ACCELERATING THE ADOPTION OF LEAN THINKING IN THE CONSTRUCTION INDUSTRY

Dawn Naney[1], Clay Goser[2] , and Marcelo Azambuja[3]

ABSTRACT

If the construction industry seeks to increase the adoption of process improvement means, methods and technologies, organizations must concentrate on understanding the nature of the change and influence the team participant's ability to identify, accept, and implement innovative ideas and technologies. This paper introduces the Gartner's Hype Cycle model as applied to change adoption of Lean Thinking in construction. Gartner's Hype Cycle is a graphic representation of the maturity, adoption, and social application of specific technologies. By examining Gartner's five phases of adoption, one can identify interesting similarities to the construction industry's acceptance of lean practices, organizational process change, and the ability to inform strategies to increase the speed of adoption. Our findings suggest that organizations can decrease time spent in the "Trough of Disillusionment" and accelerate the successful adoption of new process strategies such as Lean Thinking and Integrated Project Delivery and new technologies such as Building Information Modeling and collaborative tools through focused alignment and engagement. Recommended studies on team alignment and engagement and the impact on project process and outcome success measures will be suggested as venues to further research in this arena.

KEYWORDS

Lean Thinking, Transformation, Tipping Point, Gartner's Hype Cycle

INTRODUCTION

In order to answer the question, "Is Lean near the tipping point in the construction industry?", one must first ask whether there is a compelling need pushing the industry to adopt Lean?

In 2007, construction services accounted for 8% of jobs (nearly 11 million people) in the U.S. and 4.4% of the Gross Domestic Product (GDP), increasing to 10% as furnishings, energy, and the equipment required to make facilities function is added to the equation. Globally, the market continues to expand, highlighting the scarcity of limited resources such as economic capital, physical material, and environmental capacity. Ineffective work practices and waste account for billions in loss every year with a documented four to twelve billion dollars in annual transaction costs due to claims and disputes (National Research Council 2008). It is easy to

[1] CEO, Symphony LLC, Saint Louis, MO, 63129, USA, Phone +1 314/691-7109, dawnnaney@symphonystl.com

[2] President, Symphony LLC, Saint Louis, MO, 63129, USA, Phone +1 314/691-7109, claygoser@sbcglobal.net

[3] Assistant Professor, Dept. of Construction, Southern Illinois University Edwardsville, Edwardsville, IL, 62026, USA, Phone +1 618/650-3845, mazambu@siue.edu

accept that there is a need for drastic improvement within the design and construction industry. Industry participants can no longer afford to sit idle wondering whether Lean is a good idea. They must ask "What happens if Lean is not adopted?".

Several articles published over the last decade have started to explore widespread adoption of Lean construction citing various Lean implementation cases and strategies (e.g., www.iglc.net). The vast majority of these articles focus on understanding the process and challenges associated with the implementation of isolated lean practices and tools (e.g. Last Planner System) using individual firms as the unit of analysis (Hamzeh 2011, AlSehaimi et al. 2009, Alves et al. 2009, Kim et al. 2007, Picchi and Granja 2004). Other researchers have identified that comprehensive Lean strategies and organizational change that is respectful of external factors is key to adoption. (Moorey et al. 2011, Chesworth et al. 2010). Arbulu and Zabelle (2006) assert that cultural change must be focused on adopting new business models to support Lean enterprises. Alves et al. (2010) studied how lean production transitioned to construction and what researchers and practitioners might do to sustain learning and promote change throughout the industry.

However, literature on industry-wide (not organization centric) strategies and changes needed to accelerate the adoption of Lean Thinking is still missing. This paper introduces the Gartner's Hype Cycle model, Moore's Disruptive Technology model, and Kotter's organizational change leadership principles as applied to change adoption of Lean Thinking in construction. By examining Gartner's five phases of adoption in the context of widespread market transformations, one can identify similarities to the construction industry's acceptance of lean practices, organizational process change, and the ability to inform strategies to increase the speed of adoption and illustrate areas of focus for future research.

THE CYCLE OF INNOVATION ADOPTION

In order to understand how to lead this transformation, there is a need to understand the lifecycle of change adoption. Consumers of technology have grown accustomed to the idea of "discontinuous" or "disruptive" innovations in a variety of aspects of life. Discontinuous or disruptive innovations can be defined as technologies that require a fundamental change to behavior caused by a new process or technology. An example of disruptive technology includes the introduction of personal computers and smart phones. These technologies became "game changers", completely altering the way business is done (Moore 1991).

Over the course of the last one hundred years, the design and construction industry has adopted, albeit slowly, many of these "game changing" technologies. However, most of our delivery innovations have been continuous or evolutionary, only requiring the upgrading of existing technology, integrating it with existing business practice.

All new "technologies" go through the process of maturation. This lifecycle is well described in the Gartner Inc. Hype Cycle model. The hype cycle curve (Figure 1) compares the vertical axis, expectations around an innovation, to the horizontal axis representing time.

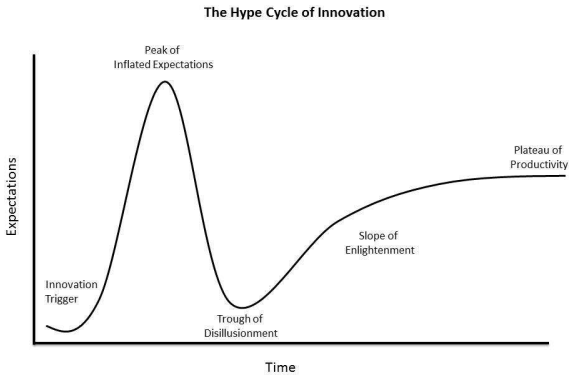

Figure 1: Gartner's Hype Cycle of Innovation (in Fenn and Raskino 2008)

According to Fenn and Raskino (2008), five distinct phases can be identified in the cycle:

1. **The Innovation Trigger-** The cycle begins when an event, product or form of innovation takes place that generates public interest. The innovation may have been in development for some time, but publicity reaches a point where buzz over its potential triggers some form of interest and early adopters seek a profitable use.
2. **The Peak of Inflated Expectations-** During this particular point, companies adopt the innovation in advance of their competitors, claiming benefit and boasting case studies. Competitors not wanting to be left behind adopt the innovation attempting its use in a variety of settings and to various degrees of success. The "bandwagon" phenomenon takes place with increasing adoption and excitement by those not wanting to be left behind.
3. **The Trough of Disillusionment**-As time progresses, excitement fades. Many of the same cases and stories continue, but new adopters begin campaigns for using the innovation without deep exploration provided by the early adopters. Implementation happens with varying degrees of success and counter marketing begins as late adopters realize potential benefit is not as easy as hoped. Many leaders and adopters along with media and reporting agencies switch to discussing challenges or obstacles rather than benefits.
4. **The Slope of Enlightenment**-The slope of enlightenment is the portion of the curve that happens after the excitement, hope and disappointment take effect. During this phase of the adoption lifecycle, early adopters overcome the initial hurdles, discover the benefits through deeper understanding and exploration and recommit effort and resources to proliferate the wide spread usage of the innovation. Over a period of time, the innovation itself matures to a point where best practices codified successfully through social acceptance.
5. **The Plateau of Productivity-** At this point, real measurable benefit is accepted and greater numbers of organizations feel comfortable with adoption having accepted greatly reduced levels of risk. Penetration in industry is accelerated as value is perceived and widespread use is visible.

The key to the successful adoption of an innovative change is to ensure that the amount of time spent between entering the Trough of Disillusionment and the climb up the Slope of Enlightenment remains as short as possible. By reducing this period, industry moves faster in acceptance of perceived benefits and best practices are codified quickly. The Trough of Disillusionment also explains why technologies often fail. They never make it out of this stage and the technology is abandoned or replaced (Fenn and Raskino 2008). This begs the question of "why" does the trough exist?

To illustrate this concept one needs to look at how people participate in the cycle (Figure 2). There are five major kinds of participants in adoption: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards (Moore 1991). The Early Majority and Late Majority account for one third of the participants each, with the rest of the participants accounting for the final third.

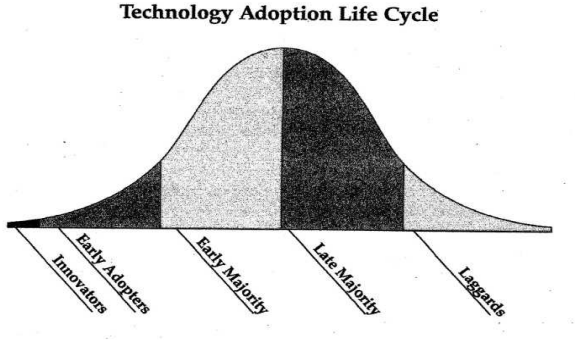

Figure 2 – Technology Adoption Life Cycle (in Moore 1991)

1. **Innovators-** Innovators pursue new technology or improvements because that is where their interests lie, often before the innovations are formally marketed. They are visionaries seeking better ways or improvement.
2. **Early Adopters-** Like Innovators, Early Adopters buy into new technology early in its infancy. They are willing to base decisions, not on well-established references, but on their own vision and intelligent conclusions.
3. **Early Majority-** While Early Majority can relate to the technology, their implementation relies on practicality. They see many passing fads and wait to see how others are using technology. They look for case studies and established successes before agreeing to substantial trials or investment.
4. **Late Majority-** These adopters share all of the concerns as the Early Majority, but one. The Early Majority tend to be acceptable of new processes or technology once they are implemented, but late adopters are not. They wait until technology is fully vetted with well-established protocols and business practices. Technology tends to be in a mature state by this point and well socialized. Late Majority adopters are the pragmatists and heavy conservatives of our industries, employing technology only after it is well proven.
5. **Laggards-**These adopters will not be prone to look at anything new and will tend to adopt new technology only when the old is outdated enough that it inhibits the traditional ways of doing business.

The hidden reality is that there are gaps between each group of participants that often stall, impede or eliminate the adoption of new technology (Figure 3). The first break is between the Innovators and the Early Adopters. During this gap, the value of the idea is not easily identifiable. Until Early Adopters determine how to utilize and often monetize the idea, innovations churn in this stage. A second break on the bell curve, usually of equal magnitude to the chasm above, lies between the Early Majority and Late Majority. This gap demonstrates that by this time in the adoption lifecycle, the technology has entered the mainstream and Early Majority is willing to expend effort to become competent in its use. The Late Majority is still waiting for the proof. At this point, the use of the technology must become increasingly easy to use, or the adoption may stall or never penetrate to the Late Majority, arguably a large portion of the market (Moore 1991).

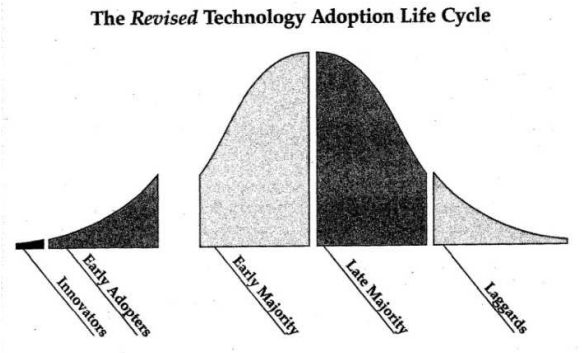

Figure 3 – The Revised Technology Life Cycle (in Moore 1991)

However, these two gaps are not the greatest risk in the adoption curve. A larger and often unrecognized gap between the Early Adopters and the Early Majority also exists. Early adopters often are buying what is perceived as a change catalyst. They are buying the promise of early differentiation from their competition through lower cost, faster speed, better service, or some other business advantage. They are the risk takers, willing to conduct test runs, research, and learn along the way. They are willing to pay the price of implementation to get some kind of discontinuous or disruptive change that makes them markedly different. In short, they are looking for revolutionary change versus evolutionary change (Moore 1991).

In contrast, the Early Majority view technology as a productivity improvement for existing operations. They strive to minimize discontinuity, instead using technology to enhance current operating paradigms that have developed over time. They want new technology to integrate with current systems and procedural business models. They are looking for evolution, not revolution. The Early Majority likely will not adopt without "proof", an explicit and compelling case, and/or a roadmap of how to integrate new innovations seamlessly into the organization's business practices. This becomes the impasse that many technologies fail to overcome.

The trough of disillusionment exists because of the chasm between the Early Adopters and the Early Majority. As the Early Adopters pioneer up and through the slope of enlightenment they blaze a trail that allows the Early Majority to follow.

LEAN CONSTRUCTION'S PLACE ON THE CYCLE

Many conclusions can be drawn from Lean Construction's adoption lifecycle. The first is that Lean Construction is a discontinuous innovation that requires a fundamental change to the way one conducts business. While Lean philosophy is not new to business and reduction of waste (non-value added activity) is firmly rooted in sixty years of development as illustrated in the Toyota Production System, it is relatively new to design and construction. The implementation of practices such as the Last Planner System, Set Based Design, Integrated Project Delivery, and Building Information Modeling, require a change in business practice.

Second, Early Adopters are currently pioneering their way through the slope of enlightenment blazing a trail for the Early Majority. On the other hand, the Late Majority and laggards, which are the majority of the industry players, are still skeptical and challenge successful implementation results. Twenty years ago, the international design and construction community began a journey to understand Lean philosophy and invent ways to integrate Lean methods in the way we design and construct. Organizations with international reach began to carry the message of a need for new processes. Early Adopters, like Sutter Health in California, began a series of experiments in design and construction team integration targeting waste in process that gained notoriety and captured imaginations of something that could be very different. Case Studies were created, research groups formed and the message started to spread across the industry. After experience the excitement of early successes many have attempted to follow suit, finding application much harder than expected. Obstacles and hurdles have arisen demonstrating that adopting widespread change in how we design and build is easier said than done. We may have been currently experiencing the Gartner's Trough of Disillusionment phase and struggling with crossing the chasm between the Early Adopters and Early Majority.

Finally, we have not created the "perfect storm" to accelerate adoption by selling Lean as a philosophy not a tool. The Early Majority is still looking for the clear definition (for examples, see Alves et al. 2010) and/or the checklist ("do this and you are Lean"). After 20 years of distributing the message, why haven't people flocked to proven methodologies that have transformed manufacturing and other industries?

CREATING THE PERFECT STORM

Lean philosophy creates an opportunity to look at specific tasks within a production system and improve that system. The real power of Lean methods is to remove waste where disparate portions of systems influence other systems. Examining the chasm between Early Adopters and the Early Majority, one begins to theorize why Lean construction may not make it through the Trough of Disillusionment to the Plateau of Productivity. As discussed, the Early Majority does not want to figure out how to use the approach, they want a tested and proven process that integrates seamlessly with current business practices and procedures. The adoption of Lean Construction as a discontinuous practice requires a change to behavior, relationships, and business models. In essence, it requires a new business paradigm that supports Lean Thinking as applied to the entire delivery system and not just discrete processes.

Waste reduction in the construction process alone would be more palatable if construction were independent of the rest of project delivery. Construction is a

system embedded in a larger system of total project delivery. The more linked parts in a system that requiring altering with each change, the more risk that you introduce to other stakeholders. This perceived risk among project participants broadens the chasm before the Early Majority as they find more processes and business practices that require development prior to acceptance.

If industry is to adopt Lean Thinking in construction, it needs to create a desire for stakeholders to participate differently to mitigate this risk. It needs to create a project delivery model that is rooted in the Lean principles and not just in the adoption of Lean tools. This creates a sustainable framework by which all activities of a project are examined through the lens of waste reduction. This approach creates a social structure in which team members are encouraged to participate in a different manner. This results in a streamlined approach where project stakeholders examine the "Leaning" of their process in concert with others throughout the entire value stream. Consequently, accelerated innovation is no longer inhibited by slightly improved production processes constrained by non-lean business practices.

The entire design and construction industry needs to rethink Lean in terms of overhauling entire project delivery models. Once it is accepted that the change is not a singular independent piece of a larger system, but an entire system of systems, teams can realign expectations not just around potential benefits, but the level of comfort (or discomfort) that will be required to transform an industry for the purpose of real strategic advantage.

CREATING THE EPIDEMIC

Lean project delivery is harder to adopt on a widespread industry level because the alteration is not a few simple business processes. Participants are being asked to create discontinuous organizations, different from the organizations of the past. The alteration requires changes in how team members participate, procure insurance, write contracts, and share in risk and rewards. For instance, design firms often resist Lean design concepts of letting others better suited complete design work for fear of reducing their traditional fee structure. While Lean processes provide vast opportunity to provide profit (by minimizing expended resources), it is easy enough to see the potential risks this new paradigm shift introduces.

As illustrated by Malcolm Gladwell in his book, The Tipping Point (Gladwell 2000), any mass adoption that reaches epidemic proportions abides by one of three Laws. The first is the Law of the Few, the second is the Law of Stickiness, and the third is the Law of Context. The Law of the Few asserts that a few influential people can accelerate an epidemic, often unintentionally, just by participating. The Law of Stickiness asserts that adoption can reach epidemic proportions if the message is compelling and memorable. The Law of Context asserts that epidemics are strongly influenced by circumstances, conditions, and the particulars of the environment in which they operate.

How does this apply to Lean Construction? All Laws may not be created equally. The development and proliferation of groups such as the International Group for Lean Construction, pilot projects by Sutter Health and other general contractors/subcontractors around the globe, and the creation of the Lean Construction Institute and professional communities of practice was enough to generate widespread interest in Lean Construction but it has not been enough to

create the epidemic. While Lean has had exceptional success in the manufacturing industry, current efforts in Lean construction research and development have yet to create a message and compelling vision strong enough to propel the epidemic.

As for the environmental catalysts; social, economic and environmental influences have yet to reach a critical mass strong enough to demand change. In essence, the Design and Construction industry is currently a victim of the "bystander effect". Studies in group psychology demonstrate that in emergency situations, people are less likely to act if others within a group are available to act. It is assumed that someone else bears the responsibility for action. However, if alone with no one else to act, people will identify the emergency and take action (Gladwell 2000). When considering a need for industry change a participant might conclude that someone else (Owners) will demand the change and solve the apparent problem. As long as Lean Construction is viewed as "optional", the risk of the "bystander effect", where improvement is someone else's responsibility, exists.

DISCUSSION

If one accepts the sustainable adoption of Lean principles requires a broader application to project delivery due to interdependencies, one might conclude this adoption across project teams will require new processes and organizations that are very different from the past and potentially disruptive to current practices. Industry leaders need to assess where they are in the adoption lifecycle and uncover the risks that threaten widespread adoption. If we accept that Lean construction adoption is in the Trough of Disillusionment struggling to climb the Slope of Enlightenment, a message that spans the gap between the Early Adopters and Early Majority may be needed. Research around the soft skills of managing and facilitating change, the psychology of communication, and the behavioral risk associated with re-organizing teams to facilitate new delivery models should be considered. By understanding the risk associated in these areas and removing those obstacles, concentration on accelerating acceptance to the tipping point that allows Lean to proliferate at epidemic proportions and speed may be multiplied.

Academics and industry leaders need to research and develop a clear and sustainable strategy that supports a holistic change in the way we organize business for project delivery. Best practices in change leadership, which have been applied in other areas of business, are required to facilitate this transformation. Acceptance requires influential leaders in industry as champions, alignment of the future state vision, and creation a sense of shared urgency. The industry needs coalitions, alignment of business systems and structures, and incremental transformation roadmaps to lead to reasonable changes in business paradigms (Kotter 1996).

These short-term processes should be supported by a system of standardized outcome and process metrics to validate solutions and drive additional opportunities for improvement. These metrics will continue to help alleviate the stress of Early Majority adoption that attempt to incrementally transition without an accepted view of the end-state. A sustainable business model that values human capital and intellectual acumen over the ability to deliver transactions should be created. Research conducted by social scientists in competition theory that demonstrates the ability to cooperate in industry R&D while maintaining a competitive stance are worthwhile pursuits.

CONCLUSIONS

Lean Construction while an important innovation with great potential and benefit as an idea, alone is not enough to tip the scales towards socialized adoption. We need to understand the barriers to that adoption in order to develop strategies to remove them. Understanding that the Design and Construction industry is huge and accepting that as an industry it is relatively conservative when it comes to change adoption and has grown to the present organizational models over a long period, one draws several parallels from other industries and areas of study.

Observing Gartner's Hype Cycle and the Technology Adoption Curves, there is always a lull during adoption for any new technology or process. Many processes or technologies have failed to ever get out of this trough on the adoption curve and die on the vine.

Studies in organizational change have shown that the more interdependent relationships existing in systems dictate the level of difficulty of implementing change (e.g., Kotter 1996). Design and Construction delivery not only has a myriad of connected relationships, but the relationships are by various companies, each with their own cultures, goals, and competing objectives. The barriers to adoption may not reside with the Lean principles in construction, but with the adoption of Lean principles across project delivery organizations that are made up of teams, historically incentivized to behave in non-lean practices. Unlearning and preventing legacy behaviors may be hard enough that individuals may resist practices that are unproven with high risk and low data to support the change.

Finally, there are demonstrated key ingredients for quick and widespread adoption. Key influencers must champion new ideas and have a message that is simple and compelling. In addition, there must be a contextual environment that promotes the change. When an environment deems a change as "optional" with no consequences, group dynamic will allow others to bear the responsibility for the change to the point where nobody will be responsible for the change.

Key objectives when promoting Lean construction for widespread adoption should be re-organizing teams to promote Lean project delivery, understanding how to acceptably bridge the gap between early adoption and early majority where processes are not completely defined, and studying social behavior and change management strategies for creating sustainable environments supportive of continuing change after its adoption.

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