The race to the bottom has been fierce and bloody. The current perception of the marketplace revolves around being the low-priced provider with little room for value propositions. Contractors routinely lament about customers only caring about the bid and the continual downward pressure on price has further fueled this belief. There are plenty of contractors that are manipulating the market and “buying work.” As long as there is one bidder willing to work for cost, or even less in some cases, the paradigm of low cost providers will win. A less popular phenomenon, but one that bears contemplation, is that some of these “buying” contractors are in fact more efficient and productive than are their peers. “There is NO WAY the competition can do it for that,” is a fairly bold proclamation heard throughout contractor bid war rooms daily. What if even 50% of the competition is able to not only to do it for that price but also make money in the process?

Many contractors fail to envision how the competition could possibly vary its construction enough to have such a dramatic effect on price. Considering contractors have such variation in the ways they individually track direct and indirect costs, it should be easy to see how so much variability could exist. It is also common for an estimator to envision a project from one perspective and have a field manager interpret it completely differently. Estimated and actual costs are rarely equal in the same company, so costs across firms are less likely to be equivalent. Simply put, construction firms that fail to recognize the differences in construction, however small or large they may be, live in a myopic and limiting vacuum.

Think of two separate crews installing a phase of work, perhaps a series of sewer lines and drainage structures. While there may be a finite number of techniques, it is unlikely that both crews will install the lines in the exact same way. Productivity-minded contractors currently employ the technique of “game film” which records these various techniques and approaches. Cameras set on top of excavators record everything from how the trench was dug to how the pipe was installed. Rather than the operations manager or “head coach” providing a critique, the crew reviews all of the videos side by side, like a quarterback reviewing game film, to discover deviations and enhancements. Inventory management, sequencing, equipment management and personnel management all affect the overall productivity. Most importantly, by enabling the crews through self-discovery rather than a dictatorial, big-brother approach, the likelihood of changing behavior is greater.

Efficiency is quickly becoming the mantra across construction organizations. Whether one examines its foundation in Total Quality Management (TQM) or its younger relative Lean Six Sigma, firms recognize the reduction of waste as an essential strategic imperative. Maintaining
While implementation of any system requires investment and commitment, one can also anticipate an appropriate return on said investment. Put another way, contractors need to innovate and avoid the pitfalls associated with “small thinking.”

There are many misconceptions about these new tools and processes. The first is the belief that only large, sophisticated contractors can benefit from construction systems such as prefabrication or elaborate modeling systems such as BIM. In all cases, there are levels and gradations from which contractors of all sizes can benefit. While implementation of any system requires investment and commitment, one can also anticipate an appropriate return on said investment. Put another way, contractors need to innovate and avoid the pitfalls associated with “small thinking.”

Another misconception is the belief that adoption of one or all of the aforementioned systems will immediately provide a return. There are no “silver bullets” or panaceas in any industry – the construction industry is no different. For instance, people discover the benefits of Lean construction and become enamored with grandiose expectations of waste reduction. The value is clearly there, but the largest hurdles to overcome lie in changing behaviors and a general reluctance to adopt a new paradigm by a firm’s associates. Incorporation of a Lean culture is not unlike dieting and getting healthy – on the surface, it is the right thing to do but battling the behavioral inertia associated with a
sedentary lifestyle becomes the greatest barrier to change. All productivity drivers carry benefits, but it is important to recognize the pitfalls associated with each one.

**LEAN**

Lean construction’s foundation stems from the automotive manufacturing sector. Known as the “Toyota Production System,” experts carefully analyzed every aspect of the production cycle, from how materials were stocked to how the fabricators interacted with the finished product. Taiichi Ohno, Shingo Shingo, Sakichi Toyoda, William Deming and Henry Ford all have impacted the Lean model during its evolution. By its strictest definition, Lean is the continuous elimination of waste driven by customer satisfaction. Combined with Six Sigma – another methodology for improving effectiveness and efficiency – Lean aims to drive out waste of all forms including, but not limited to, the following:

- **Defects** – construction not completed to the specifications the first time
- **Overproduction** – construction that is faster, sooner or more than required or that leads to waste in another capacity
- **Waiting** – time lost when people, materials or equipment is kept waiting
- **Nonutilized talent** – wasted potential when the people doing the work are not consulted for improvements to the methodology
- **Transportation** – poor handling of materials and equipment around a site
- **Inventory** – excess materials not needed
- **Motion** – movement of personnel and equipment that does not add value
- **Extra processing** – doing more than the specified requirements to transform the raw materials into the finished product

There is a cavalcade of examples for each of these forms of waste within the construction industry. Experts have long viewed the construction industry as simply an extension of the manufacturing process, making Lean methodologies applicable to any trade.

Excitement and intrigue about Lean have contractors at a fever pitch. However, the overall concept of process improvement is far from new. FMI’s 2012 Productivity Survey examined Lean and its implications on the industry. Exhibit 2 illustrates that an overwhelming 42% of the survey respondents felt that Lean is more or less management best practices rehomogenized under a new heading.
As one examines the connectivity between such management philosophies as Lean, Total Quality Management, Six Sigma, etc., it is easy to see many of the same figures leaving their indelible mark. Regardless of the packaging, it is important to recognize that the processes and tools for driving out waste, poor quality and inefficiency are very valid and provide results. Six Sigma’s DMAIC methodology (Define, Measure, Analyze, Improve, Control), which helps consultants and organizations alike develop solutions, is timeless and the foundation for any best practice development. Elimination of “labor waste” greatly affects contractors and their customers.

While perceptions of Lean may vary, translation to bottom-line growth is apparent. Exhibit 3 shows that 77% of the survey respondents saw some level of productivity enhancement as a result of their Lean initiatives.

For contractors that achieve as low a net income as 2% to 3%, a 5% to 10% improvement in labor productivity has the ability to double the bottom line dramatically. While businesses appear far too concerned about top-line growth, productivity improvements impact the more important aspect of the income statement.

As discussed previously, the challenges of Lean lie not with the tools themselves, but in the deeply ingrained behaviors associated with the status quo. For instance, short-interval planning tools, or “last planners” in Lean terminology, are important proactive devices to help field managers allocate resources and set measurable goals. The benefit is clear – better planning eliminates emergencies and reduces costs associated with overtime, quick shipping, rework, etc. However, adoption of a new planning system across a contingent of managers and supervisors is not easy, and without strict accountability metrics from senior management, the planning tools simply become another sheet of paper. Skepticism of new doctrines such as Lean does not originate from disbelief in the tools or process, but rather in the inability of an organization to change simple human behavior. Superintendents and managers need to see how new tools and processes will reduce costs over the long term, while changing their habits in the short term. Just as one needs to change a car’s oil on a long journey, businesses need to incorporate new systems on theirs. It is incumbent on construction firms in this new era to
create sustainable models that allow their personnel to construct projects as efficiently as possible. Whether that is called Lean, Six Sigma or TQM is irrelevant.

**Building Information Modeling and Leveraging Technology**

Dramatic changes in the design of projects have had one of the most influential changes on contractor productivity. Interestingly enough, the groundswell in this design enhancement has been led by trade contractors, not by the designers. Recognizing the need to compensate for poor or inadequately designed structures and systems, contractors assumed the reigns of this three- or four-dimensional design tool to control their risk and delivery higher quality finished projects. According to FMI’s Productivity Survey, 63% of the respondents have engaged in a project on which BIM was used (see Exhibit 4).

From a strategic perspective, firms must make a serious commitment to the long-term use of BIM. Many firms view the costs associated with rework, inefficiency and poor coordination as enough motivation to consider integration of such a system. The contrarian view is the considerable investment and operational costs associated with BIM, which have a tendency to scare many contractors away from adoption. Exhibit 5 shows that 62% of the respondents experienced some increase in their labor productivity relating to the application of BIM.

**Proactive contractors recognize the movement toward this model is inevitable. In fact, the future is less likely to include a world without BIM, but, more likely, BIM 2.0.**
One could argue that while labor savings occurred on these projects, there was the corresponding cost associated with BIM offsetting any savings. Furthermore, the cost only exists because of inefficiencies in the delivery system and compensation for design inadequacies. Regardless of the rationale behind needing BIM, it is important to recognize that the likelihood of designs improving in the short and long term is doubtful. Architects and engineers are under many of the same budgetary constraints as contractors, and within this risk-adverse business, contractors are better-suited to adopt and cope rather than argue and complain. Proactive contractors recognize the movement toward this model is inevitable. In fact, the future is less likely to include a world without BIM, but, more likely, BIM 2.0. The software capabilities are no longer limited to simple three-dimensional designs, but also incorporation of budget and scheduling dimensions to further aid in the ultimate goal – better construction.

Mechanical contractors, electrical contractors and steel fabricators view this as a platform to supplement their prefabrication capabilities. One of the main challenges to BIM is in the overall adoption across a team of contractors, not just by the individual firm. It is much like the early days of the fax machine – a great tool, but the real benefits are realized when everyone has one. According to the summary in Exhibit 6, respondents to the productivity survey declared that “clash detection and interference management” remain the primary tactical reason for BIM.

Exhibit 6: Primary Utilization Tactics of BIM
The cost associated with an unproductive crew waiting on a resolution to a conflict is enormous. There are countless case studies demonstrating the power of clash detection by eliminating requests for information and contentious claims. It is apparent that BIM offers not only direct correlation to labor productivity but also customer management, trade coordination and materials handling. BIM’s larger role in the world of integrated project delivery provides another competitive advantage for organizations seeking to avoid the fray of the hard bid marketplace. However, just like any strategic initiative, it is imperative for contractors to recognize that there is little room for dabblers, and it requires a wholesale investment.

Technological enhancements relating to productivity are not limited to BIM. Truly innovative organizations are utilizing everything from RFID tags for tools and materials management, to handheld devices, such as tablet computers, to drive information to the field. Drawings, specifications, planning documents, time reporting and labor-cost feedback are just a few examples of data being shared in real time with field managers and foremen. No longer is it necessary to wait 30 days to evaluate job performance. Instantaneous flow of information allows everyone to know the score of the game. More importantly, many of these tools are extremely cost-effective and require a significantly smaller investment than one would anticipate. The infrastructure required is minimal and, more importantly, the training required to drive the necessary change is less than the anticipated commitment of learning the intricacies of a laptop. The main theme contractors should recognize is the embracing of new technology and the incorporation of productivity enhancers. With some of these alternatives, there is the question of investment a firm needs to consider. However, there are equally lower-cost options available that may integrate with minimal conflict. Neophyte thinking is dangerous, and too often contracting organizations assume the role of laggard. It is acceptable to be innovative and be in construction simultaneously.

Prefabrication and Modularization

Whether inspired by the engineering spirit of the “Extreme Home Makeover” or simply recognizing the similarities to the manufacturing world, prefabrication and modularization have begun to revolutionize the construction industry. Many contractors are examining their projects from the perspective of what they can prefabricate rather than what they cannot. While some trades lack the ability to prefabricate (i.e., earthwork), more and more are utilizing a controlled environment to mitigate site risks and lower their labor expenditures.

Both concepts; Lean construction and BIM – bear significant weight in the world of prefabrication. BIM creates spools of documents that allow for fabrication that is more accurate, while Lean construction principles correlate even more to this new manufacturing setting. Many experts agree that construction in future generations will more accurately resemble an assembly line, with workers piecing systems together in the same way as a factory worker connects an engine to a chassis. Unions will debate the intricacies and nuances of “ownership,” but smart businesses are recognizing the need to build more efficiently through the dictation of the end users and customers. Labor issues aside, few can argue the benefits of constructing an electrical system in a climate-
controlled facility, as opposed to the extreme elements of a northern winter or southern summer. Additionally, prefabrication provides mitigation against safety hazards that exist in one of the world’s most dangerous workplaces. According to Exhibit 7 from the Productivity Survey, 69% of the respondents have engaged in some sort of prefabrication on their projects.

Prefabrication also allows for improved scrutiny of production rates by limiting external factors that impact construction. With the exception of extremely customized construction and construction within the bounds of unknown site conditions, there are few examples where even small prefabricated or modularized products would not benefit a contractor. Furthermore, the list of prefabricated and modularized systems continues to grow:

- Mechanical, electrical and plumbing systems
- Bathroom pods
- Hospital headwalls
- Pipe racks
- Load-bearing wall systems
- Internal and exterior wall systems
- Sectional bridges

Within the realm of integrated project delivery systems, it is much more common to see true collaboration across firms. For instance, mechanical contractors and electrical contractors work in tandem to construct modular systems because it benefits the entire project, not just one party.
Much like BIM, case studies abound about contractors building complex and sophisticated projects using this delivery system, all while saving time and money. However, unlike BIM, the initial investment in prefabrication is much lower. Careful experimentation is allowing new contractors exposure with less risk and less investment. The greatest hurdle that these businesses will encounter lies in the human element. Spatial constraints aside, individual can-do attitude is a pitfall that must be monitored and adjusted. Should further evidence be required, Exhibit 8 illustrates the savings achieved through prefabrication.

Overall, 98% of the survey participants achieved at least a 1% labor savings. A proponent of prefabrication and modularization would argue that as the process becomes further ingrained, firms would naturally achieve higher savings through consistency, standardization and repetition. Once again, in this controlled environment, measurement is achieved through process transparency, ultimately allowing enhancements to the production techniques.

CONCLUSIONS
Many contractors give the concept of productivity lip service – they know they need to do it but they fall victim to the circumstances surrounding them. Poor designs, onerous contracts, inconsistent site conditions and demanding owners appear to command more attention than focusing on controllable factors associated with their businesses. Market conditions have necessitated the need to make productivity a strategic priority. Simply building a better mousetrap will not suffice. Contractors must take an exhaustive and introspective look at how they build. Change at field level truly begins at the top of the organization. Once the leaders of the organization are committed to making any enhancement for the good, they can begin not only to employ new techniques and tactics, but also to address the human element. Lean, BIM and prefabrication are mere examples of productivity enhancements in 2012 and the coming years. One inalienable truth that exists is the need to commit to efficiency, regardless of the buzzword.

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