* MP stands for the Population of the Management Professionals in the Construction Industry at time (t)
Diffusion Model's Goodness of fit: F (11993.9) and R² (0.998)
“If we all worked on the assumption that what is accepted as true is really true, there would be little hope of advance.” – Orville Wright

For the past 18 years, CII’s Performance Assessment Program has helped CII members understand and improve the performance of their projects through the implementation of best practices. Through this research program, CII has been able to quantify what works and what does not work when managing projects. Yet, the Capital Projects industry continues to “experiment” when it comes to deployment of best practices; patterns of implementation across the industry are “haphazard” at best. Is this the best the industry can do? Is there any hope of advance?

This issue of Performance Assessment examines the cumulative impact that 30 years (i.e., from 1983 to 2013) of CII research findings and tools have had on the Capital Projects industry. Its findings present both challenges and opportunities for the field of project management going forward. Ultimately, this study should encourage a wider discussion about the value of implementing CII research. It should also encourage all industry stakeholders – from owners and contractors to vendors and suppliers to regulatory and funding agencies (to name but a few) – to continue to press forward in an ongoing quest for even more and greater innovations.

**Diffusion of Innovations**

In 1962, Dr. Everett Rogers – a Sociology Professor at Ohio State University – proposed that the adopters of any new innovation or idea could be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%) based on a normal distribution (i.e., Bell curve). These categories, based on standard deviations from the mean of the normal curve, provide a common language for innovation researchers. Each potential adopter’s willingness and ability to adopt an innovation or idea depends on their awareness, interest, evaluation, trial, and adoption. The key is that people can fall into different categories for different innovations based on their function or role and based on how they perceive different types of innovations.

When graphed, the rate of adoption (shown as the gold logistic function line in the figure above) typifies today’s Diffusion of Innovations model – that is, an “S-shaped” curve. This graph essentially shows a cumulative percentage of adopters over time – slow at the start, more rapid as adoption increases, then leveling off until only a small percentage of laggards have not yet adopted the innovation. Historically, when new products are introduced there is an intense amount of research and development which leads to dramatic improvements in quality and reductions in cost. This leads to a period of rapid industry improvement and/or growth. Inventions such as railroads, incandescent light bulbs, the Ford Model T, air travel and computers are typical examples that follow the rate of adoption curve. It is, however, important to note that the speed at which the innovation is diffused and adopted is highly variable over time. Finally, when dramatic improvements and cost reduction opportunities are exhausted and the innovative products or processes are in widespread use with few remaining potential adopters, the marketplace for the innovation becomes saturated.
Experience is what you get when you didn’t get what you wanted.” – Randy Pausch

As CII’s 30th Anniversary approached, staff members of CII’s Performance Assessment Program decided that it would be interesting to graph the rate of adoption for various CII research products and practice areas using innovation diffusion models. This task was in keeping with the original charter of the CII Performance Assessment Committee to evaluate the impact of CII practices and best practices. However, in order to create such models, information regarding the diffusion of the innovation was needed. As a result, it was decided to use data regarding the sale or download of CII products and publications from applicable Research Teams (RT) for each innovation or practice. In the end, 13 statistically significant innovation diffusion models were created for 13 different research areas. The results obtained from these models are contained in this document.

![Safety / ZAT](image)

* MP stands for the Population of the Management Professionals in the Construction Industry at time (t)

Diffusion Model's Goodness of fit: F (2334.6) and R² (0.994)

To provide an orientation, the innovation diffusion model for safety and zero accident techniques (ZAT) can be seen in the figure above. The dotted red line is the expected rate of adoption calculated by the model (i.e., if CII did not do any more research in the area – what would adoption look like through 2030?). The solid red line is the actual observed rate of diffusion of products and publications from nine different research teams focused on improving safety performance. The output of the model can be seen on the right hand side of the figure as the percentage of saturation for these CII products amongst forecast prospective adopters. It should be noted that a different number of potential adopters exist for each innovation or practice.

To provide context, CII Performance Assessment staff obtained the number of Management Professionals (MP) in the construction industry from the U.S. Bureau of Labor Statistics (BLS) employment data (NAICS 236200). This number was subsequently modified to only include MPs employed in nonresidential construction. Further, direct field supervision, administrative support, and trade workers were not included. For the safety/ZAT practice, the model produced an 85.1% saturation level based on a cumulative 15,720 publications diffused through the end of 2013 (note that the last 8 months of 2013 are forecasted). This translates to approximately 7.1% of Management Professionals being exposed to at least one safety/ZAT product from CII. Exposure results from both external push (e.g., CII events and communications) and internal advocacy (e.g., communication within a member company).
“When you don’t know where the bar should be, you’re only going to do a disservice by putting it anywhere.” – Andries van Dam

Mixed innovation diffusion models were used for 12 of the 13 practice areas evaluated. Only the research products in project control (figure can be seen on the cover) incorporated a logistic innovation diffusion model to achieve a best fit and statistically significant results. Use of two different model types presents some interesting conclusions about the nature of adoption in CII for the respective innovations:

- Mixed innovation diffusion models are widely used in marketing for the forecasting of consumer goods adoption rates including market saturation. They incorporate both aspects of exposure (external push and internal advocacy) for the innovation or practice.
- Logistic innovation diffusion models have a sigmoidal shape that fit the data well when slow initial growth is present and when the population of potential adopters is growing. This is the case for project controls which has one of the longest research histories and a growing population of Management Professionals.

![Front End Planning (FEP)](image)

* MP stands for the Population of the Management Professionals in the Construction Industry at time (t)

Diffusion Model's Goodness of fit: F (10981.75) and R^2 (0.999)

Of the practice areas modeled, the largest overall populations of Management Professionals forecast by 2030 are in project controls (95,130) and front end planning (69,224). Unlike project controls (saturation of 18.6%), the saturation rate for front end planning (FEP) has grown significantly since 1993 and currently stands at 50.2%. In addition, FEP has reached approximately 15.2% of Management Professionals (forecast to 19.6% by 2030 if no further research was completed). Currently, only front end planning is close to reaching the early majority (at 16% MP). All other CII practice areas have only reached the innovators (first 2.5%) or the early adopters (2.5% to 16%). A complete table of MP percentages can be seen on the next page.

In his book Crossing the Chasm, author Geoffrey Moore uses the diffusions of innovations theory developed by Dr. Rogers but argues that there is a chasm between the early adopters of a product (i.e., the enthusiasts and visionaries) and the early majority (i.e., the pragmatists).
Moore believes that visionaries and pragmatists have very different expectation and he suggests techniques that can be used to successfully cross the “chasm” between them. Some of the techniques include targeting a particular industry sector, creating a ‘whole product’ concept, positioning the innovation, and choosing the most appropriate distribution channel and pricing. In the case of front end planning, some of these techniques (industry sector and distribution channel) have been explored – but more remains to be done for FEP to become a commonly-accepted way of managing a project. For example, incorporation of capital budgeting and finance strategy may help build front end planning into a ‘whole product’ in order to reach the pragmatists (e.g., business personnel) in the early majority.

Without a doubt, CII is making the capital projects industry better by providing the research products and innovations which must be diffused and adopted throughout the industry. But the truth is that the CII companies (i.e., nearly 140 as of summer 2013) still do not comprise enough of the industry to change it purely on their own. Instead, CII products have to be broadly communicated and widely available in order for the entire industry (i.e., the non-CII member population) to adopt them. This process is beginning to happen through the new CII Strategic Plan and the recently-formed CII Strategic Communications Committee.

“You don’t concentrate on risks. You concentrate on results. No risk is too great to prevent the necessary job from getting done.” – Chuck Yeager

The saturation levels and percent of management professionals reached can be seen in the table above for each of the 13 CII practice areas modeled in this research effort – in 2013 as well as forecast by 2030. Notably, these innovation or practice areas can be assembled into two distinct groups:

1) High saturation (above 50%) – benchmarking (94.6%), lean construction (90.5%), safety/ZAT (85.1%), leading indicators/PHI (82.6%), modularization (78.6%), field rework (77.6%), change management (72.1%), quality management (62.2%) and front end planning (50.2%).

2) Low saturation (below 50%) – constructability (41.9%), planning for startup (39.4%), implementation (32.1%), and project controls (18.6%).

<table>
<thead>
<tr>
<th>CII Innovation / Research / Practice Area</th>
<th>2013 Saturation level</th>
<th># of People</th>
<th>Equals to % MP*</th>
<th>2030 Saturation level</th>
<th># of People</th>
<th>Equals to % MP*</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front End Planning (FEP)</td>
<td>50.2%</td>
<td>35,255</td>
<td>15.2% of MP*</td>
<td>98.6%</td>
<td>69,224</td>
<td>19.6% of MP*</td>
<td></td>
</tr>
<tr>
<td>Benchmarking</td>
<td>94.6%</td>
<td>17,191</td>
<td>7.4% of MP*</td>
<td>100.0%</td>
<td>18,165</td>
<td>7.8% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Lean Construction</td>
<td>90.5%</td>
<td>5,037</td>
<td>2.2% of MP*</td>
<td>100.0%</td>
<td>5,563</td>
<td>2.5% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Leading Indicators (PHI)</td>
<td>82.6%</td>
<td>3,871</td>
<td>1.6% of MP*</td>
<td>99.9%</td>
<td>4,684</td>
<td>1.9% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Constructability</td>
<td>41.9%</td>
<td>9,683</td>
<td>4.2% of MP*</td>
<td>97.1%</td>
<td>22,435</td>
<td>6.4% of MP*</td>
<td></td>
</tr>
<tr>
<td>Modularization</td>
<td>78.6%</td>
<td>5,720</td>
<td>2.4% of MP*</td>
<td>99.9%</td>
<td>7,267</td>
<td>3.0% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Implementation</td>
<td>32.1%</td>
<td>7,236</td>
<td>3.1% of MP*</td>
<td>98.3%</td>
<td>22,116</td>
<td>6.3% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Change Management</td>
<td>72.1%</td>
<td>8,387</td>
<td>3.6% of MP*</td>
<td>99.2%</td>
<td>11,536</td>
<td>4.9% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Field Rework</td>
<td>77.6%</td>
<td>3,670</td>
<td>1.6% of MP*</td>
<td>99.8%</td>
<td>4,723</td>
<td>2.1% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Planning for Startup</td>
<td>39.4%</td>
<td>4,544</td>
<td>2.0% of MP*</td>
<td>90.5%</td>
<td>10,426</td>
<td>3.0% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Quality Management</td>
<td>62.2%</td>
<td>7,859</td>
<td>3.4% of MP*</td>
<td>98.6%</td>
<td>12,454</td>
<td>3.5% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Safety (ZAT)</td>
<td>85.1%</td>
<td>15,720</td>
<td>7.1% of MP*</td>
<td>99.9%</td>
<td>19,223</td>
<td>8.7% of MP*</td>
<td>**</td>
</tr>
<tr>
<td>Project Controls</td>
<td>18.6%</td>
<td>23,635</td>
<td>10.2% of MP*</td>
<td>75.0%</td>
<td>95,130</td>
<td>27.0% of MP*</td>
<td></td>
</tr>
</tbody>
</table>

* MP stands for the Population of the Management Professionals in the Construction Industry at time (t)
** % Management Professionals in 2030 is interpolated
Regardless of saturation percentage, all CII practice areas have yet to be adopted by the early majority, though front end planning is close at 15.2% of management professionals in the construction industry. Interestingly, five practice areas (i.e., modularization, lean construction, planning for startup, leading indicators, and field rework) have not yet reached the early adoption stage. While this could be viewed negatively, that might be a mistake. Instead, it is important to realize that the research and development of at least 13 practice areas are complete. Consequently, the benefits for the capital projects industry and all its participants are still largely unrealized. Innovations such as those created within CII must be widely adopted in order to sustain themselves and become a standard industry practice. The road forged by innovators and early adopters is often rocky.

“The larger the circle of light becomes, the greater the perimeter of darkness around it.” – Albert Einstein

Rogers’s diffusion of innovations theory purports that there are four main elements that influence the spread of a new idea: the innovation, communication channels, time, and a social system. This process relies on human capital – that is – the stock of competencies, knowledge, creativity, and social and personality attributes embodied in the ability of a management professional to produce economic value. One aspect of this that is deserving of future research is an understanding of the social, cultural, and psychological complexity of project teams and organizations as they endeavor to plan and execute projects. Traditionally, theories of human capital development are tied to education and the productivity growth, innovation, and economic development which often result.

To explore the rate of diffusion amongst management professionals, CII Performance Assessment Staff examined the cumulative number of new attendees at CII’s Annual Conference since it began in 1985. This can be seen in the internally-influenced innovation diffusion model in the figure above. Through the 2012 Annual Conference in Baltimore, 6,142 distinct management professionals have attended at least one CII Annual Conference and have been exposed to research and innovations developed at CII. Although impressive, these individuals comprise just 0.7% of all management professionals in the construction industry. Events conducted by CII each year (e.g., Performance Improvement Workshops, CII Board of Advisors meetings, Communities of Practice, etc.) all work to increase the diffusion of research throughout the capital projects industry until critical mass (37%) is reached.

* MP stands for the Population of the Management Professionals in the Construction Industry at time (t)

Diffusion Model’s Goodness of fit: $F (55585.73)$ and $R^2 (0.999)$
Prologue

What is the legacy of CII at its 30th anniversary? Like a prologue to a new story, the past 30 years have strongly set the stage for an even more remarkable future for the capital projects business. In 30 short years, CII participants have developed many innovations and practices that are poised to improve the entire industry. Practices such as safety/ZAT and front end planning have already made a dramatic and lasting impact upon one of the oldest industries in existence, though they have yet to reach critical mass!

The future ahead of CII is bright. There is an ongoing, tremendous impact from additive research to existing practice areas. The figure below illustrates the anticipated impact that probabilistic controls (RT280) and workface planning (RT272) may have on project controls by 2030. The work of these two research teams alone have raised the diffusion of research by 2,393 products – a 1% increase in management professionals using innovative project controls in the short-term and a forecast 10% increase over the next 13 years. For practice areas with low saturation rates (i.e., project controls), CII has to keep expanding its research findings.

For CII research products with high saturation rates, the institute must research and develop the next new innovations in order to improve practice areas such as safety, lean, quality, change, benchmarking and leading indicators. To do so will require a different approach than has been taken in the past. How will the capital projects business get to 0 recordable incidents on its worksites? Is active hazard recognition the answer? Does CII need to investigate the potential for droids? How long will that take? Certainly, the answers to these questions are unknown. For that reason, CII must continue to push for ever higher levels of research and innovation.

CII is forging ahead with a new type of innovation in the areas of benchmarking and leading indicators. Since both practice areas have mostly saturated their existing audiences, a new approach was taken to focus on the human and organizational dimensions of project management. Dramatic gains in project performance will likely result from the benchmarking of project team chemistry and organizational physics, amongst others. CII’s Performance Assessment Committee calls this new innovation the 10-10 Program. Its implementation is also new, anonymous, and part of an ongoing industry campaign. Will 10-10 move benchmarking from 7.4% to 16% of management professionals? Maybe. What is known is that CII must keep pressing forward and keep innovating!
CII Performance Assessment Today

The CII Performance Assessment Program is a user-friendly, resource efficient, statistically credible benchmarking system. As a non-profit, university-based research institute, CII is uniquely positioned to provide quantitative project performance information to its member companies. Since 1995, the program has:

- Assessed more than 2,100 projects worth $300 Billion
- Trained over 1,200 people as Benchmarking Associates
- Involved more than 160 companies submitting at least one project
- Produced over 50 Benchmarking reports and publications
- Been advised by 175 current and former committee members

Today, the program employs seven staff members to advance project performance through benchmarking research. CII’s Performance Assessment staff also produces publications loaded with analyses of industry performance and trends. The benefits of analyzing projects with CII are numerous and all CII Member companies can submit projects for free. Real-time project performance information can be obtained using CII’s online Performance Assessment System (PAS) and Data Miner.

New for 2013: CII’s 10-10 Performance Assessment Program and Campaign

For many years, CII’s Performance Assessment Committee has observed a growing disconnect between the valuable and detailed CII Performance Assessment Program metrics and Senior Managements’ needs around higher-level output (e.g., cost-capacity, schedule efficiency, phase burn rate, etc.) and input (e.g., planning, controlling, human resource, etc.) metrics. Consequently, in 2012, the Committee and Staff began development of the 10-10 Program as a companion to CII’s legacy Benchmarking Program and Performance Assessment System.

The 10-10 Program is based on the concept of anonymously surveying members of a project’s management team regarding their project’s performance, team dynamics, and organizational relationships. Since the 10-10 Program surveys by phase using both quantitative and qualitative data, a set of leading indicators are obtained throughout a project’s development, thereby helping warn Senior Management of impending problems. This diagnostic capability also aids the development of corrective action plans which may also include selective implementation of CII research and toolsets. High-level outcome measures such as $/BOE or $/GSF provide certainty that the project is proceeding on target towards its intended business outcomes, regardless of project type.

The 10-10 Program is simple in its approach and execution – but it is likely to be highly effective in its impact. Admittedly, this is a new approach to benchmarking capital projects. Yet, it is an approach that will work by itself or in tandem with CII’s ongoing Performance Assessment Program. Undoubtedly, it is one of the most important CII initiatives. For this reason, the Committee is beginning a year-long campaign to engage each CII member company to submit 10 phase-level questionnaires for analysis by April 2014. The industry is on the verge of many breakthroughs and the 10-10 Program is here to help ensure that these breakthroughs are realized.

For additional information about CII’s Performance Assessment Program, please contact:

Stephen P. Mulva, Ph.D.
Associate Director
e-mail: smulva@mail.utexas.edu
phone: (512) 232-3013

www.construction-institute.org/performance