

Finding the answer to the question asked above is the primary goal of this analysis. This answer will be derived through a variety of resources. As mentioned above, the experience and knowledge of industry members plays a key role. It is also necessary to explore how the design-build delivery method specifically affected this particular project, with regards to productivity and efficiency for the project team. Since not every project team is entirely familiar and comfortable with the design-build method of construction, simply due to lack of exposure, it is also necessary to analyze the potential benefits and restrictions that are presented with this delivery method when it is used as intended.

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



MEASUREMENTS OF ANALYSIS

A specific set of measurements must be employed in order to determine if design-build does indeed create better efficiency and productivity for the design and management teams of a particular project. There are no true numerical values to compare, only individuals' inputs and perspectives based on previous experiences. Since production rates for office work are rarely calculated, it is more of an abstract idea to analyze; hence the predetermined measurements which are listed below. These measurements will again be discussed to conclude this analysis after examination of the information provided.

- Time spent for preconstruction activities
 - Design
 - Estimating
 - Acquisition of subcontractors
- Amount of paperwork required to be completed during construction
 - Requests for Information
 - Change Orders
 - Submittals
- Ability to work ahead
 - Long lead item procurement
 - Permitting
 - Determining means and methods for construction
 - Subcontractors scheduling their labor and equipment in advance

PROJECT MANAGER SURVEY

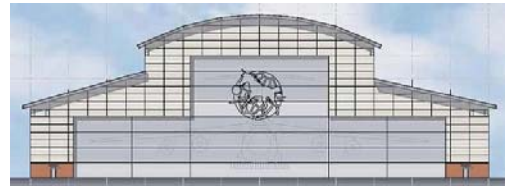
To procure information from industry members who have been involved in the management of both design-bid-build projects and design-build projects, it was decided that survey would be the most efficient option. The following questions were sent to several professionals working in the realm of project management, with a variety of levels of experience.

1. How many design-build projects have you worked on? How many design-bid-build projects?
2. Which delivery method typically runs more smoothly from a management perspective?
3. In your opinion, is the productivity level higher within the management and design teams for one method over the other? If so which one is higher?
4. Have you noticed a significant difference in the number of RFI's and change orders for one method over the other? If so, which one typically has fewer?
5. Which delivery method do you prefer to work with? Please provide reasons.

The responses to these survey questions were mostly in favor of the design-build delivery method over design-bid-build. As mentioned, the level of experience of these individuals varied greatly, which became apparent when reviewing the responses to the first question. The preferences that were displayed through the responses to Question #2 were much more similar. Design-build was the clear leader as far as

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



how smoothly a project typically runs from the management perspective. One explanation for this decision is as follows:

“There is less coordination during construction because the design-build contractors have designed, coordinated, and selected their material during design. It makes the submittal, procurement, and field coordination process smoother.”

Another response to this question, though in favor of the design-build method, explained that this method requires a significantly greater amount of time spent by the management team due to involvement with the design process, rather than simply helping in the bidding stages of the project as is done with a design-bid-build method. One survey participant who was in favor of the design-bid-build approach stated that design-build does not run as smoothly due to the fact that the project team must deal with a design that is not fully developed, making it harder to manage the project.

Question #3 again received responses that were strongly in favor of using the design-build delivery method. Some examples that were provided to support the responses were as follows:

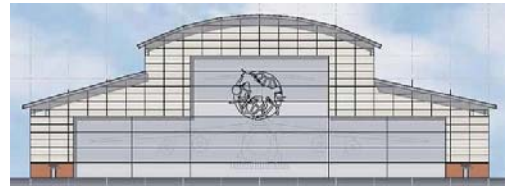
- Construction methods are decided during the design phase so the design is completed accordingly.
- Response time from the design team is better since they are contracted together.
- Submittal process is reduced by almost half since the design and construction teams choose the materials together. This means that the specifications are met the first time the paperwork is submitted.
- Costs are known upfront since estimating procedures take place simultaneously with design, rather than waiting until design is completely finished.
- Procurement of long lead items and permits can begin immediately after certain design phases are completed. In design-bid-build, the contractor must wait until they are awarded the job.

Clearly one of the repeating themes of these responses is saving time and beginning activities sooner. Reduction of the overall schedule of a project has been, and always will be, one of the major challenges in the construction industry.

The fourth question, which dealt with comparing the number of RFI's and change orders that occur for the two different delivery systems, received a unanimous response that design-build has fewer of each, as was expected. Most survey participants explained that RFI's are not truly present in the design-build system, at least not in the formal sense that they exist in design-bid-build. Instead, all questions are discussed openly at meetings since the contractor and designers work as a team. Change orders are also minimized since the design-builder and the subcontractors have a much better understanding of their scope of work and costs. The design-build team is responsible for having everything covered in the design documents from the start. The only change orders that occur are due to changes by the owner and unforeseen conditions that may arise during construction.

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



In regards to the question concerning the preferred delivery method to work with, mixed responses were received. Some said that they have no real preference since they believe there are pros and cons to each method. One response stated that the traditional design-bid-build system is better because there is less gray area, while another explained that design-build is preferred because it gives the contractor greater control in directing the progress of the project. A theme that was repeated in most responses though, was that the right individuals can make either system work.

OWNER PERSPECTIVE

As mentioned in the *Background Information* section, the Contracting Officer for the 167th Airlift Wing for the Fuel Cell Facility project was also involved in the construction of each of the other two C-5 aircraft hangars on the base. Lt. Col. Burkhart was willing to grant me a phone interview to discuss delivery method differences from his perspective in the project. If there was one resounding point that the Lt. Col. made clear in our discussion, it was that the delivery method is only as successful as the contractor who is implementing it. From his experiences in dealing with both design-bid-build and design-build projects, the contractor is the most important variable in the equation.

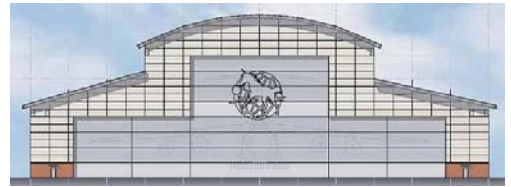
He explained that he has found the traditional method to be very successful, especially if the design documents are well done. However, he also stated that if the design documents are unclear, life as the owner representative can be a nightmare. In the design-bid-build methodology, the contractor has minimal say in the design process and therefore is subject to the drawings they receive. In summary the traditional method, from the Lt. Col.'s perspective, is more dependent on the design professional and takes away some of the control that the contractor has on the project.

In the design-build method, the contractor is able to be a part of the design phase and in that sense has much greater control over the quality of the design documents which they will be using. The Lt. Col. specifically noted that the design-build delivery method forces the contractor to be much more knowledgeable since they are involved in the design. He stated that the contractor needs to "do their homework" to be sure they understand the project much earlier on in the process than is required in the traditional method. It was also acknowledged that projects such as the Fuel Cell Facility and other government-funded projects typically have a different process that must be followed as well as some slightly different standards which can make life difficult for both the contractor and owner if the contractor is unfamiliar with that type of work. This accentuates the point of the contractor needing to work ahead of time to be sure to understand the project.

The final factor that the Lt. Col. addressed concerning the use of design-build methodology is the necessity of the owner to know what he or she wants. He explained that, while the contractor needs to put in the extra time to understand the project, the owner is accountable for assisting the contractor and design teams when questions arise. If the owner is indecisive and incapable of expressing the needs and desires for the project, the contractor and design team will be delayed and possibly produce something that is not satisfactory. The overall knowledge gained from the interview with Lt. Col. Burkhart was that the productivity, or efficiency, of a delivery method is restricted by the capabilities of the contractor selected for the project, and the efficiency of that contractor can only be as good as the resources he is allowed to work with.

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



CAUSES OF DELAYS

It is also important to take a look at how using the design-build delivery method may or may not have affected the productivity on the C-5 Fuel Cell Facility project. A brief discussion with the Project Manager for the project provided some insight into this topic. It had been brought to my attention early on in my studies of this project that it had fallen behind the original schedule by a significant amount of time and this was due in large part to the design of the structural steel system. Since the erection of steel was the driving factor of the critical path, it became apparent that schedule acceleration techniques were necessary. This topic was discussed in Technical Assignment #3 and will not be explained in detail at this time.

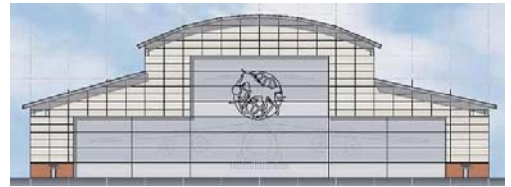
The driving point of the conversation with the PM was determining what the exact cause was for the delays in the steel design, and whether or not it was a function of the delivery method. When asked if he felt the delays were related to the design-build method being used, for example due to unfamiliarity with the process, the PM was pretty adamant that this was not the cause. Rather he explained that the major cause of delays in the structural design phase was a lack of familiarity with designing structures like that of the Fuel Cell Facility. I was informed that TranSystems was selected as the structural design firm by Kinsley Construction because of their experience with hangar design. Unfortunately, TranSystems is a nationwide firm and the designers having experience with hangar design resided in a different office than the one working on the Fuel Cell Facility. Help was eventually provided by the more experienced offices, but until the schedule had already suffered significant delays. In other words, the potential for high productivity in design due to previous experience was never realized.

The Project Manager also explained that another opportunity for improved efficiency that was not realized came in the design of the MEP systems. This was especially disappointing considering the design of all MEP systems was completed by a single firm, again TranSystems. It is not the intent of this analysis to "pick on" this company, simply to point out room for potential improvement from an educational standpoint. It was explained to me that all of the MEP subcontractors were brought into the project early for a design-assist role, which is very common in design-build, and worked with the design team to create an efficient construction process. Regrettably, the MEP design teams did not coordinate well with each other and many issues still occurred during construction. It might be assumed that, had this project not implemented a design-build delivery method, the coordination issues could have been even greater for the MEP trades.

As far as coordination between the design teams and the project management team, the PM stated that he did not feel there were any issues. His only regret was that he did not become more involved in the design phase, particularly the structural design since he has a strong background in this area. He explained that his knowledge of structural design did come in useful for the foundation design as far as simplifying an over-designed system. The main problem that arose with the structural design process was that by getting behind early the design team was forced to react to new issues rather than being proactive and coming up with more efficient designs. In summary, several potential chances for improved efficiency through the design-build method were never fulfilled. The PM did express his personal feeling that the design-build method yields better productivity within the design and management teams if those opportunities are realized.

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



POTENTIAL BENEFITS AND RESTRICTIONS

In the research of this topic, there were instances in which opposing arguments occurred. For example, one source provided information about accountability being greater in the design-build method, explaining that the system reduces finger-pointing between the contractor and design team since they all work together to meet the owner's needs. Another source discussed how accountability is reduced because there is no process of checks and balances between the design team and contractor since they are all working as one entity. Both are valid points and emphasize what has already been discussed earlier, the efficiency and effectiveness of the design-build method is highly dependent on the contractor, or more specifically the design-builder.

There were several other examples of both benefits and restrictions which reiterated information presented earlier in this analysis. Some examples of benefits include: the ability of the contractor to control the cost of the project through the design process; the capability of procuring long lead items early on; and the almost complete elimination of change orders. Examples of restrictions include: the need for a knowledgeable and decisive owner, and the need for coordination between members of the design-build team.

CONCLUSIONS

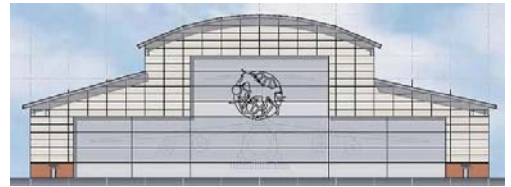
To summarize the information that has been discussed in the previous sections, it is necessary to review the predetermined measurements of analysis and see what the studies of this topic have found. Based on what was found, it appears that the preconstruction time is capable of being reduced, but is highly dependent on the knowledge and experience of the design team as well as the focus on coordination between parts of the design team. It was determined that the design phase can be completed more efficiently because of the ability for subcontractors to assist the design team and reduce the number of changes that occur later in the project. Also, because cost estimating can be completed simultaneously with design, there is not an extended period of time spent for take-off. Cost comparison of materials is handled as the systems are selected, and overall cost is known much earlier so there is a reduced likelihood of exceeding the budget. The design-builder is also able to select subcontractors much earlier in the process through prequalification, and allow the subs to assist in design.

The amount of paperwork, and time spent reviewing it, was proven to be greatly reduced for the design-build method based on the survey responses. All participants explained that Requests for Information are far fewer since the subcontractors helped in the design phase. They also expressed that Change Orders are almost completely eliminated except for owner changes and unforeseen conditions. Finally the participants agreed that the submittal process is greatly shortened because the specifications are defined with the aid of the subcontractors and are therefore typically met with the first submission.

In regards to being able to work ahead, it can be surmised from the information already discussed that the design-build method is much better than the traditional method. Design-build allows the contractor to begin the procurement process for long lead items much earlier since they are helping choose materials in the design process. Permits can also be purchased earlier since the contractor knows they have been awarded the project before the design is complete. This reduces delays which can often

Kyle Goodyear
C-5 Fuel Cell Facility
April 7, 2010
Advisor: Dr. Magent

Construction Management
Martinsburg, WV



occur in the permitting process. It is also easier for the subcontractors to plan ahead. Since they are likely to be involved in the design phase, unlike for design-bid-build construction, the means and methods of construction can be decided on sooner. In fact many methods of construction can be considered during the design process in order to improve efficiency in the field. The subcontractors are also able to use their advanced knowledge to schedule their labor force and equipment to be sure delays do not occur in construction.

According to the measurements that were determined and the information that was found, it seems quite obvious that using the design-build delivery method can indeed improve productivity for the management and design teams. It is important to understand and make special note of the repeated theme in this analysis, that the productivity and efficiency of this method is highly dependent on the team that is selected for the project. If the contractor or design team is not knowledgeable of the owner's desires for the project, the design-build method will not be effective. The same result will occur if the owner is unable to express their needs and wants for the project. However, these restrictions are just as important to a successful project with the design-bid-build method. It is the *potential* for efficiency that can be achieved by the two delivery methods that must be compared, and it has been shown that design-build has greater potential.