Experts suggest the application of Lean to knowledge workers is a promising area for future growth. At a conceptual level, the core principles of Lean are certainly applicable. Yet, the tools of lean are heavily rooted in manufacturing, and appear inapplicable to knowledge work. We resolve this dilemma by using an affinity diagram is used to isolate the key methods of Lean that are embodied in these tools, and demonstrating their applicability to knowledge work.

KEYWORDS: Lean, Knowledge Work

INTRODUCTION

Recently, a panel of top Lean experts suggested that Lean principles applied to knowledge workers represented a promising area for future growth of the field. (Behling 2014) But, is this really realistic? Knowledge work differs significantly from manufacturing, in that we process information rather than products, and the processes themselves are primarily mental rather than physical.

Viewed from a broad perspective, the core principles of flowing value to the customer and eliminating waste are clearly valid for knowledge workers. Yet, many of the tools of lean, such as andon pulls and jidoka appear too rooted in manufacturing to be applicable to knowledge work. Managing knowledge work according to the core principles of Lean without the benefit of the underlying tools and methods may be good management philosophy, but would not really be an application of Lean management.

The real question is if the methods of lean, separated from the manufacturing-oriented lean techniques, are applicable as a total system to knowledge work. If they are, then those techniques can be modified or recreated to implement these methods in the new context. If they are not actually applicable, then referring to any resulting management system as Lean would not be appropriate.

The challenge is that the core principles are too generic in and of themselves to be considered a lean system, yet the individual tools are too rooted in manufacturing practices to apply directly to knowledge work. We need to identify the set of methods embodied in the manufacturing-based techniques that constitute the essence of Lean management. To extract these lean management methods, we will begin with a relatively exhaustive list of Lean tools, techniques and terminology captured in The Lean Lexicon (2003). Then, through a card sort technique (affinity diagramming), we will identify the key methods that constitute Lean independent from their manufacturing
roots. These key methods can then be more clearly assessed against differences posed by knowledge work, to judge the suitability of applying Lean in this context.

**AFFINITY DIAGRAM OF LEAN TOOLS**

The Lean Lexicon contains 143 separate Lean terms. Many of these terms are alternative names for the same tool, such as ‘error-proofing’, ‘mistake-proofing’ and ‘poka-yoke’. In addition, there are many terms that are commonly used in Lean discussions, but are not Lean tool, such as ‘brownfield’, or ‘chief engineer’. Once these definitional and duplicate terms were removed, we were left with a list of 50 Lean methods. Some of these methods were specific tools, such as ‘A3 Reports’ and others were more focused Lean principles such as ‘every part every interval’.

Affinity diagramming is a technique that identifies natural categories that exist in a large collection of concepts, terms, or other form of qualitative data. The process places each term on a card (or sticky note), and the cards are grouped into natural categories. No pre-conceived categorization is used to sort the cards, but rather they are placed with other cards that appear similar or closely related. Through an iterative process of grouping and combining, natural categories emerge. These categories are then named to reflect their shared content.

Table 1 presents the 13 natural categories that resulted from our affinity diagram. Each category has been given a name, beneath which is listed the individual terms that made up the category. Each term is also labeled with two letters. The first letter indicates if the term is a specific tool (T) or a lean principle (P), and the second letter indicates if the tool or principle appears relevant to knowledge work (Yes, No or Possibly). Although there might be some disagreement about the inclusion or omission of an individual item from a category, the categories themselves are relatively robust to these differences. The categories represent our key methods of Lean.

<table>
<thead>
<tr>
<th>Table 1. Key Methods of Lean</th>
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<tbody>
<tr>
<td><strong>Work Only to Meet Known Customer Demand</strong></td>
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<tr>
<td>- Pull Production (P/P)</td>
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<tr>
<td>- Apparent vs. True Efficiency (P/Y)</td>
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<tr>
<td>- JIT Production (P/P)</td>
</tr>
<tr>
<td>- Build to Order (P/Y)</td>
</tr>
<tr>
<td><strong>Address Problems Immediately</strong></td>
</tr>
<tr>
<td>- Jidoka (P/P)</td>
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<tr>
<td>- Automatic Line Stop (T/N)</td>
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<tr>
<td>- Fixed Position Stop System (T/N)</td>
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<td>- Andon (T/N)</td>
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MANUFACTURING VS. KNOWLEDGE WORK

Before we consider the applicability of our key Lean methods to knowledge work, we must clarify how knowledge work differs from manufacturing work. The defining difference is that knowledge work is primarily the manipulation of information rather than products. This means that the processes are predominantly mental rather than physical. Many specific differences follow naturally from this distinction.

Measurement and control of knowledge processes is more challenging. Adherence to a specific or standardized process is primarily an internal function of the worker’s self-discipline and cannot be easily imposed or verified by an external agent.

Effort and its relationship to output is less clear in knowledge work. Adding manufacturing labor will increase output, yet doubling the workers on a knowledge-based activity may not increase output significantly, or may increase it four-fold. Rather than adjusting capacity to the work it may be necessary to adjust the work to the realized capacity. Complicating this is that manufacturing work comes only from the system, while unrelated knowledge-based demands (both personal and job-related) can easily impinge on the knowledge worker. Mental fatigue may be a tougher issue as well, since different tasks can require dramatically different amounts of effort for the same
time spent. Finally, there is also an impact from sleep, non-work time, and subconscious processing on knowledge output.

The structure of knowledge work is also much less clear. While manufacturing work flow tends to be linear and sequential, dictated by the order of assembly, knowledge work can be non-linear or non-contiguous. When changing over from one task to another in manufacturing, the direction of the change is rarely an issue, yet in knowledge work the direction of the change is often significant. For instance, switching from research to teaching takes far less time than switching from teaching to research. And, in manufacturing, significant inventory can show problem areas, while in knowledge work, similar problem areas are identified by make-work and bureaucracy.

THE PROSPECT FOR LEAN KNOWLEDGE WORK

With the differences between knowledge work and manufacturing work in mind, we can now consider the potential for applying Lean to knowledge work. Few of the actual tools of Lean would be applicable to knowledge work in their current form, and although some could probably be adapted to this context, others could not. However, if we consider the key methods of Lean, the prospects are more promising.

Our first key method is working only to meet known customer demand. This would be actually relatively easy to implement in knowledge work. Much knowledge work cannot be inventoried, nor can the work be performed without relevant information. Both of these tend to naturally limit the amount of work done in anticipation of demand. However, the same desire to avoid leaving expensive resources idle tends to exert itself upon knowledge workers. This desire tends to manifest as additional work that is unrelated to the generation of value. For instance a standing committee may meet even if there is no new business to discuss. Or, status reports and memos may be drafted and circulated even though nobody will actually read them.

The application of continuous flow to knowledge work is a bit more problematical. While some aspects such as maintaining FIFO order of activities may not pose a particular challenge, moving small increments of knowledge-work between workers at regular intervals doesn’t really make sense. In the context of collaborative knowledge work, this method implies that as incremental knowledge is generated by one member of a team, the knowledge is shared quickly with the other team members. An appropriate approach would be to have knowledge workers organized as small collaborative teams in continuous communication with each other. For non-collaborative knowledge work, continuous flow is unlikely to be an issue.

Leveling the workload will require buffering the knowledge worker from the external sources of demand, and releasing work in consistent amounts over time. This would be easier for knowledge work that is relatively routine. For instance, reading patient histories or interpreting radiology images may be sufficiently consistent to allow consistent amounts of work to be assigned over time. Non-routine knowledge work, such as planning a legal defense may be highly variable from one job to the next. In this context, a fair bit of judgment will be required to assign consistent amounts of work over time to each employee or team.

Every task every interval could be applied to knowledge work, however care must be taken to determining appropriate intervals. An appropriate interval must allow
the worker to focus for an extended period on one activity without distraction, yet also allow the full range of activities to be performed. In knowledge work, the greater challenge may be preventing unintended switching to tasks with higher real or perceived priorities before their turn, such as pausing to read arriving email messages. Or, with so much time being spent on ‘critical’ activities that less important activities are not addressed. A clear schedule with firm time periods allocated to specific tasks would ensure that all activities are addressed on a regular basis, and would make it clear when the work assigned for any activity is exceeding its allotted capacity.

Simplifying the information flows will be very similar in knowledge work to simplifying the material flows in manufacturing. Some form of process mapping tool should be equally helpful in this context.

Focus is extremely relevant to knowledge work, but will require a significant change in how we view and manage knowledge workers. Too often we consider knowledge workers as general purpose machines, since they are capable of doing wide range of different knowledge activities. We neglect to consider the often significant switching costs of moving from one activity to another, as well as the role of non-work time and subconscious processes in many forms of knowledge work. A knowledge worker who spends all of their time dealing with a focused activity set, will not have to switch mental gears constantly throughout the day, and will likely continue to mull over the problems consciously or subconsciously outside of work. The benefit of focus can be seen in the creative productivity boost of faculty on sabbatical, when they only need to engage in activities related to their research, without the unrelated work associated with teaching, advising and university committees.

Consistent effort is also applicable to knowledge work. Little attention is given to the amount of effort expected over a period of time in knowledge work. The symptoms of this can be seen in knowledge workers who become burned-out, frantic work to meet impending deadlines, and backlogs of work that never seem to clear. The buffering required to level the workload along with appropriate scheduling can also be used to ensure that the effort required remains consistent over time.

Reliable processes may not be completely applicable to knowledge work, since so much of that work is internal to the worker. It is certainly possible to ensure the reliability of some aspects of knowledge work. Support systems can be made more reliable, routine calculations and dimensions can be verified by computer, and technological aids can improve visualization of problems and solutions. Consistency of reports and time spent on certain activities can also be ensured. The reliability of other aspects of knowledge work will remain a function of the individual performing the work.

The three methods associated with ensuring quality and value appear easily applicable to knowledge work. Addressing problems immediately is good practice for all businesses. Often in knowledge work, this takes the form of a crisis meeting of the relevant work group to decide on a course of action. And, process improvement and value enhancement are sufficiently generic to apply to a wide range of business activities.

The two methods of Lean that appear completely inconsistent with knowledge work are standardizing the work and efficient material handling. By its very nature knowledge work can only be standardized in the most general sense. The knowledge component in knowledge work involves processing the unique, creative, and complex.
Information-based work that can be sufficiently standardized becomes something other than knowledge work, and is often automated. Similarly, material handling, efficient or not, is simply not part of knowledge work.

**CONCLUSION**

After isolating the key methods of a Lean system we can conclude that Lean would be applicable to knowledge work. However, while the methods are applicable, implementing these methods will require a new, or at least heavily modified, set of Lean tools, and a significant shift in how we view and manage knowledge workers. Continuous flow and reliable processes may pose particular challenges in implementing Lean in this context, required a more substantial rethinking of what these methods imply for knowledge work. The methods of standardizing work and efficient material handling are incompatible with knowledge work, and unnecessary in this context.

**REFERENCES**


*Lean Lexicon*, (2003) Lean Enterprise Institute, Brookline, MA