Technology Needs Assessment

CII Research Summary 173-1

Executive Summary

The Technology Needs Assessment Research Team was initiated to take a snapshot of current industry technology needs. As a result, the team has provided a technology development and implementation model to improve the process of future technology development and implementation in the industry.

By surveying a cross-section of site supervision and management personnel, the team identified the current technology needs as those of on-site information flow and site materials management. Respondents felt there was much room for improvement in these areas and that improvements could eliminate waste and add significant value to the overall project delivery.

In addition to assessing technology needs, the team surveyed the industry to better understand the technology development and implementation processes. The team then developed a Technology Implementation Cycle model that describes a standard process for implementing new technologies in the industry. The pamphlet describing the process was developed by the team and is available at no charge from CII. It provides a roadmap for anyone interested in developing or implementing a new technology or tool. It provides insight into the issues an organization might face in implementing a new technology, thereby allowing the organization to develop better plans and budgets for the task and increasing the chances of successful development and deployment.

1. Introduction

There has been, and is today, a continuing concern that the construction industry including every phase of the design build process is slow to adopt new technologies. Whereas for example the computer and consumer electronics industries can innovate, adopt and bring to market new technologies in a matter of months, the construction industry often takes decades.

The lag has been a source of concern in the industry since the 1980s. As a partial solution, CII has regularly commissioned research dedicated to highlighting the current technological needs of the industry. CII believed that the knowledge would give some impetus for technology providers to develop tools and technologies to fill the gaps. In addition, it regularly commissioned teams to study specific new technologies and tools to encourage and help guide the development of new technologies.

The Technology Needs Assessment Research Team was commissioned to take a snapshot of the circumstances of the construction industry today and to highlight areas of the industry that would most benefit from new technology. From the beginning, the team saw the overall mission as too specific. Although the task may have been an honorable one in 1982 and 1992 when The Business Roundtable and the Construction 2000 Task Force did their work, respectively, the pace of technological development has picked up exponentially since that time. The team was concerned that the problem at hand had less to do with understanding what technologies could be brought to bear and more to do with understanding and facilitating the processes of implementing new technologies in the industry.

Given this double focus, the team set out to do two things. First, to honor the intent of the original mission, the team interviewed a wide cross-section of people in the industry to understand the work

processes that would most benefit from adoption of new technologies. Secondly, the team developed and refined a model of how new technological improvements are developed and introduced into the industry. This model will provide a guide to future organizations interested in developing and implementing new technologies and tools in the business.

Although the two objectives were independent of each other, the surveys and research provided a window into the technology implementation process by highlighting the people, processes, barriers, and enablers. Many of the "war stories" heard during collection of the data provided insight into the technology implementation process.

2. The Survey and Analysis

For the survey, the team focused on the construction phase of the work. There was a general consensus that although the business planning, engineering and procurement phases of projects could benefit from the implementation of new technologies, these operations had adopted new technologies more effectively than the construction operations had through the years. As a result, the team set out to interview people more familiar with the construction phase of the work.

The surveys asked respondents about:

- Work process and operational activities
    - Which operational activities could be most improved by technology?
    - Which of the list of operations, when improved, would improve the bottom line most?
- CII Knowledge Areas
    - Which of pre-selected CII Knowledge Areas would benefit from technology?
    - Which Knowledge Area, if improved, would improve the bottom line most?
- Technology adoption and work force issues
- Implementation enablers and barriers
- General perceptions of technology implementation

The following is a summary of the results.

Work Processes and Operations

The respondents evaluated (a) the potential for improvement in certain work processes and operations and (b) the impact that an actual development in these areas would have. The operations were:

1. Personnel management
2. Task and work performance
3. On-site information flow
4. Field materials management
5. Layout and position control
6. Improving existing operations
7. Changing existing operations

The improvement potential score was calculated as the percentage of responses indicating that developments could significantly or very significantly improve performance. The development impact score was obtained as the percentage of responses indicating that actual developments would have a significant or very significant impact on performance. The results are presented in Figures 1 and 2, and are discussed below.

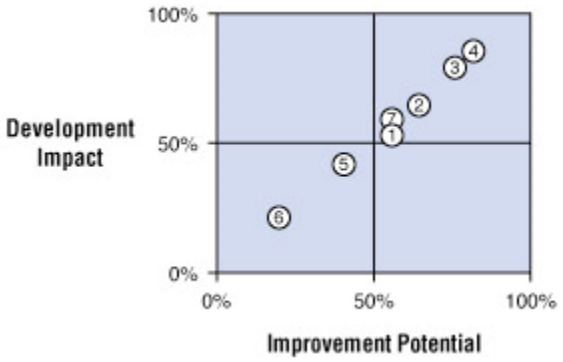

Figure 1. Work Process or Operation (CII Member Organizations)

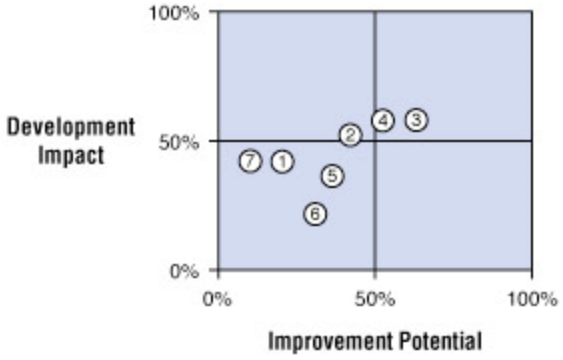

Figure 2. Work Process or Operation (Craft Superintendents)

Points on the left half of Figures 1 and 2 indicate that the respondents felt there was low improvement potential and that technology could not significantly improve the operation. Points on the bottom half indicate low development impact, and that even if the operation were improved by technology, the improvement would not significantly affect the overall bottom line. Points in the top right quadrant of the figures indicate the operation can be significantly improved by technology and will have a significant impact to the bottom line if improved. These operations are the ones that should have the highest priority for improvement through technology.

Work processes and operations related to “On-Site Information Flow” (3) and “Field Materials Management” (4) scored highest, while “Task and Work Performance” was third highest (2).

CII Knowledge Areas

To provide some insight into the perceived technology needs in the CII Knowledge Areas, the team included similar questions about selected areas that were seen as pertaining to the thrust of this research. CII member organizations were asked for the improvement potential and development impact for the following CII Knowledge Areas:

1. Front-End Planning
2. Design
4. Construction
5. Start-Up & Operation
9. Project Controls
11. Safety
12. Information/Technology Systems

Knowledge Areas 3 (Procurement), 6 (People), 7 (Organization), 8 (Processes), and 10 (Contracts) were not included in the list since the team felt that these areas could not be significantly improved through technology.

Figure 3 illustrates the results. Knowledge Areas 2 (Design) and 4 (Construction) were ranked highest, followed by 12 (Information/Technology Systems).

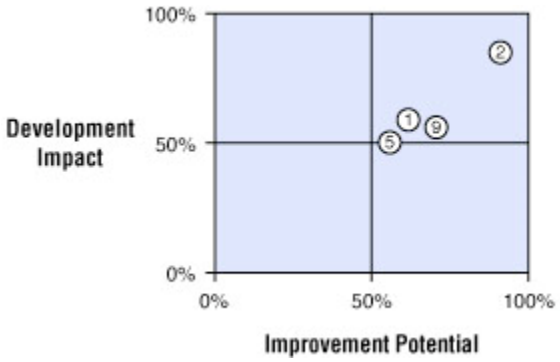

Figure 3. CII Knowledge Areas

Technology Adoption and Work Force Issues

To get a better sense of the issues involved in technology adoption, the team included a series of statements in the survey and asked respondents to give their degree of agreement. Scores were calculated as the percentage of responses indicating agreement or strong agreement.

Figure 4 presents the results. CII member sponsors gave about 75 percent agreement, except for statement 5, which still yielded an agreement of about two-thirds. Craft superintendents agreed at about 60 to 80 percent, in particular for statements 1 and 3.

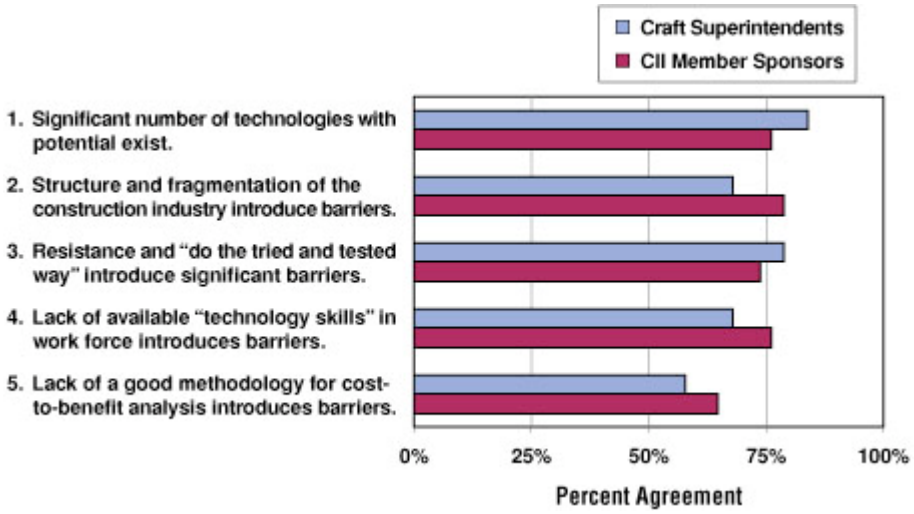

Figure 4. Technology Adoption and Work Force Issues

Implementation Enablers

The team wanted to understand what the perceived enablers were. The survey provided a list of important attributes for new and emerging technologies and respondents were asked to rank their importance. Results of the ranking are presented in Table 1.

Table 1. Rankings of Attributes

Attribute	CII Member Organization Ranking	Craft Superintendent Ranking
A clearly demonstrable and positive benefit to cost ratio	1.	1.
The ability to produce more work with fewer more highly skilled individuals	2.	5.
Robust and reliable to operate	3.	8.
The ability to replace or augment a shortage of skills in the work force	4.	4.
The ability to improve safety in the workplace	5.	2.
Effective training in the application and use of technology under field conditions	6.	3.
Acceptance of process and work product by owner, engineer, or testing agency	7.	7.
Supplier capability, support, and service	8.	6.

A clear benefit-to-cost ratio is by far the most important attribute. Higher productivity with fewer (but skilled) members of the work force ranked second for CII member organizations, whereas the ability to improve safety ranked second for craft supervision. What was surprising were some of the differences in perception. CII member company leaders ranked “robust and reliable to operate” third, but the craft supervision ranked this item least important.

3. Technology Implementation Model

A clear and consistent model of how technology is implemented throughout the construction industry became apparent from the less structured survey responses. There were a number of stories of new technologies or tools given to users with no follow-up or training or changes in expectations or work processes. Often more development work was necessary. Equally likely however, the new tools were put on a shelf and never used. Time after time respondents described how surprised they had been at the difficulty of the development and implementation process. They were constantly confronted with new, unexpected barriers. More often than not, new technologies or tools were not adopted for one reason or another.

The people and processes required for successful implementation of a new tool or technology and the barriers and enablers were similar from survey to survey in all phases of the work. What emerged was a consistent and simple model (see Figure 5) of how the process works (and also how it fails).

Figure 5. Technology Implementation Model

The process often starts in the field or an engineering office with an engineer or craftsperson and an idea for a solution to a perceived problem. This person is usually confronted with the problem or issue on a day-to-day basis, but is so focused on the project or task at hand that they do not have time to take the idea any further.

The Development Champion

At this point the idea must go to someone with a broader perspective and who has the authority to develop the idea further. This person serves as the development champion for the idea. He or she identifies and prioritizes the ideas, identifies potential solution providers, and communicates or sells the idea. They often have to provide resourses to facilitate the process and then structure a deal with a solution provider. The development champion then shepherds the idea along through the process.

The Technology Solution Provider

The technology solution provider may or may not start off with any knowledge about the specific need or work process for which a solution is being provided. If the solution is bulky or complex or requires significant changes to how the user operates, the chances for successful adoption of this solution drop and the timeframe of adoption expands.

The Implementation Champion

Ultimate adoption by the users is the responsibility of the implementation champion. This person or entity reviews all the new technologies and tools in the marketplace and facilitates the implementation of the new tool. If training is necessary, or new work processes are required, or expectations need to be changed, the implementation champion is responsible for doing it or providing the resources to do it. This role of change manager is one that is often overlooked and generally unappreciated. It is a role however, that is absolutely necessary for successful adoption of a new tool or technology. When the implementation champion sucessfully passes the solution off to the users who fully adopt it, the cycle is complete.

The Technology Implementation Cycle Processes

The Technology Implementation Cycle is, however, a long and arduous process with a number of different and diverse participants passing the idea off to the next person in the chain. There are many barriers and a number of enablers that must be managed effectively. With a clear understanding of the process and barriers and enablers, the development champions, solution providers, and implementation champions stand a much better chance of success.

The model developed by the research team works for a wide range of circumstances. It is typical for engineering, procurement and construction technology needs. It applies to the smallest of tools used for individual tasks as well as for industry-wide, standardized systems of communications. It applies to company-wide tools and solutions as well as it does for those of a specific discipline or group. Its power is its simplicity and ease of understanding.

The Technology Implementation Cycle pamphlet (CII Implementation Resource 173-2) published by this team clearly and succinctly describes the entire process. It describes the characteristics, traits, and tasks of each of the participants and highlights the barriers, enablers, and drivers. This document is ideal for any person or group interested in developing or implementing a new technology solution. The pamphlet helps the person or team anticipate the needs and barriers and facilitate the design of a successful development and implementation plan specific to the idea or solution.

4. Conclusions and Recommendations

The Technology Needs Assessment Research Team has studied the construction industry's technology needs and has developed a technology implementation model.

The research demonstrated the need for technology solutions in field material management and on-site information flow. With the increasing complexity of projects and the decreasing time frames in which to complete them, the need for real-time information on materials, design, plans, progress, and documents rises. These are areas that can be serviced by the current information and communications technologies. Whereas 10 years ago technology did not exist to support these needs, now the technologies are universally available. Today, however, the barriers to implementation are a lack of hardware and software tools designed to deal with specific industry and company needs.

The construction industry is fractured, with thousands of participating companies, and organizations all mostly focused on reducing total installed costs. This is not an environment for encouraging innovation and long-term investment. The result has been an industry that is extremely slow to innovate and adopt new technologies.

Industry organizations like CII and FIATECH begin the process of research and development as companies fund these organizations to benefit the industry. An industry model documenting the standard processes, barriers, and enablers for implementing technology takes the industry one step closer to the goal by facilitating the development and adoption processes.

The industry must facilitate and encourage a market-driven environment for solution providers to work with champions and construction technology users. An open and energized marketplace will, in turn, drive technology development and implementation in the construction industry. Then, and only then, will the construction industry begin to catch up in technology development and implementation.

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