

The Value of the Commissioning Process: Costs and Benefits

Chad Dorgan, P.E., Ph.D.¹
 Robert Cox, P.E.²
 Charles Dorgan, P.E., Ph.D.³

¹ Senior Project Manager, Facility Technology and Research Division, Farnsworth Group, Inc., 7601 Ganser Way, Madison, WI 53719. Phone: 608-827-6880. Fax: 608-827-6886. E-mail: cbdorgan@f-w.com

² Senior Project Manger, Facility Technology and Research Division, Farnsworth Group, Inc., 20 Allen Avenue, Suite 200, St. Louis, MO 63119. Phone: 314-962-7900 Ext. 279. Fax: 314-962-1253. E-mail: rcox@f-w.com

³ Principal, Facility Technology and Research Division, Farnsworth Group, Inc., 7601 Ganser Way, Madison, WI 53719. Phone: 608-827-6880. Fax: 608-827-6886. E-mail: cedorgan@f-w.com

1. INTRODUCTION

If your Commissioning Authority for your project cannot clearly document that their fee has been recovered during design (early construction at the latest), you are not properly implementing the Commissioning Process. If this has caught your attention, this paper is for you. We will not only provide clear examples of the savings attained through a properly implemented Commissioning Process and the associated costs, but will also provide you with a clear understanding of what the Commissioning Process really is and guidelines for documenting the benefits.

2. BENEFITS: PAYBACK DURING THE DESIGN PHASE

First the details, then the explanation. Table 1 provides a summary of nine projects where the owner elected to adopt the Commissioning Process as their means of procuring the facility.

Table 1 Benefits of the Commissioning Process (CxP) for LEED™ and non-LEED™ Projects.

Project	State	LEED™	Project Cost	Project Status	CxP Savings	% CxP Cost
Natural Food Store	WI	Yes ¹	\$2.1 million	Complete	\$85,000-\$604,000	315%-2,237%
Warehouse	IL	Yes	Confidential	Complete	Confid.	200%
Science Center	CO	Yes	\$12 million	15% Constructed	\$319,000	189%
Hospital	CO	Yes	\$52 million	20% Constructed	\$425,600	141%
Vivarium	NC	No	\$28 million	60% Constructed	\$500,000	152%
Science Building	AL	No	\$49 million	50% Constructed	\$400,000	105%
Elementary School	IN	No	\$11 million	95% Constructed	\$60,000	171%

¹ Outpost used the LEED™ rating system during planning, design, and construction but elected not to pursue formal certification.

As is indicated in the last column, the savings are much higher than the original cost for the Commissioning Authority, well before the completion of the project. What this means is that the owner's investment into the Commissioning Process is paid for well before the project is completed.

While it is great to be able to show such savings, the components of the savings are just as important. For the above projects, the savings by implementing the Commissioning Process are composed of the following:

- **Eliminate Change Orders:** most of the savings are due to the elimination of change orders by identifying and resolving issues as early as possible during the design phase. This is accomplished through the application of quality process techniques, clear definition of the project's success criteria, and on-going verification that these criteria are met. For example, during design of the natural foods store it was identified that the air conditioning unit was 50% undersized (simple transposition of numbers in engineer's calculations). By identifying this early, a \$50,000 change order, once the submittals were received by the engineer, was avoided.
- **Eliminate Requests for Information:** the cost to a project in time, money, and quality for resolving requests for information can be extreme. This is due to the fact that each request for information requires the contractor to first identify the issue, then document the issue for the architect's or engineer's review, followed by either agreement by the contractor or another round of inquiry. This process typically costs a contractor \$500, the owner \$100, and the architect or engineer \$700 for each request for information. By improving the project construction documents through focused quality reviews, the Commissioning Process greatly decreases the number of requests for information.
- **Proper System/Component Selection:** oftentimes the architect or engineer either does not obtain proper information on what the owner requires or does not convey this information to their staff. Therefore, with the focus on the project's success criteria, the Commissioning Process verifies that the systems, components, and materials used in project achieve the owner's requirements. In LEED™ projects this is especially important in that simple changes to material or system selection, results in not getting certified or a reduction in certification level. For example, on the warehouse facility, the heating system for the storage area was changed from gas-fired air units to gas-fired infrared units, resulting in a reduction of approximately 30% in gas usage and improved occupant comfort.
- **Improved Performance:** by knowing the owner's success criteria, the performance of the facility can be optimized. The specific performance will vary depending upon the focus of the owner, but typically includes energy, indoor air quality, material durability, and occupant productivity. For example, during construction of the vivarium the continuity of the envelope was compromised. By focusing the contractor on the owner's requirements, construction of the envelope and building tightness was improved (control of airflow and avoiding infiltration critical in vivariums – rat research).

- Operational from Day One: it is estimated that each contractor callback during the first year of operation costs an owner approximately \$2,000 in reduced employee productivity (10 people each with 8 hours lost work time) and \$1,000 in operations and maintenance staff time in initially troubleshooting problems and working with the contractor to ultimately resolve. For example, by functionally testing the entire building for the elementary schools, we were able to show to the owner, architect, engineers, and contractors that the project success criteria were achieved and callbacks were virtually eliminated.

3. COSTS: DEPENDS UPON PROJECT SIZE

A major confusion of an owner in implementing the Commissioning Process is that regardless of project size, certain activities have to be accomplished. For example, the time required to document the owner’s Project Intent does not vary from a \$5 million project to a \$80 million project. However, without the Project Intent, the project success criteria are not documented and the focus required for success is lost.

Even with this reality, it is important to understand that it is often the smaller projects that require the Commissioning Process even greater. The reason for this is that on the smaller projects the design fee is also reduced and the time often taken by the architect and engineer to fully understand the owner’s needs is reduced. The Commissioning Process on these smaller projects maintains the owner’s focus and achieves a better building.

While providing a simple percentage of construction cost is not the ideal way for the Commissioning Process service to be evaluated, it is the easiest means of conveying Commissioning Process costs. Therefore, Table 2 provides a summary of Commissioning Process costs based on 20 years of history.

Table 2 Commissioning Process Costs as Percentage of Construction Cost

Construction Cost	CxP Cost	Notes
< \$5 million	2%-4%	These costs include a moderate amount of travel expenses. Complexity, timing (# site visits), and team cooperation greatly effects cost. Obtain hourly estimates by task to understand Commissioning Authority’s role and involvement.
<\$10 million	1%-3%	
<\$50 million	0.8%-2.0%	
>\$50 million	0.5%-1.0%	
Complex projects (labs)	add 0.25%-1.0%	

The values shown in Table 2 are for total building commissioning. The values do not translate directly to subsystems. The primary reason for this, especially on LEED™ projects, is that a properly designed and commissioned system will have less construction cost, but takes more time to plan and design. Further, for LEED™ projects, total building commissioning must be used due to the focus on a successful building, not a successful component or system.

It is also important to understand that to get the best possible Commissioning Authority often requires not hiring locally. As there are only a dozen or so firms that have been through the Building Commissioning Association’s (BCxA) 5-day training course, and less who are LEED™ trained and certified, there is a limited pool of qualified Commissioning Authorities for LEED™ projects. Hiring a non-experienced Commissioning Authority will cost a project more money and

the savings shown in Table 1 will not be achieved. On projects with long-distance travel, the Commissioning Process cost can increase up to 0.5% to 1.0% of construction cost.

4. WHAT IS THE COMMISSIONING PROCESS?

If you understand and believe in the savings and the costs of the Commissioning Process, but are still confused on just what the Commissioning Process is, don't worry, you are not alone. Due to poorly provided services, untrained personnel selling themselves as Commissioning Authorities, and the fact that the term commissioning is used differently in other industries (ship building), most owners, architects, engineers, and contractors have misconceptions of just what the Commissioning Process is. Luckily you are reading this paper – the answer is below.

First, a little background. The Commissioning Process is based upon the larger quality process movement in industry around the globe. Therefore, it is best to understand the key tenants of a quality process, so that the Commissioning Process can be put in context. The key tenants are:

- Must define the end goal: while common sense, it is amazing how many times a team starts a project without knowing what the end goal is. In a quality process it is essential that the end goal be defined so that we can gauge progress and work together in a single direction. In the Commissioning Process, this is the Project Intent.
- Work done right the first time: schedules and budgets are maintained or reduced only if work is done right the first time. Therefore, information must be provided so that rework (new drawings, reinstallation, etc.) is not required.
- Each individual worker is responsible for quality: this is one that must be understood and agreed to by all. The owner can only inform the team of the expected level of quality they wish to receive. However, it is up to the individual draftsman and installation technician that actually determines the level of quality received. If the individual does a poor job, quality is compromised.
- Verification of work, not inspection: in concert with only the individual being responsible for quality, a supervisor or other entity cannot inspect in quality – they can only verify what level of quality was received. By changing the process, quality can be improved, not by finding and correcting mistakes at the end. Therefore, the Commissioning Authority's role is not to find all of the mistakes made, but to evaluate the architect's, engineer's, and contractor's processes to determine if the owner's Project Intent is being achieved – a verification role, not inspection.
- Focus on life of building, not first day of occupancy: most non-quality processes focus on a short-term timeline (finish the drawings, building the product). In a quality process, the focus is not just the immediate product, but how that product will work for its expected life. This long-term viewpoint enables achieving all of the goals, not just those that will occur in the next year or two.
- Improved quality results with lower project costs: ultimately, a quality process reduces project costs. In the case of the Commissioning Process, when initiated during the

planning phase, the fee can be recovered during design. However, the owner's focus must be on the life of the building, so that the operational savings of adopting the Commissioning Process are included in the savings calculation.

So, have you picked up on the clues to what the Commissioning Process is?

In a nutshell, the Commissioning Process is adopted by an owner as their means and method for procuring (planning, designing, constructing, and operating) their facilities. The Commissioning Process activities are those that must be accomplished by the owner in order to achieve the success they define at the beginning of the project (Project Intent) at the end of the project (occupancy and beyond). Therefore, the Commissioning Process cannot be abdicated to the architect, engineer, or contractor – it must be accomplished independently of these entities. If the owner does not have the internal resources, processes, or procedures in place, then an independent Commissioning Authority can be hired.

To better understand this concept, Figure 1 graphically shows the key activities that an architect, engineer, and contractor currently performs on behalf of the owner (left column). Also shown (right column) are the activities required by an owner to achieve success, independently of the architect, engineer, and contractor. These activities (Commissioning Process) always refer back to the Project Intent as the criteria on which to judge the work products.

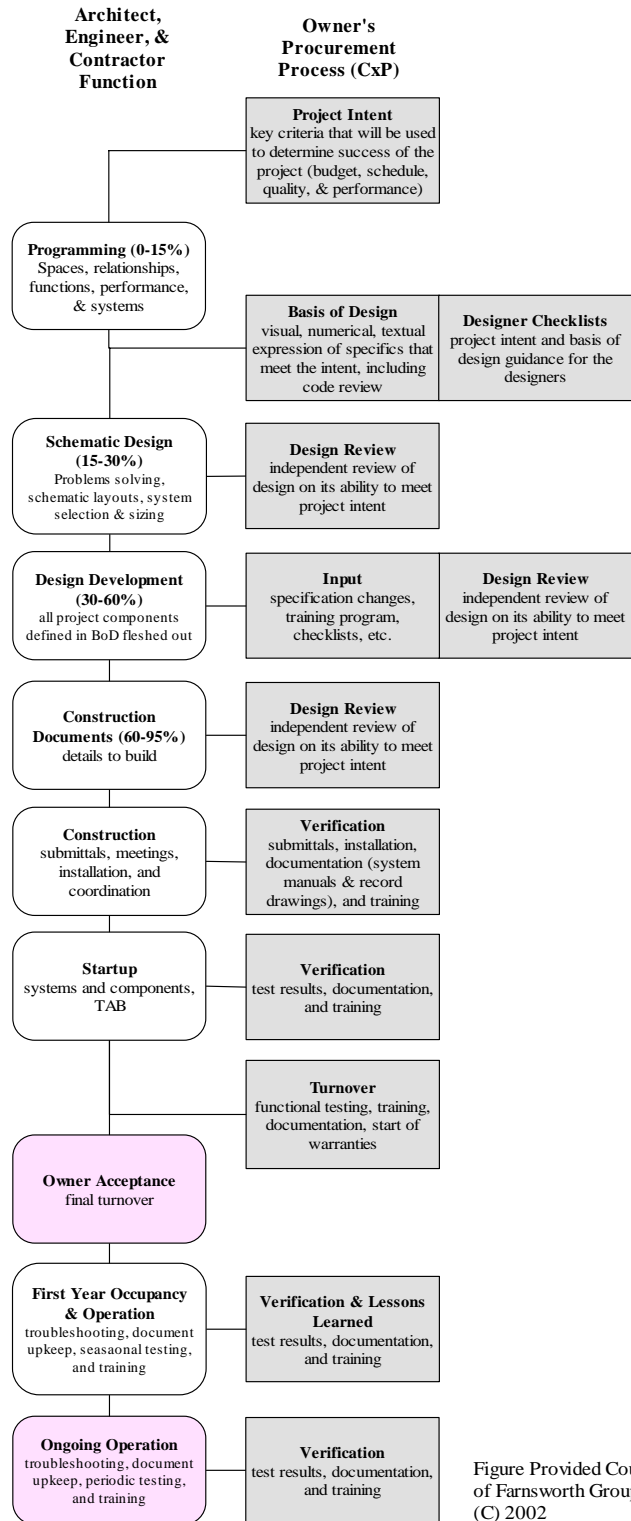


Figure Provided Courtesy of Farnsworth Group, Inc (C) 2002

Figure 1 The Commissioning Process (right) relative to current contractor work (left).

5. GUIDELINES FOR DOCUMENTING BENEFITS

Altwies and McIntosh (2001) developed a methodology to document the benefits of the Commissioning Process on a project. This methodology was designed with the following characteristics:

- Can be consistently applied no matter what type of project or the scope of the project.
- Can be applied to the entire project or just in one or more phases.
- Thorough, repeatable, and conservative.
- Gives the best possible estimate using available data.
- Can be developed with minimal time input and minimal additional effort by the Commissioning Authority.
- Can be understood by the owner and the members of the Commissioning Process Team.
- Gives a range of values based on valid, conservative estimates of cost factors and savings.

The result was a 3-step procedure:

1. **Identify and Record Issue:** this step required that the issue be identified and thoroughly documented so that the impact of not resolving can be clearly understood. The key parts of the documentation are:
 - Issue "birth" - date the issue is discovered and brought to the attention of the appropriate team member or owner.
 - Description of the issue - including information about the equipment affected and the current state of progress (in design, partially constructed, etc.).
 - Contact person and party responsible for resolution (e.g., designer, architect, mechanical contractor, electrical contractor, etc.).
 - Issue "life" - the amount of time between the issue "birth" and its resolution.
 - Role of Commissioning Process - the role the Commissioning Process played in identifying and resolving the issue.

2. Calculate Avoided Costs: the avoided cost is the amount of money that the Commissioning Process saved – it is the additional cost that the owner would have paid in order to receive the same high quality facility if the Commissioning Process was not implemented. The key costs to be documented are:
 - Repair Costs – the total costs to fix systems, subsystems or components (may include purchase of parts and transportation).
 - Replacement Costs – the total cost to replace systems, subsystems or components (may include purchase of parts and transportation).
 - Installation Costs – the total cost to purchase, transport, and install systems, subsystems or components.
 - Professional Costs – the total cost of professional time (architects, engineers, designers, etc.) needed to evaluate the issue and implement a remedy.
 - Energy Cost – the total costs due to higher energy consumption.
 - Depreciation Cost – the total costs due to an increase in the rate depreciation of systems, subsystems, and components.
 - Maintenance Cost – the total costs due to an increase in maintenance of systems, subsystems and components.
 - Revenue loss Cost – the total income lost due to decrease in sales (e.g., in stores, supermarkets, etc.) and decrease in business opportunities and services rendered (e.g., in commercial buildings, medical facilities, etc.).
 - Productivity loss Cost – the total income lost due to the decrease in employees’ work performance and output.
3. Evaluate Range of Avoided Costs: the last step is to estimate the upper and lower range of avoided costs. The lower range would be for the case where the issue was resolved “perfectly” by the team members (e.g., wrong size unit identified during submittals and not after construction). The upper range would be the most likely solution (e.g., was not caught until occupancy).

6. CONCLUSION

The intent of this paper was to convey four key objectives:

1. A properly implemented Commissioning Process should pay for itself during the design phase.
2. The cost of implementing the Commissioning Process is dependent upon the size, complexity, and location of the project.

3. A formalized procedure should be put in place to document the benefits of the Commissioning Process.
4. The Commissioning Process is the owner's procurement process and must be adopted and completed by the owner, not the architect, engineer, or contractor.

Think about the third one. If the Commissioning Process is properly implemented what do the other team member see? They see that there were few problems and the building works from day one. If the benefits of the Commissioning Process are not documented, the owner will not shift fees to avoid problems, as they had no problems. There are numerous examples of this happening (would identify them, but want to protect the innocent and guilty).

7. ACKNOWLEDGMENTS

The results in this paper are based on over 20 years experience in developing and implementing the Commissioning Process. It is important to recognize all the owners who have adopted the Commissioning Process and provided us with this material. Further, the Farnsworth Group Team, including Joy Altwies, Ian McIntosh, Zach Obert, Svein Morner, Chad Grindle, Suzanne Bowen, Jerry McClellan, Steve Doty, and Rich Walkenhorst, have provided the manpower to successfully complete the projects and collect the data for this paper.

8. REFERENCES

J.E. Altwies and I.B.D. McIntosh. 2001. Quantifying the Cost Benefits of Commissioning. National Conference on Building Commissioning Proceedings, Cherry Hill, NJ.