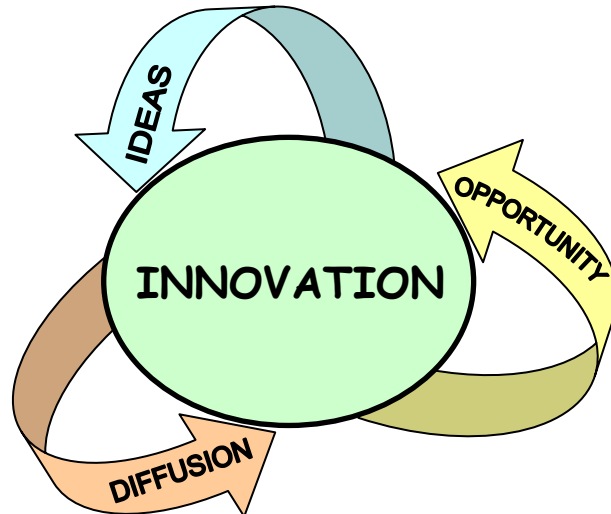


ENERGIZING INNOVATION IN INTEGRATED PROJECT DELIVERY

INNOVATION MANUAL OF PRACTICE



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Input regarding this manual's content and utility is welcomed and encouraged to increase its value and benefit to the construction industry. Comments about the manual and suggestions for improvements should be directed to Dr. John Gambatese at Oregon State University (john.gambatese@oregonstate.edu).

EXECUTIVE SUMMARY

The construction industry has struggled for years with a lack of innovation on projects. To enhance and encourage innovation, *Engineering News-Record* (ENR), for example, has hosted innovation forums to help communicate success stories within the industry. The Construction Innovation Forum has established the NOVA Award that recognizes significant contributions to innovation in construction. ASCE's Charles Pankow Award for Innovation gives nationwide recognition to innovative advances in design, materials, or construction-related research and development transferred into construction practice. Despite such efforts, however, *ENR* suggests that one of the biggest owner frustrations is the lack of progress in technological innovation in the industry. The magazine has written that construction firms seem to cling to old business models and processes, and that subs which do not get up to speed will be left behind at bidding time. The leadership within the industry must increase its pursuit of innovation and innovative techniques.

This manual addresses innovation, and specifically how firms can work to make innovation a significant part of project delivery. Integrated project delivery is at the forefront of helping implement innovation on projects. Firms find it easier to integrate functions, communicate actively with other parties to the project, and cross-pollinate ideas in this delivery method. It also makes it easier to use techniques such as constructability reviews, which in turn generates innovative impacts on cost, productivity, quality, and safety.

Research has found that the design-build project delivery method provides the most opportunity for innovation followed by CM-at-risk, negotiated design-bid-build, and design-bid-build, in that order. Design-build projects are preferable with respect to innovation over traditional project delivery methods because:

- overlap of the design and construction phases allows for greater communication among designers and builders;
- constructability reviews are more common;
- employees with diverse backgrounds are more likely to work together and generate unique ideas;
- the goals of the designers and builders are coordinated; and
- ideas that are generated during design often have a greater rate of implementation when constructors have input during conception.

Maximizing the potential for innovation requires overlapping of the design and construction phases, encouraging active communication among all project team members, and establishing a level of equality between designers and builders.

This manual is intended to serve as a guide for practitioners when contemplating innovation on their projects. Best practices that research has shown to be the most effective are described first, with other methods also detailed so that the reader has a good understanding of all of the components involved in pursuing innovation. The goal is to energize innovation within the construction industry and help owners, designers, and contractors collaborate more effectively to deliver successful projects.

ABOUT THE MANUAL

This manual, which focuses on integrated project delivery, is a product of research funded by the Design-Build Institute of America (DBIA) and the Charles Pankow Foundation (CPF). The manual is authored by Dr. John Gambatese, Associate Professor at Oregon State University, with assistance from Rusty Haggard, Technical Writer/Editor at the Construction Industry Institute (CII), and Matthew Hallowell, PhD Candidate at Oregon State University.

The resources utilized in the research to develop this manual reflect a wide spectrum of the construction industry. The research findings are based on: an extensive literature review; a survey and interviews of 79 members of the Design-Build Institute of America (DBIA) and the Associated General Contractors (AGC); an on-line survey of 34 firms which have developed innovative products for the construction industry; and in-depth case studies of ten diverse projects of various sizes located in nine states across the U.S. Significant efforts were made to accurately capture the perspectives of the entire construction community and the fundamental properties and practices of innovation.

The manual is intended for use by owners, architects, engineers, and constructors and on all types of construction projects. The manual contains several components to assist with implementation. An implementation flowchart is provided that indicates steps to take to enhance and maintain innovation. Best practices that appear to be the most effective in spurring on innovation are provided as well.

The manual utilizes the following definition of innovation:

“Innovation is the actual use of a non-trivial change and improvement in a process, product, or system that is novel to the institution developing the change.”

Under this definition, innovation includes both the generation of a new product, technology, or process, and its implementation. Additionally, innovation may be the application of a product, technology, or process that already exists but is just new to the organization adopting it. Innovation is not just problem-solving on a specific project; innovation includes diffusion of the change to other projects and the industry.

USING THE MANUAL IN PRACTICE

Manual users are encouraged to follow the flowchart. The flowchart places 31 unique practices from the research effort into a process for practitioners' use. The practices are rated on a scale of 1 to 5 based on their influence on innovation. Highly effective practices, signified by a “5”, have the greatest impact on innovation. Practices rated as moderately (2) or minimally (1) effective are beneficial to the innovation process and should be considered for implementation, yet do not have as significant an impact as more highly rated practices. The practices are:

Extremely Effective Practices (5)

1. Innovation vision of the owner
2. Owner investment/commitment
3. Owner's commitment of resources for innovation efforts
4. Integrated functional areas
5. Overlapping phases
6. Risk tolerance and management
7. Lessons learned/knowledge management program

Very Effective Practices (4)

8. Innovative visionaries within the firm
9. Presence of a champion/sponsor for the innovation
10. Innovation as a goal of the project
11. Project delivery method
12. Employee recognition and rewards
13. Upper management support and commitment

Effective Practices (3)

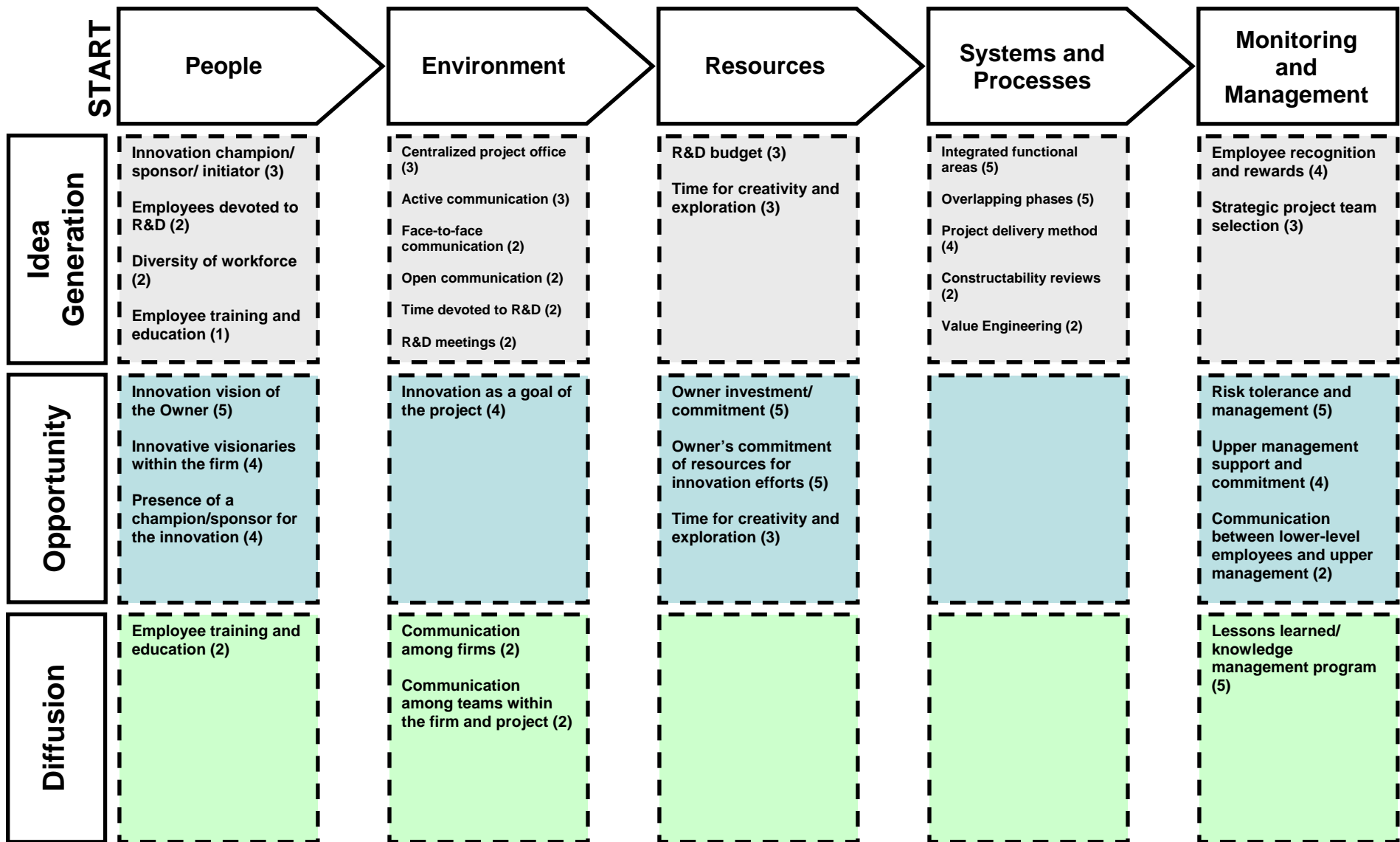
14. Innovation champion/sponsor/initiator within a firm
15. Centralized project office
16. Active communication
17. R&D budget
18. Time for creativity and exploration
19. Strategic project team selection

Moderately Effective Practices (2)

20. Employees devoted to R&D
21. Diversity of workforce
22. Face-to-face communication
23. Open communication
24. Time devoted to R&D
25. R&D meetings
26. Communication among firms
27. Communication among teams within firm and project
28. Communication between field personnel and upper management
29. Constructability reviews
30. Value engineering
31. Employee training and education

The first step in the process towards enhancing innovation, as indicated in the flowchart, entails getting people involved in the innovation process. This step is followed by: establishing an innovation-friendly environment, providing the necessary resources to support the innovation process, and creating systems and processes to provide a structure for enhancing innovation. Lastly, monitoring and management practices are implemented to sustain a climate of innovation and continued and effective efforts to enhance innovation.

The innovation process contains three components with each step: Idea Generation, Opportunity, and Diffusion. Innovation begins with the generation of new ideas to solve problems and improve performance. To realize these ideas, there must be an opportunity or need for the ideas. Diffusion of the innovation to other projects and companies confirms its value and acceptance as an innovation. Each step in the innovation process should focus on each of these components. Effectively implementing the components for each of the five steps will enhance innovation on projects.



Innovation Components and Process Steps Flowchart

LEGEND

Influence of Practice on Innovation:
 (5) Extremely Effective
 (4) Very Effective
 (3) Effective
 (2) Moderately Effective
 (1) Minimally effective

BEST PRACTICES

As shown in the flowchart, some practices have more influence on innovation than others (signified by the rating of a “5”). The following innovation best practices are highlighted since they each received the highest rating.

1. Innovation Vision of the Owner: A Strong Influence

Innovative vision involves the explicit desire for a project that employs new products, processes, technologies, and/or services and the communication of these desires to the project team. This practice is typically more effective when the owner provides resources for innovation. Owners who are visionaries have the following characteristics:

- Dedicated to a particular attribute of a project that requires innovation (e.g., sustainable design and construction).
- Well-educated in the attribute that requires innovation.
- Strong understanding of the paths required to achieve innovation.
- Continuous support for all efforts required to achieve the goals.
- Provides funding to support the resources required to achieve the goals.

2. Owner Investment/Commitment: Others Mirror the Commitment

Owners who invest in the innovativeness of their projects typically have a high impact on the overall success. Since the owner provides funding for the project, the goals of the designers and builders typically mirror the goals of the owner. Owners may demonstrate their commitment by implementing the following practices:

- Stating the importance of innovation early in the project, preferably during the conception and design phases.
- Allowing flexibility, through contract provisions, to facilitate innovation.
- Communicating the importance of innovation to all firms involved in the project.
- Rewarding and publicizing innovation successes during the project.
- Including innovation as an agenda item at project meetings.
- Encouraging the transfer of knowledge from other industries.

3. Owner’s Commitment of Resources: Perhaps the Strongest Influence

Perhaps the strongest influence on innovation is the commitment of resources to innovation. Owners who allocate resources specifically for innovation have a tremendous affect on the rate and impact of innovation on their projects. Resources may include time, money, people, or equipment. Firms may find that committing resources to innovation is easier to justify on larger projects because it represents only a small portion of the total project cost. Owners may find that investing resources in innovation has a stronger impact on hard bid, design-bid-build projects, especially where budgets are tight.

4. Integrated Functional Areas: Collaboration is the Key

Outside of owner influence, the most effective method of enhancing innovation is the integration of functions. Bringing different project functions together to work as peers in a collaborative and coordinated effort can pay big dividends in innovation. The most common output of integrating functional areas is the application of techniques used in one specialty field to another discipline, even a discipline that is seemingly unrelated. Such application of techniques can result in new products, processes and technologies which, when implemented and diffused, may become significant innovations.

Assimilating functional areas under the design-bid-build project delivery method is more difficult to accomplish and requires modifying traditional design and construction contracts to allow for collaborative work efforts. Integrating functional areas to enhance innovation on projects may be achieved through the following practices:

- Creating a project team with members from a variety of specialty fields (e.g., design-build project delivery method).
- Employee sharing among project team members.
- Hiring employees with backgrounds and work experience in multiple fields of study.
- Involving specialty consultants.
- Conducting periodic disciplinary reviews of planning and design documents.

5. Overlapping Phases: Getting Others' Input Early Can Make a Difference

Overlapping the design and construction phases of a project can have a positive impact on innovation along with constructability, cost, productivity, quality, and safety. Unlike traditional design-bid-build project delivery, when the design and construction phases overlap, builders can become involved early in design phase of a project and have increased opportunities to share construction knowledge with the designer. When ideas are generated during design, the overlapping of the phases allows the constructor to provide practical information related to implementation at the time in the project when it can be most beneficially utilized.

6. Risk Tolerance and Management: Assuming Risks Can Be a Bold Move

Firms willing to take calculated risks, especially when implementing new ideas, products, processes, technologies, and services, find that their overall innovation success is far greater than risk-averse counterparts. Firms that take risks know that their rate of success is often far higher because they proactively anticipate and manage the risk. Decision-making at the corporate level allows for integrating a company-wide view and considerations, a practice which is more difficult to carry out and is often lacking at the project-level.

7. Knowledge Management Program: Useful in Various Ways throughout a Firm

The most influential factor for the diffusion of innovation throughout a firm is the creation and continued use of an extensive knowledge management program. Knowledge management involves recording lessons learned, best practices, and other forms of knowledge that may have application on multiple projects. Lessons learned systems also facilitate the transfer of knowledge from one functional area to another, from employees in the field to upper management, from more experienced employees to new hires. These programs are especially effective when organizations have offices in multiple geographic locations.

OTHER HIGH IMPACT PRACTICES

The flowchart also shows some practices that, although not identified as best practices, still have high impact (signified by the rating of a “4”). The high impact practices are described below.

Innovative Visionaries within the Firm

These individuals distinguish themselves by their constant effort to develop, implement, promote, and diffuse new ideas. Furthermore, visionaries are different from champions in that visionaries promote the innovation on a long term and grand scale. Typically, the most effective innovative visionaries are those who are members of upper management with the ability to allocate resources to efforts related to innovation and assess and manage the associated risk at the corporate level.

Presence of a Sponsor for the Innovation

An effective sponsor may support the concept, educate other employees about the concept and its benefits, improve upon the concept, and justify the concept to decision-makers and stakeholders in other divisions of the firm. In this role the champion reduces or eliminates obstacles to further development and implementation of the innovation. This person can be the initiator of the innovation or an employee assigned to shepherd the innovation through to realization.

Innovation as an Owner’s Goal for the Project

An owner with an explicit goal of innovation is more likely to cause innovation to occur throughout the lifecycle of the project. The owner’s goal is commonly assumed by other project team members who strive to incorporate it in their scopes of work.

Project Delivery Method

Design-build and other integrated project delivery methods provide the most opportunity for innovation. Innovation is enhanced through the communication, collaboration, and integration of design and construction disciplines that exists under a design-build framework.

Employee Recognition and Rewards

When employees are recognized for their innovative efforts and know that they will be recognized on a regular basis, they are more likely to make efforts to take risks and act as champions who generate and sponsor ideas for innovations. Recognition acknowledges the positive benefits that an employee has given to the firm. When this achievement is supported by a reward to the employee, an incentive is created for the employees to continue to search for innovative change.

Upper Management Support and Commitment

Upper management of a firm must actively demonstrate their dedication to innovation, uphold the commitment, and ensure that it does not lapse. When innovation is a stated goal of upper managers, innovation success can dramatically increase. In addition to simply stating innovation as a goal, upper management may maximize their influence on innovation by:

- Including the generation, implementation, and diffusion of new ideas in performance evaluations, bonuses, and other forms of employee recognition.
- Including innovation-related activities in the firm's budget.
- Hiring employees on the basis of their innovation potential.
- Taking time to explore new ideas and serve as champions for innovation.

ADDITIONAL PRACTICES

Other effective practices (signified by the rating of a “3” in the flowchart) that can lead to innovation are briefly described below.

People

Innovation Sponsor

The following practices can positively influence the emergence of a sponsor in an organization or on a project:

- Positive reinforcement for championing a successful innovation.
- Verbal encouragement for exploring and supporting the implementation of new ideas.
- Attributing a large portion of success of an innovation to the sponsor.
- Financial support for the innovation-related activities of the sponsor.

Environment

Centralized Project Office

The purpose of such an office is to collect the primary members of the project team (e.g., general contractor, architect/engineer, and construction manager) under one roof with the goal of increased frequency of face-to-face communication. A centralized office improves collaboration among firms leading to new ideas that, once implemented on the project,

become innovations. Additionally, increased communication resulting from the proximity of the project team may improve acceptance of new ideas from all members of the project team.

Active Communication

Active communication first requires leadership. Upper management commitment to innovation must be known by all project participants, and management's communication must be consistent and effective. Communication by upper management must be proactive as well. This will involve upper management actively participating in the generation of innovative ideas, encouraging field and engineering personnel to contribute, and leading by example. Investment in emerging telecommunication technologies, PDAs (personal digital assistants), cell phones, and radio systems, and assuring that the project team is well-acquainted with communication technologies and uses them effectively, help support active communication.

Resources

R&D Budget

The presence of a research and development (R&D) budget ensures that funds will be available to support R&D efforts without compromising other project funding needs. An R&D budget also indicates support for innovation and that innovation is important to a firm and a project. Funding for research and development can be allocated to specific efforts such as:

- Implementing a general and/or focused R&D program within the firm or on a project.
- Tying a portion of employee salaries to R&D efforts.
- Hiring consultants to perform R&D tasks.
- Using profits indirectly generated by innovation to diffuse the innovation throughout the firm and seed additional innovations.

Time for Creativity and Exploration

Workers should be trained and encouraged to explore new means and methods of construction, new design methods, and new product concepts in an effort to improve organizational performance. Allowing time to explore new ideas positively impacts the rate of idea generation without sacrificing project performance.

Monitoring and Management

Strategic Project Team Selection

Owners who have highly innovative projects select their project team on the basis of past performance, ability to work closely with other firms, innovative capacity, commitment to innovation, shared innovation goals with the owner, and overall trust of the firms. Strategic project team selection is typically accompanied by integrated project delivery, a negotiated bid, and a large investment of resources for innovation on the part of the owner.

CONCLUSIONS

Innovation is a requirement under the pressures to deliver successful projects and maintain a profitable firm in the construction industry. Applying the best practices outlined in this manual will initiate and stimulate innovation. Users will find that the practices lead to enhanced innovation through better communication amongst project team members, integration of the design and construction disciplines, more efficient designs, development of unique ways of completing work, and sharing of the lessons learned. The end-result will be projects that successfully meet and exceed cost, quality, schedule, and safety goals.

It should be recognized that innovation can occur at all different levels. Change can be big or small. However, it is much easier to create the change if it is small, and it is more reliable. Many small changes can eventually lead to a big change. The change is significant if it is positive, regardless of its magnitude. Whatever its size, the spectacle of innovations within the construction industry continues to attract attention from all peoples of the world and motivate those involved to continually search for how to do it better.

REFERENCES AND RESOURCES

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Other Resources

An annotated bibliography of innovation publications and documents is available that complements this manual. The bibliography is available from the researchers listed above. The following documents are particularly valuable resources recommended for those interested in learning more about innovation in construction.

Bossink, B.A.G. (2004). "[Managing Drivers of Innovation in Construction Networks.](#)" *Journal of Construction Engineering and Management*, ASCE, 130(3): 337-345.

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