Discussion of "Improving Labor Flow Reliability for Better Productivity as Lean Construction Principle" by H. Randolph Thomas, Michael J. Horman, R. Edward Minchin Jr., and Dong Chen

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Thomas et al.'s paper has the stated objective, "…to test whether improving flow reliability improves construction productivity." They understand flow in terms of both the flow of work, that on which resources are to be expended, and of labor. Improving flow reliability is said to be a lean construction principle, and it is concluded to be valid. However, they argue that advocates of lean construction have overemphasized work flow and underemphasized labor flow as a means for improving labor productivity. They present case studies to show that failures to manage flows substantially reduce labor productivity. A 51% loss of efficiency is attributed to flow management failures; 58% of those losses are attributed to failures in labor flow management and 42% to failures in work flow management. We reject the authors' conclusion, as it misunderstands the problem to be solved, rests on a faulty argument that mischaracterizes the approach it criticizes, and proposes a solution that compounds the problem.

Are Work Flow and Labor Flow Correctly Understood as Factors Influencing Productivity?

The first issue is the relationship between work flow and labor flow. Contrary to the authors' presentation of work flow and labor flow as "factors" influencing productivity, managing labor flow starts with making work flow predictable—i.e., making production planning an accurate indicator of the future. If you don't know what work will be available to be done in the future, labor cannot be matched to it. Neither can any other resource.

Has Lean Construction Neglected Labor Flow?

The next issue is the claim that lean construction has neglected labor flow. "It seems that by not including labor as a component of flow, the application of lean principles ignores a potentially large opportunity for cost and schedule improvement" (p. 261). The case studies categorize and quantify causes of below-budget labor productivity as follows (cf. Tables 5, 7, and 9):

- Overstaffing
- Interference with other crews
- Workforce management
- Insufficient work to perform
- Weather
- Equipment
- Design error
- Rework
- Conversion technology
- Materials

The separation of causes into work flow and labor flow is misleading, another consequence of the conceptualization of performance in terms of factors. Putting aside for the moment the question of what "workforce management" means, with the possible exception of weather, all of these contributors to poor productivity could have been anticipated in short-term production planning as advocated by lean construction. Within the Last Planner system, look-ahead planning performs multiple functions, including (1) identifying and removing constraints (faulty design, lack of materials, lack of equipment, and interference with other crews), (2) adjusting labor capacity to anticipated work load (overstaffing, insufficient work to perform), and (3) detailed design of operations through first-run studies (conversion technology, rework). As noted by the authors themselves on p. 252, a further management practice advocated by lean construction is to apply quality criteria to assignments. Those quality criteria include matching workload to actual capacity of those to whom tasks are assigned. So, it can hardly be said that lean construction has neglected labor flow.

Are "Flexible Capacity Strategies" Different from Traditional Thinking and Practice?

The question remains, do the authors' proposed "flexible capacity strategies" make a contribution to theory and practice? Alternatively, are they really the traditional industry focus on labor productivity improvement disguised in the language of production management?

First of all, we advocates of lean construction propose a distinction between prerequisite work and resources. Prerequisite work is the information or materials, in whatever state of completion, to be processed or converted into the output for which they are prerequisite. For example: a soils report is prerequisite to the design of a slab; concrete is prerequisite to pouring a foundation. Resources are the various capacities consumed in processing and include labor, instruments of labor (tools, equipment), and space. It is easily agreed that in conditions of variability in the amount, type, and timing of prerequisite work, it is necessary to maintain

more resource capacity than will likely be used (capacity buffers), and also to be prepared on short notice to reassign resources to different tasks. Given the fact that variability cannot be completely eliminated, buffers of various types will always be necessary and resource flexibility desirable.

However, the first line of defense advocated by lean construction is to reduce variability. The second-best solution is to plan alternative assignments for the crews on-site, for cases where it is not possible to carry out the given assignments as planned. In the Last Planner system, that is termed "workable backlog." A third option is to provide alternative uses of labor time such as for training and providing feedback. Only when all else fails should we try to regulate labor flow according to the unplanned variation of work available.

We have concerns beyond the issues already mentioned. First, we do not think that the elevation of flexible capacity strategy to a primary principle is ethically justifiable. The International Labour Conference declared in 1944 (Declaration of Philadelphia) that labor is not a commodity. The flexibility strategy treats labor exactly as a commodity that is switched among sites according to the vagaries caused by poor management.

Another ethical concern is related to safety. According to data presented in Oglesby et al. (1989), 24% of total accidents to construction workers occurred in the first month of employment (which usually equals to a new site). In the subsequent months of employment, the accident rate was considerably lower. According to a newer study, 12% of serious injuries occurred during a worker's first day at a job site ("Hispanic workers" 2001). A Japanese study found that one of four falling accidents happened on the worker's first day on site (Asahi Shinbun, February 6, 2001). Thus, we know that the first days on a site are the most dangerous for a worker. The flexible capacity strategy would mean that the number of situations where a worker goes to a new site is multiplied, with an increase of the accident rate as a direct result.

Second, flexibility has been the traditional way of dealing with work flow variability in construction and has increased that variability, thus increasing the need for flexibility—what is known in systems dynamics terms as a positive feedback system; in more common parlance, a death spiral. This is exactly what happened in mass manufacturing. Setup times were accepted rather than attacked, leading to ever-larger batch sizes and ever-longer lead times, thus reducing flexibility in the overall production system. Variability was accepted and managed through ever-larger inventory buffers, which again increased lead times and further deteriorated system flexibility.

Lean construction calls for attacking and reducing variability, for attacking and reducing setup times, for attacking and reducing product defects. The alternative is a wasteful project delivery process that costs too much, kills too many, takes too long, and frequently delivers what's not wanted by the customer. Flexibility has been the home base for traditional thinking and practice. Flying the flexibility flag will undoubtedly attract many who are unwilling to do what needs to be done to transform our industry, regardless of the intentions of those who hoist the flag.

References

Ballard, H. G. (2000). "The Last Planner System of production control." PhD dissertation, Dept. of Civil Engineering, Univ. of Birmingham, Table 3.1, p. 3–7.

"Hispanic workers die at higher rate." (2001). *New York Times*, July 16, A 11.

Oglesby, C. A., Parker, H. W., and Howell, G. A. (1989). *Productivity improvement in construction*, McGraw-Hill, New York.

Closure to "Improving Labor Flow Reliability for Better Productivity as Lean Construction Principle" by H. Randolph Thomas, Michael J. Horman, R. Edward Minchin Jr., and Dong Chen

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We thank the discussers for their interest in this paper. However, we find this discussion to be confusing. The discussers "reject [the] conclusion" of the paper despite the paper, in part, finding that improving flow reliability is valid. Flow reliability is one of the key principles of lean production, and a premise of the Last Planner Technique, of which the discussers are big proponents. If they reject the conclusion of this paper, is the Last Planner Technique irrelevant? It is also noteworthy that the discussers advocate flexible strategies in their work elsewhere (e.g., underloading and flexible designs).

The discussers, by reviewing our paper from the perspective of the Last Planner Technique, confirm our assertion in the paper that proponents of lean construction do not place sufficient emphasis on labor flows. While the Last Planner Technique has perhaps been the most successful use of lean production in construction, there is more to lean production. Other lean techniques include inventory management, contracting strategies, supply chain management, and design methods, to name a few. We think a little more perspective should be adopted.

Far from labor being a commodity, we think the key to achieving real gains in industry performance is improving workforce management strategies to address the realities of construction projects. Inspired by Spear and Bowen (1999), this is close to the "DNA of Toyota."

> *So why has it been so difficult to decode the Toyota Production System? The answer, we believe, is that observers confuse the tools and practices they see on their plant visits with the system itself. That makes it impossible for them to resolve an apparent paradox of the system—namely, that activities, connections and production flows in a Toyota factory are rigidly scripted, yet at the same time enormously flexible and adaptable* (Spear and Bowen 1999, p. 97).

Our work in workforce management strategies is a start to managing some of these issues. More research is needed in this part of lean construction to provide data. Only through research will the body of knowledge be advanced.

References

Spear, S., and Bowen, H. K. (1999). "Decoding the DNA of the Toyota production system." *Harvard Business Review*, Sept./Oct., 96–106.