A VALUE COMPARISON

AT COLORADO STATE UNIVERSITY

Higher education institutions are challenged today with limited capital construction funding, aging facilities and increasing enrollments. Although Colorado has seen tremendous economic growth in recent years, it remains one of lowest states for funding higher education due in part to the State Constitution and its "Tabor laws".

In 2011, The American Council on Education stated that "Colorado has reduced its support for higher education by nearly 69.4%, from $10.52 in fiscal 1980 (and a peak of $13.85 in fiscal 1971) to $3.22 by fiscal 2011. At this rate of decline, Colorado appropriations will reach 0 in 2022, just 11 years from now. Projections using more recent data find that Colorado could hit zero as soon as 2019. Colorado higher education institutions in turn have raised tuition and solicited private donors to assist in funding their much-needed construction growth.

Colorado State University (CSU) has also been maximizing their funding by utilizing a Design/Build Lump Sum delivery approach on recent construction projects on campus. Over the past few years, much research has been dedicated to understanding the strengths and weaknesses of the Design/Build process, with a great deal of credit given to the integrated teaming often seen in a Design/Build partnership. CSU had a unique opportunity to test this process and have since chosen this acquisition strategy due to the inherent collaboration of the team structure and speed of schedule that, in an escalating market, has reduced project costs.

The opportunity to test the Design/Build strategy came as a result of having the same architect, general contractor and owner for three separate projects on campus. Our Design/Build team of Hord Coplan Macht and Haselden Construction were selected to design and build three separate laboratory buildings over the past 10 years using three different delivery methods: GMP Lump Sum Construction Manager/General Contractor (CM/GC or CMAR), Design/Bid/Build and Design/Build Lump Sum. This situation provided a perfect opportunity to isolate the team from the equation and test the delivery methods themselves.

CASE STUDY PROJECTS

LAB No. 1:

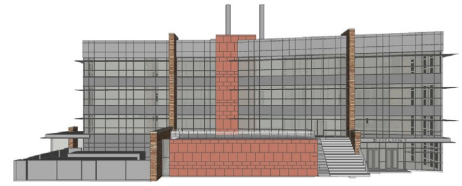
Suzanne & Walter Scott Jr. Bioengineering Building (CM/GC Delivery Method)

In 2007, CSU, Hord Coplan Macht (HCM) and Haselden Construction (Haselden) designed and built the 122,000 square-foot Suzanne and Walter Scott Jr. Bioengineering building. The project was procured using the CM/GC method where HCM was hired through a qualification-based selection process with Haselden brought on as the CM/GC. Our firms contracted separately with the University and the project successfully opened on time in 2010 and obtained LEED Gold certification.

LAB No. 2:

Chemistry Research Building (Design/Bid/Build (D/B/B) Delivery Method)

In 2015, CSU made the decision to use the traditional Design/Bid/Build (D/B/B) delivery method for the Chemistry Research building as the capital construction funding was largely provided by the state and available in three phases. Phase one funding aligned with the building design expenditure, phase two with the building core and shell and phase three with the interior finishes. Instead of waiting three years in an escalating market to begin the project under a Design/Build Lump Sum approach, CSU determined it would be best to leverage the resources with a traditional Design/Bid/Build development strategy. In this scenario, the project could be designed in the first year and bid with floor-by-floor interior fit up alternates to accommodate uncertainty around the amount of funding that would be available for phase three. Construction was then planned to begin in the second year with the core and shell nearing completion by the time the phase funding became available. All three phases of funding materialized at the appropriate time and CSU saved two years of market escalation costs. On this particular job, HCM was hired through a qualification-based selection process and Haselden won the competitive bid for construction. Once again, our firms contracted separately with the University and the 60,000-square-foot Chemistry building successfully opened on-time in August 2017 with LEED Gold certification currently pending.



LAB No. 3:

Biology Building (Design/Build Lump Sum (D/B) Delivery Method)

The 154,000-square-foot CSU Biology building was cash funded by the University. The project leveraged a project-specific student facility fee with donor funds to accommodate the debt service on the bond. Again, in an escalating market and since the funding was available all at once, CSU determined that a Design/Build Lump Sum acquisition strategy would offer the best speed-to-market and most expeditious construction schedule.

CSU created robust bridging documents for the Biology building using an in-house team and design criteria consultant. The bridging documents were developed by the team through the procurement to the extent required for the design/builder to provide a lump sum cost proposal. Points were awarded during the interview for “innovative departures” and “structured alternates” that added value to the project. HCM teamed with Haselden and won the commission by working as an integrated unit finding over $1.5 million in cost savings by introducing a slightly larger four-story building that could be fully finished in lieu of a five-story building in which a portion would remain unfinished. Unlike the previous projects, CSU contracted with Haselden directly who in-turn contracted with HCM and HCM held the contract for all engineering consultants. In tandem with the Chemistry building, the Biology building opened on time in August 2017 with LEED Gold certification currently pending. The Biology and Chemistry building were planned and designed at the same time and situated side-by-side on the site.

Given the unique situation with the three distinct delivery methods, we collaborated with CSU and Haselden to collect statistical, empirical and qualitative data to compare the various delivery methods.

Our team tracked the speed of the projects by comparing schedules and productivity, quality of the projects through punch list items and cost of the projects through number of RFI's, added value, change orders and contingency usage. It was also important to our team to understand the qualitative issues associated with the delivery methods and how the methods affected the team. Interviews were conducted at the conclusion of the projects to gather information from team members regarding each project delivery system.

WHAT IS DESIGN/BUILD LUMP SUM

Design/Build Lump Sum is different than a standard Design/Build contract. With a Design/Build Lump Sum model, the owner provides "bridging documents" to a group of Design/Build teams who bid on the bridging documents and provide a price for the overall project. Typically, the lowest cost wins.

CSU has a unique approach and has worked diligently to create a competitive and fair solicitation process for their newly defined Design/Build Lump Sum process. CSU has also worked with the State Architect to ensure that its process it is legal and impartial. Much of the planning work is done in-house by the CSU design and construction team.

They begin with a culture of trust empowering the CSU project manager to make decisions and work directly with the building stakeholders to verify the project program with in-house personnel or limited consulting support. Strategic conversations about space utilization and efficiency are resolved before the architect/engineer project team is ever selected. CSU produces a comprehensive set of performance criteria to explain the University's needs, expectations, standards and technical requirements.

The selection process is limited to three short-listed Design/Build teams. Four pre-proposal conferences are scheduled with the building stakeholders allowing the Design/Build teams to interact with them and typically involve design workshops. This gives the building stakeholders an opportunity to see the teams' working relationships, while allowing the designer to provide design options and solicit feedback before the final presentations. The scope is broken into a base scope and a priorities scope ladder (alternates). Much like a design competition, at the final interview, teams present their design solutions and a sealed envelope with the final cost. Selections are based on 70% scope/cost and 30% oral interviews.

FINDINGS

We collected data in the following four categories to evaluate the three different delivery methods.

SPEED
Speed of schedule + productivity

QUALITY
Number + duration of punch list

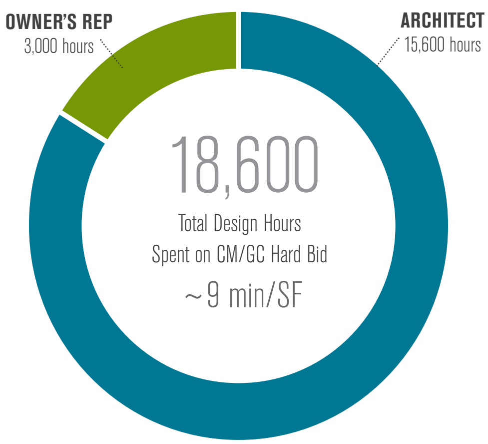
COST
RFI's, # Change Orders + Contingency usage

PEOPLE
Collaboration + qualitative data

SPEED: SCHEDULE

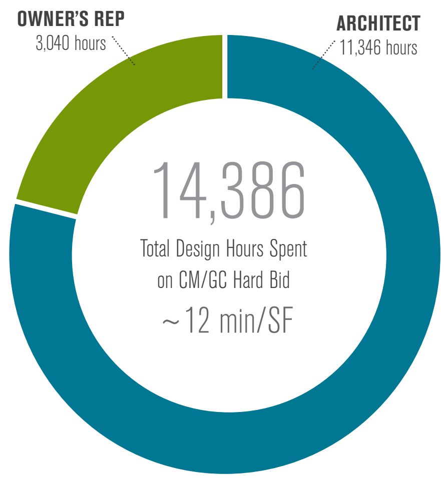
CSU SCOTT BIOENGINEERING

CM/GC - (122,000 SF)



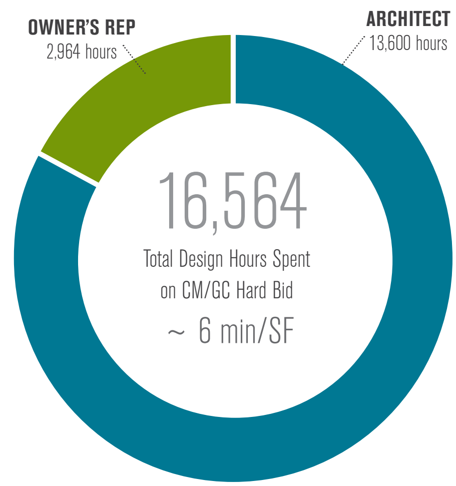
CSU CHEMISTRY

Design/Bid/Build - (60,000 SF)



CSU BIOLOGY

Design/Build - (154,000 SF)



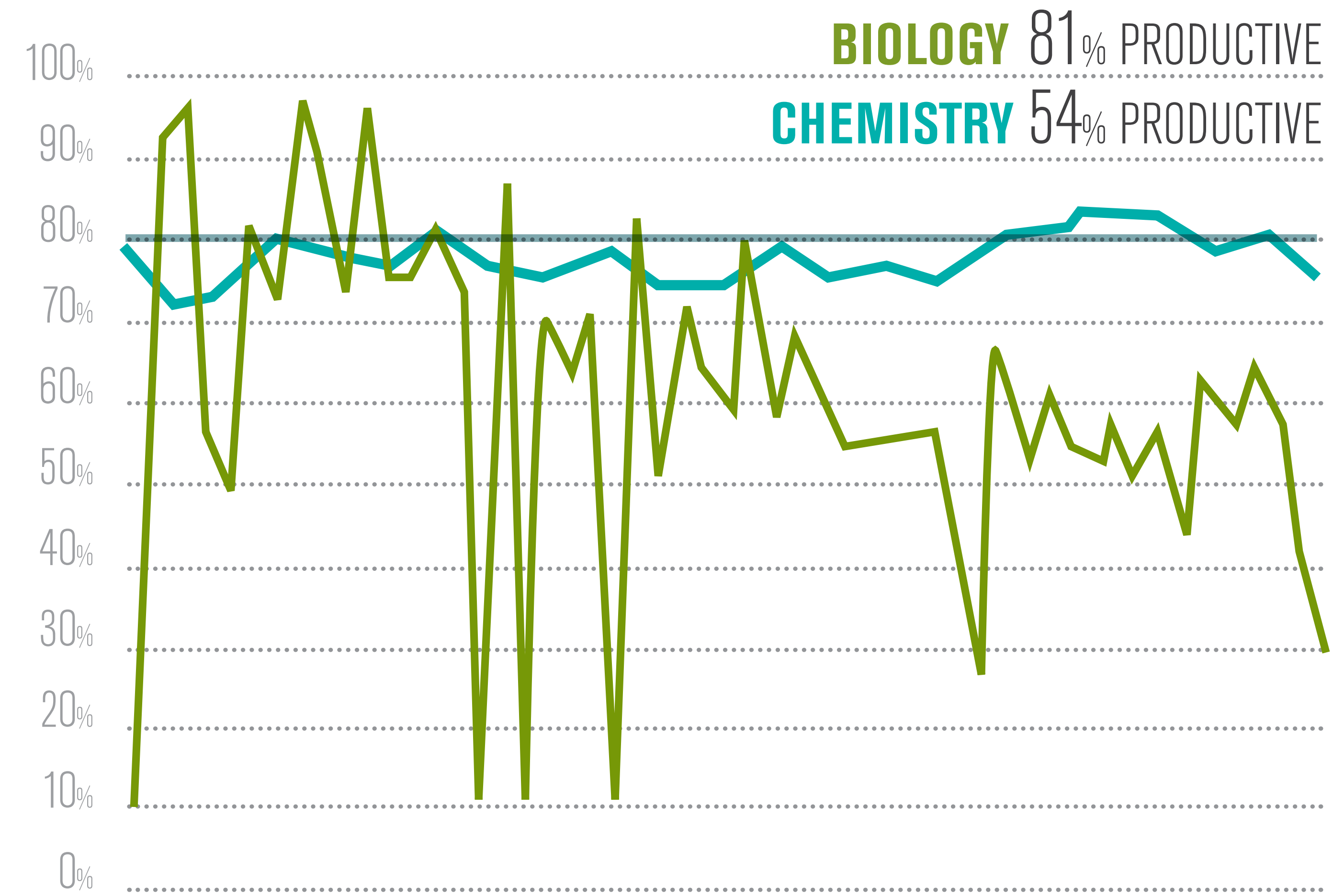
We found that the Design/Build Lump Sum (D/B) project design time was 11.5% faster than Design/Bid/Build (D/B/B) and 6% faster than GMP Lump Sum Construction Manager/General Contractor (CM/GC) allowing our team to start construction more quickly. This was due in part to the extensive work the University did with user groups before the project was handed off to our team for design. CSU Project Manager & Interim Supervisor of Capital Construction, Tracey Abel, logged hundreds of hours for over a six-month period to build consensus toward a common vision amongst various user group.

"We had eight months of time before funding would be available. By spending the upfront time to collect information from each user group, it generated efficiencies and adjacencies that informed the floor plates. During the discovery process the user groups' realized how they could better utilize the overall square footage of the building by going to an open lab concept with specialty labs in the center core. The bridging documents captured the grouping of users in wet and dry labs, as well as how many could be housed on each floor. By getting through departmental discussions and have consensus prior to sending out the bridging documents, it allowed the Design/Build team to focus on design and not bringing the Design/Build team into long departmental discussions or issues." Tracey Abel, Interim Supervisor of Capital Construction, Colorado State University.

Given the robust performance criteria provided by CSU, we were surprised at the number of design hours for the Biology building relative to the Chemistry Research building, which was half the size. Upon deeper investigation, we found that the D/B process required a more experienced team and thus the cost per hour was higher than with the other two delivery methods. After much analysis, we found that the D/B process required our Senior Project Manager to actively participate in every meeting because of the high-level constructibility discussions. Though some believe construction documents on a D/B project require less detail, we found that they required more detail due in part to the project speed, which required critical technical decisions be made quickly thus necessitating an experienced architect in all meetings and on the job site more often.

"From the contractors' standpoint, we found that the quality of the documents from the D/B process to be higher than that of the other two delivery methods. In the D/B process, the contractor has more skin in the game to insure the documents are complete and constructible. We worked very closely with the design team to develop details as well as bring in subcontractors as trade management partners to help provide details that correlate to a specific system we were planning to build. Due to this high level of collaboration during design, the result was less RFI's and less coordination issues during construction." Colby Stodden, Senior Project Manager, Haselden Construction

SPEED: PRODUCTIVITY



The D/B model was 27% more productive as compared to the D/B/B model. We attributed the increased productivity to the inclusive process Haselden uses with their D/B teams. Key trades were involved with creating the D/B schedule and thus understood the manpower needs to meet the schedule. In D/B/B process, the schedule is mandated to the general contractor and the trades. They rarely have time to coordinate an integrated schedule because the subcontractors are selected based on the lowest price and not teamwork. We found that although the schedule is often given to the subcontractors, many do not review it in detail before submitting a bid to the general contractor and that the subcontractors are typically only selected based on the lowest price estimate. This often results in manpower issues on site and lower productivity. We also observed that when there is lower productivity on site, less money is made and tensions can elevate creating a stressful work environment, increased errors and lower quality craftsmanship.

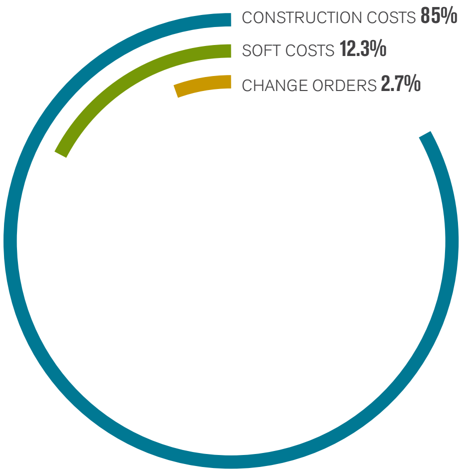
Although detailed performance specifications were provided for the Biology building, we offered 54 innovative design alternates (IDAs) during the project interview to add value on the project. Nine IDAs were accepted and significantly altered the design expression of the building.

COST

CSU SCOTT BIOENGINEERING

CM/GC

TOTAL PROJECT COST = $72,866,000

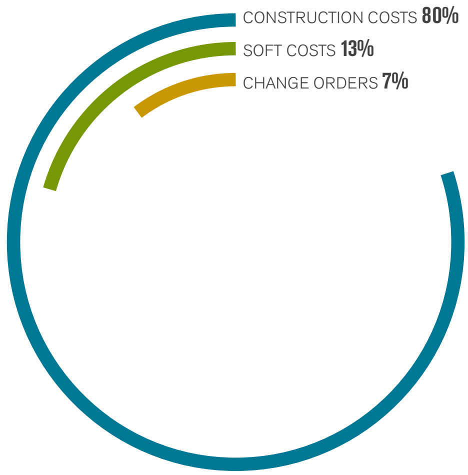


Request for Information (RFI's) documents are often used as a statistic to judge architectural drawings. Many in the industry understand that RFI's are a tool to "formally" communicate between the general contractor and the architectural/engineering team. Some would argue that a high RFI count reflects strong communication among the team. We recognized that RFI's were an evaluation of the subcontractors' integration into the team and thus their understanding of the design. When adjusted for square footage, the D/B method resulted in 62% fewer RFIs than the D/B/B method. The CM/GC method resulted in a 29% reduction in RFIs. We interpreted this data to mean that the sub-trades understood the design intent best in the D/B method and clearly better when integrated into the team early in the process. A positive correlation was found between the number of RFI's and the amount of change order dollars on each project.

CSU CHEMISTRY

Design/Bid/Build

TOTAL PROJECT COST = $40,246,649



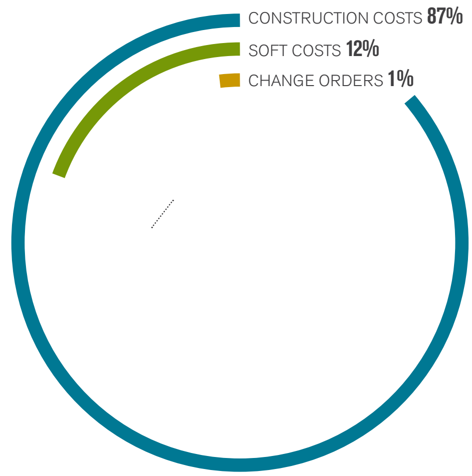
The D/B method resulted in an 86% reduction in change orders when compared to the traditional D/B/B method. The CM/GC method resulted in a 61% reduction.

Many in the design and construction industry agree that the most competitive evaluation of first cost is realized in the D/B/B or "hard bid" method. When general contractors and associated subcontractors bid on a common set of construction documents it is a competitive evaluation of the project's scope in that moment in the economic market. The debate often becomes impassioned by those in the design and construction industry when discussing the "actual" cost of work or final cost of the project. Once the competitive bid is awarded, most field-related changes will be resolved with a change order which typically adds cost. The risk of the "actual" project cost is solely shouldered by the owner in a D/B/B delivery method and typically the general contractor does not carry a contingency (unless required by the contract or contract documents) in an effort to have the lowest cost on bid day.

CSU BIOLOGY

Design/Build

TOTAL PROJECT COST = $66,528,800

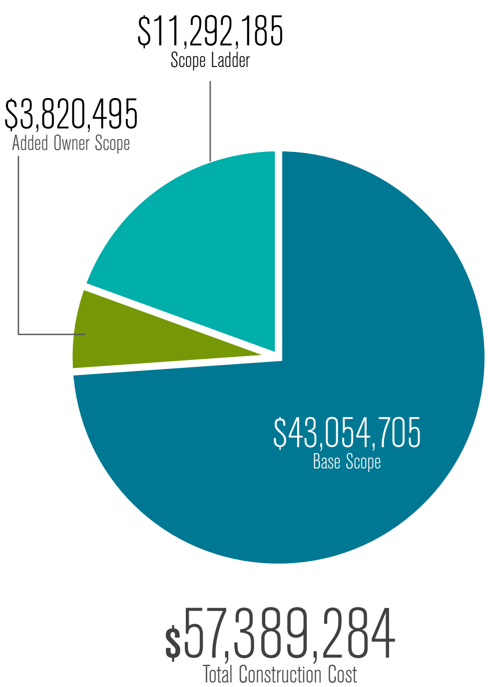


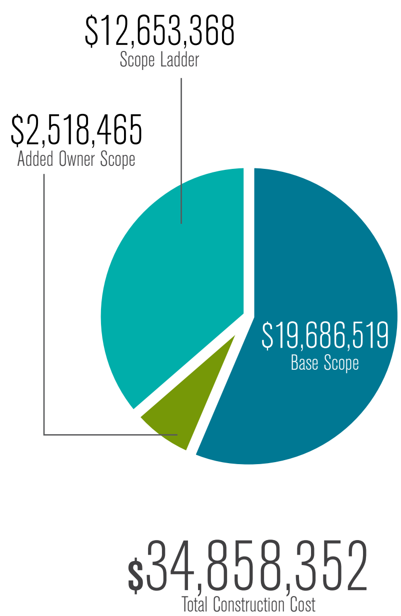
We found that the CM/GC process shifted some of the "actual cost" risk onto the general contractor on the Bioengineering building, but we lost the opportunity to spend $47,000 due to this shared risk. Under the CM/GC delivery method, CSU spent $778,101 of the owner's held contingency on field changes and value- added (owner-requested) changes in addition to $908,495 of the contractor held contingency, which Haselden was required to carry per the State of Colorado CM/GC contract. At the end of the project, $47,000 remained, which Haselden returned to CSU after substantial completion. Although the return of funds was likely the best alternative, we all recognized that this savings symbolized value that was not included in the project. During the Biology building construction process, Haselden was required to resolve all unforeseen issues ($680,861 worth) within the budget identified during procurement. This allowed CSU to spend their owner held contingency on added scope, such as building out the originally shelled 4th floor and adding state-of-the-art exhibits throughout the 1st floor to enhance the user experience in the building, including adding a "Living Green Wall", 10,000-gallon fresh and salt water aquarium and museum grade exhibits of the natural history collection.

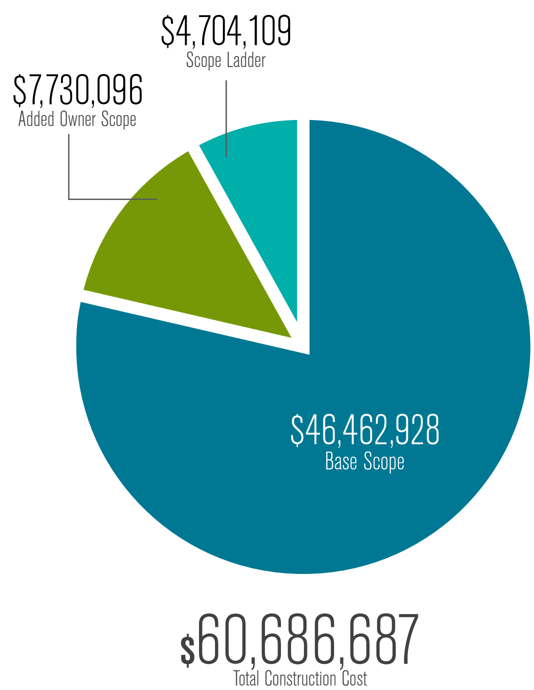
CSU SCOTT BIOENGINEERING
CM/GC
TOTAL PROJECT COST = $72,866,000

CSU CHEMISTRY
Design/Bid/Build
(11:11 alternates)

CSU BIOLOGY
Design/Build
(7:9 alternates + 45 added value owner scope items)







The most fascinating finding was that in 2009, CSU built the 122,000-square-foot Bioengineering building for $57.4 million. (Note: 2009 was in the middle of the national recession.) Six years later, as the recession was recovering, CSU built the 154,000-gross-square-foot Biology building for $56.7 million. This included the addition of 45 additional owner changes, which resulted in higher value for the University and the Biology department.

1,270	5,151	1,087
Punch List Items	*Punch List Items*	*Punch List Items*
CSU Scott Bioengineering CM/GC	CSU Chemistry Design/Bid/Build	CSU Biology Design/Build
122,000 SF	**60,000 SF**	**154,000 SF**

QUALITY

With a typical D/B contract, unspent contingency stays with the D/B team. Many argue that this incentives contractors to reduce quality to make a profit. CSU has focused a great deal of their effort here and now creates a robust set of performance specifications and technical specifications which must be adhered to by the D/B team on each project.

We believe that the extent and duration of the punch lists on each project were strong measures of construction quality, although we continue to track the overall durability of each project. The D/B project had 92% less punch list items compared to the D/B/B delivery method and 32% less than the CM/GC method. We believe this showcased the subcontractors' involvement and dedication, as well as the overall level of quality with an integrated team.

While it is impossible to agree on a statistic proving "great design", we can agree that happy and healthy building users are a strong indication of success. Over the last 15 years, CSU has worked hard to improve the CSU student experience and building design is important to the University architect and campus leadership. All three laboratory buildings on campus were developed and approved with input from the CSU Design Review Committee.

PEOPLE

As part of the evaluation process, it was important for the University to understand how the various delivery methods affected those working with and for the University. Finding empirical data to prove the effects on people was challenging, but our team gleaned information from interviews and observations on the job site.

From our observations, it was evident that the D/B and CM/GC projects had a more positive affect on the team members than the D/B/B project. Although Haselden worked hard to maintain a consistent culture on all three job sites, the D/B/B project proved to be the most challenging. Due to the varied productivity and difficult schedule, there was significant personnel turnover and the increased stress on the site of the Chemistry building could be "felt" during subcontractor appreciation events. CSU and Haselden hosted two events on the same day approximately an hour apart. During the D/B lunch there was palatable camaraderie with team members laughing and talking, unlike the D/B/B event where it was nearly silent. In addition, during the family night event hosted by CSU, which allowed the team members' families to view the building before it was open to the public, no subcontractors from the Chemistry building attended with their families and the only attendees were from the Biology building project teams. Although not scientific proof, these observations point to the notion that an integrated team produces a better working environment.

CONCLUSION

CSU has found that leveraging the strengths of each delivery method allowed them to maximize the funds available for their design and construction projects and, while initially unintended, allowed us to examine the value of the various delivery methods.

After evaluating all three methods, it became clear that the D/B/B process has allowed CSU to begin projects before funding is fully in place and save costs in the escalating Colorado construction market. In this delivery model, the first cost is the lowest and the schedule is predictable and mandated by the University.

The CM/GC method has allowed CSU to place additional significant scope after substantial completion when construction contingency refunds are realized.

But it is the D/B delivery method that has brought the most value to the school based on the combination of speed, quality, cost and team satisfaction.

CSU has utilized a design competition model to solicit talented and motivated teams for their projects. With reduced cost, increased speed and design consistency, the University has completed seven D/B projects with six more projects planned. They have evolved their procurement process so that it only takes six months to develop performance criteria for new projects. They have also continued to update campus standards and technical specifications to advance the process and allow for innovation from the industry.

While there is no doubt that there is a time and place for each delivery method, our data supports that, if the client has a trust-based culture and sets clear expectations, the Design/Build Lump Sum process is more cost efficient and enjoyable, while retaining a high level of design and construction.

"We appreciated having HCM and Haselden as partners in this. It was productive. It was fun. I count you all as friends now- I know that not every project ends that way!"

-Dr. Joe Von Fisher

hord | coplan | macht

ARCHITECTURE
LANDSCAPE ARCHITECTURE
INTERIOR DESIGN
PLANNING

www.hcm2.com