

# “How to Implement Research Wisdom to Change the Construction Industry”

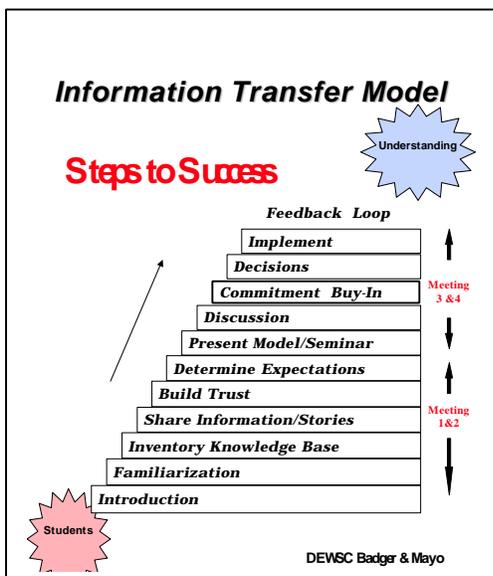
Bill Badger, PE, Director and Professor in the Del E. Webb School of Construction,  
College of Engineering and Applied Sciences, Arizona State University

Whether you are working in the construction industry or teaching at the university level, transferring new knowledge to a diverse group of people is the ultimate challenge. It is imperative that we learn how to implement this new knowledge to the academic student or the industry professional.

An example of a recent educational success is the industry short course where presenters circumvented some of the educational barriers by interviewing participants individually prior to the seminar. The interviews provided the presenters with insights into the audience’s educational level, needs, and capabilities. This level of presenter understanding helped create a gateway to the new knowledge being transferred to the participants. Academic faculty realized that a new delivery approach is needed to increase a participant’s ability to accept and process the new knowledge. The challenge is how to effectively transfer construction process knowledge to a large diverse group when the body of knowledge is continuously changing. Our knowledge is distributed to a diverse group; from the high school graduate to Ph.D.’s and from company presidents down to the construction foreman.

I have a simple educational model that embodies the complex nature of construction education, “**Recruit Students**”, “**Create and Distribute New Knowledge**”, and “**Keep Score**”. The difficulty of implementation of the model is the breadth of students, the faculty and the industry audience we serve.

“**Recruit Students**” is the process of raising scholarship funds, establishing a program’s national reputation, assembling the quality faculty, and creating a retention system that is more competitive than other programs and disciplines seeking the same target group. Marketing becomes critical when we add the continuing education of Alumni, distance education for industry professionals, and life long education to all. Identifying and recruiting a **diverse group of students** is the first step in implementing change.



“**Create and Distribute New Knowledge**” seems easy with well-developed curriculum clearly showing the body of knowledge of the construction process. Finding dedicated faculty full of wisdom, using the latest teaching techniques, and possessing 15 years of construction experience with an excellent disposition is not an easy task. Our problems seem to start when we realize that the program leader is like the manager of a baseball team and the skill positions to play the game are filled by the faculty. We encourage them to practice and to train, but they may be too busy to do so. However we rally the team. **Dedicate faculty help educate and change the industry.**

The final step is the “**keeping score**”. How well do we

share new ideas among faculty? Do the faculty pass it on to the diverse student bodies? When we create new knowledge through research how is it distributed? And finally, how well do we transfer that knowledge to the Construction Industry? Our publications demonstrate our scholarly work, but who is reading them? I am concerned about the different metrics, or lack of metrics, that measure the effectiveness of the transfer of knowledge. **To manage the transfer system we need to measure how well we are doing.**

The 1997 NSF/CII workshops identified barriers that reduce the effectiveness in implementing (transferring) research information to the construction industry.

**Risk** -- First is the risk of the unknowns. If problems occur will there be liabilities? Who will be responsible? The drive to complete engineering and construction within budget, on time, safely, and without hassle meditates against using many new technologies. The notion of “let others work out the difficulties” makes the industry slow to accept change. Risk seems to be the greatest barrier to implementation.

**Lack of incentives to do so** -- When companies are driven by competitive markets to keep cost down and investment low, only a few of the new research products are implemented. The incentives to implement and to make changes are not generally part of the company culture.

**Standards and codes difficulties** -- The systemic view of governmental regulatory organizations is to protect us. The drive to protect us has built-in barriers to **not** accepting change. The proof that something will work usually rests with the designer or builder who is attempting to implement. The buyer of the new construction is the funding agent. The beneficiary of most changes is the user. This divided responsibilities and coordination of cost, benefits, and funding between players makes standardization a significant coordination barrier.

**Information overload** -- The wide range of information concerning the AEC industry that is available make identification, collection, distribution, and assimilation of new information almost an impossible task. The e-mail and web have added to the overload of data received from employees, customers, professional societies, the phone, and printed hard copy. How to locate, screen, and select the appropriate information challenges us. We have so much data that we can not find what we need.

**No champion to promote transfer** -- The recognition that a local champion is needed to implement change may be the first organizational barrier. It appears that few companies have a formal system to introduce innovation into their company.

**Not part of the company culture** -- Many company cultures operate in a competitive market with a lean management style and under a compressed schedule. Changes are not promoted and may be resisted. An implementation program allows the introduction of new information and changes.

**Can't quantify benefits of education** -- The manager who is concerned about return on investment may attempt to have education measured as a dollar investment. Many agree that indeed continuing education is a good investment, but recognize the difficulty in measuring the benefits. Most professionals will intuitively agree that education is worthwhile and the benefits of education will have to be accepted on faith. Some real challenges may be how to quantify the benefit of education or how to build fate in education.

The principles of change were identified as:

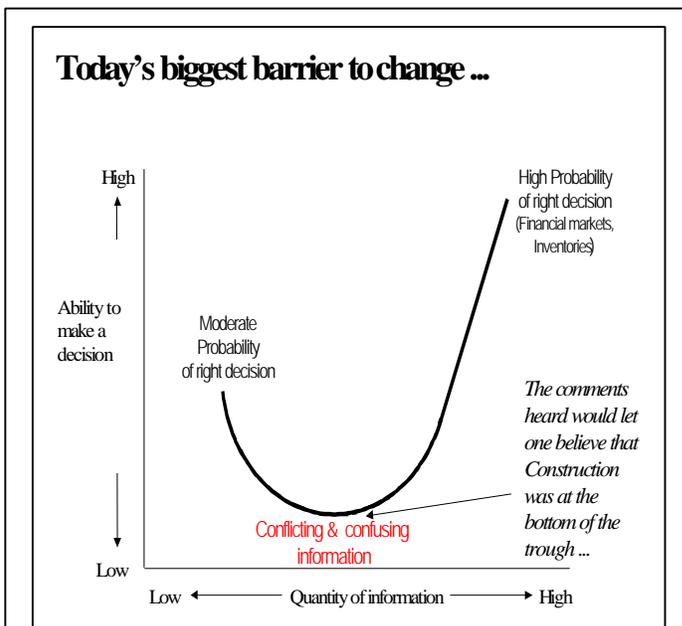
**Must have owner value** -- The owner buys AEC services. Most changes happen when demanded by the owner. They allocate and control funding and must see financial value in change.

**Proof that it works is the first defense against change.** The demand to prove that it works and then to answer the question of “what if it does not” is used often. The reality that research may have happened in a controlled environment and the implementation will happen on the job site lead to questions about applicability to this specific application. If it does not work, the cost is increased and time is lost. We hear comments like “I know that this worked in the past” and “I don’t have time to experiment”. **Maybe the real issue is who pays for the proof-that-it-works effort.**

**Collect and disseminate information (Implementation culture)** The first challenge is where to find the information and how to disseminate it. -- If the source of information does not have credibility then it will not be accepted. If we do not have a champion, then we most likely can not disseminate it. To ensure that the implementation culture is changing, measurement of its effectiveness is required. Lastly, we need to reward implementers.

**Agents-of-change** -- A champion has to be designated for changes to happen in most organizations or Companies. This champion must be the caretaker of the change. Additionally, the CEO must endorse and support the change initiative. Finally, the most significant change-agent may be “**crisis**”. When crisis happens, the drive, the treat, and motive are in place to make change. One way to speed-up change is by creating a crisis - but one that does not involve the suffering, turmoil and liabilities which often accompany a crisis like Hurricane Andrew. The Y2K issue (crisis) has probably been the driver to change more software and hardware than any crisis in history. One could argue that Y2K is not nearly the crisis as pictured, but is an incredible revenue resource that computer folks keep it alive.

**Owner Protocol** -- With construction a series of processes starting with planning, design, procurement, construction, maintenance, operations, and improvement may be needed. The owner who funds and operates the construction facility may not understand the value of changes, especially those with future benefits in the process. The AEC industry professionals need to do a better job of informing the owners on what is needed.



Peter Bopp, of Dupont, raises another issue that was mentioned many times in the context of construction research. The information overload - the lack of time to absorb and interpret conflicting information – the confusion created by disjointed data - simply too much data in forms that are not relevant to our needs.

The ability to make the right decision decreases initially as the quantity of information grows but begin to improve when a critical mass of well-organized information is reached. At

this point information is more than just data. It begins to reliably describe the real world in forms heretofore unavailable. Decisions are now less based on intuition and more on reliable information. Probably the most dramatic example of this can be seen in how industry manages inventories today - in real time instead of continually lagging behind and trying to catch up. Rarely do we hear today about excess inventories or inability to supply. Another example is the financial markets, which increasingly are able to predict the performance of companies and entire industry segments. In both cases the available information has not only become very large but has also been managed and conveyed in forms meaningful to the users.

**Some proposed solutions** -- Many users of research materials are not aware of the volume of information available. Most managers are unable to read research summaries much less the reports or journal articles. I propose a **Book of Wisdom** be developed to package the knowledge into “bite size” pieces. If our body of construction knowledge is like an onion, most of us never get past the first layer. The challenge is how to create an attractive, easy to read first layer. We can not expect more than two minutes of people’s time. Sketches and cartoons are great attention grabbers.

One approach would be to create a special review team or committees that would systematically study CII, CERF, and other research publications and draft a formatted wisdom document. The document could be in electronic form or hard copy. It is envisioned that the identified wisdom would be presented in a one-half page standard format. Then another group would score the draft work and judge it 1) acceptable, 2) requires rework, or 3) reject. Quality control is essential in this effort. Most construction academic programs do not package their products well or market their successes. We will change this lack of marketing.

I believe this challenge requires a new approach of observing the living lab of AEC process. It requires improved communication between the public, government, industry, owners, designers, engineers, constructors, and university partners, to accomplish unification of a fragmented industry directed at building and maintaining infrastructure. This will require us to study the principles of change so we can improve transfer of our research results

To provide the faculty an opportunity to enter the AEC process early the **Academic Partner (AP) Concept** is suggested. This concept is to create a four tiered information collection, analysis, dissemination, and implementation system. The owner would hire the AP and the AP will track and capture wisdom about the AEC process. The collection system will use APs from various universities. The lessons learned distribution system (information transfer) will operate semi-annually, and the implementation of lessons learned will function through a system of industry change agents. Education and outreach components will operate from the university to individual companies. AEC issues will be addressed. It will be the mission of the AP to effect change through involvement with the impediments to rapid implementation of research.

**Recommendations:** Potential NSF research grants:

- 1) To develop books of wisdom about the AEC process to facilitate the distribution of knowledge.
- 2) To identify and market the principles of change. Develop “how” on each principle, design research to be used, develop metrics on implementation, and test the metrology.
- 3) To develop how to create and test the Academic Partner (AP) Concept.