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Four decades of lean: a systematic literature review

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Abstract

Purpose – The purpose of this paper is to present a systematic review of four decades of scholarly lean literature and identify phases of lean while highlighting core knowledge and voids from within the scholarly lean literature.

Design/methodology/approach – The methodology applied to better understand lean over the past four decades was a systematic review of literature, as described by Machi and McEvoy in *The Literature Review: Six Steps to Success*.

Findings – This literature review has synthesized and categorized four decades of scholarly literature, along with influential books from credible researchers and practitioners of lean, in an effort to decipher the lean thinking paradigm from jargon to a commonly-shared language. In total, five themes evolved from the analysis starting with the Discovery phase (1970-1990), Dissemination phase (1991-1996), Implementation phase (1997-2000), Enterprise phase (2001-2005), and the most recent phase of Performance (2006-2009).

Research limitations/implications – The literature review was limited to articles available to the researcher using search terms restricted to: lean manufacturing, lean production, lean thinking, lean and review, lean and Toyota Production System, lean assessment, lean culture, lean transformation. The databases accessed through EBSCO were: Academic Source Premier, Business Source Premier, ERIC, and PsycINFO.

Originality/value – Publications tracing the lineage of lean over the past four decades are sparse, based on lean scholarly literature, exposing a void in the knowledge base. This literature review should assist other scholars and practitioners who are interested in substantiating their lean endeavours.

Keywords Lean production, Research work, Manufacturing systems, Lean manufacturing, Lean thinking, Toyota Production System, Lean assessment, Lean culture, Lean transformation

Paper type Literature review

Introduction

Since the early 1970s scholars have been engaged in research to better understand and predict outcomes of lean transformations while practitioners continue their quest to operationalize and apply lean concepts for process and business improvement. Throughout this 40-year journey of research, theory, and practice various meanings of knowledge and interpretations evolved specific to “lean” and its associated philosophies, principles, and measurement. This article attempts to address the challenge many scholars and practitioners encounter when communicating the ideology of lean by offering a literature review of the four decades of scholarly lean literature. The intended audience for this article is scholars needing to substantiate their own research with a credible literature review and practitioners interested in a historical roadmap of the evolution of lean.

Defining lean

When describing ideas and concepts the development of a shared language should be the first step in dissemination. Unfortunately, when communicating ideologies the tendency



is to use loosely defined jargon often resulting in confusion for those outside the specific context. Developing a shared language can decrease ambiguity and contribute to increased learning by those less familiar with the specific ideology as described in Figure 1 (Lynham and Stone, 2009).

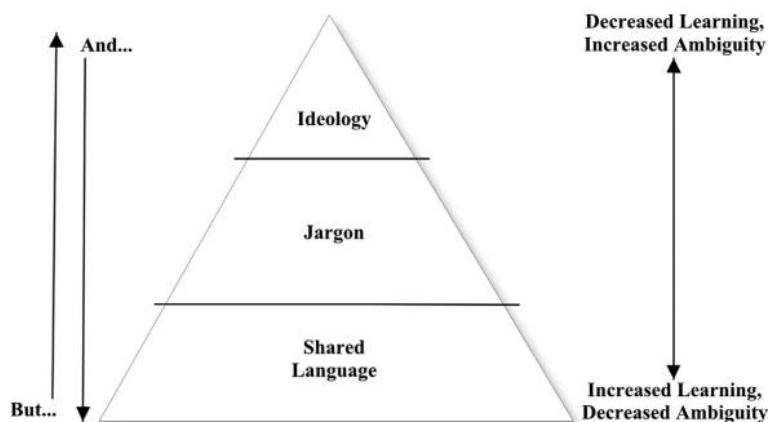
An example of ill-defined jargon is the term lean, which is probably connected for most people to an image of red meat with very little fat or possibly the image of an athlete's trim physique. When the statement "being lean" within an organisational context is made, the initial thought is often associated to "doing more with less" (Hampson, 1999; Ziskovsky and Ziskovsky, 2007; Radnor and Boaden, 2004). Merriam-Webster (Lean, 2009) defined lean as "lacking or deficient in flesh; containing little or no fat; lacking richness, sufficiency, or productiveness; deficient in an essential or important quality or ingredient." With this diversity of definitions and visual imagery of lean, it is not surprising the term has been diluted and difficult to define when used in the context of process improvement methodologies such as lean thinking, lean principles, and leanness of organisations.

To complicate matters more the term "lean production" has become somewhat convoluted since initially described by Womack *et al.* (1990) in *The Machine that Changed the World* which summarized the results of a five year research initiative hosted by Massachusetts Institute of Technology (MIT) called the International Motor Vehicle Program (IMVP) started in 1985. The term "lean production" was defined in 1990 to describe manufacturing techniques developed over the past 100 years by Toyota Motor Company (Baines *et al.*, 2006; Emiliani, 2006; Holweg, 2007). Internal to Toyota, the same principles and philosophies are known as the Toyota production system (TPS) and recently re-articulated in an internal Toyota document called "The Toyota Way" (Liker, 2004; Lander and Liker, 2007).

Confusion surrounding exactly what lean means has resulted in numerous implementation approaches often starting and ending with misguided efforts initiated by "companies that use only the toolbox without embracing the underlying philosophy [and] are unlikely to gain more than limited and temporary results" (Seddon and Caulkin, 2007). Hallam (2003, p. 32) noted: "[...] the same term has been used to refer to

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Source: © Lynham and Stone (2009)

Figure 1.
Developing shared
language and
understanding

four aspects of the manufacturing firm, namely the operating philosophy, the tools, the activities, and the state of the manufacturer”.

Other terms commonly associated with lean are: just-in-time (JIT); continuous improvement (CI); total quality management (TQM); world class manufacturing; theory of constraints (TOC); and Six Sigma, to name a few, each process improvement “trends” heavily influenced by lean (Bendell, 2006; Cua *et al.*, 2001; Dahlgaard and Dahlgaard-Park, 2006). Hallam (2003, p. 32) suggested:

[...] the proper delineation of the terminology should actually contain three terms, one to describe the end state, one to describe the process that achieves the end state, and one to describe the tools used to execute the process.

Throughout this article the term *lean thinking* will refer to “operational philosophy” of the organisation, *lean principles* are associated with the “tools used to execute” lean thinking strategies, and *leanness* to describe the “state” of the organisation’s transformation when employing lean thinking and implementing lean principles (Stone, 2012).

Simply stated, the lean thinking paradigm differentiates between *waste* and *value* within an organisation. Womack and Jones (1996b, p. 15) defined waste “as any human activity which absorbs resources but creates no *value*”. *Value* defined as “a capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer” (p. 311). Lean thinking in action is the continuous identification and elimination of waste from an organisation’s processes, leaving only value added activities in the value stream (Rother and Shook, 1999). In summary, the act of identifying and eliminating waste are the hallmarks of the lean thinking paradigm.

Four decades of lean literature

The methodology applied to better understand lean over the past four decades was a systematic review of literature as described in Machi and Mcevoy (2009, p. 4) and defined as “a written document that presents a logical argued case founded on a comprehensive understanding of the current state of knowledge about a topic of study”. The six steps in the literature review process are:

- (1) select a topic (specifies and frames);
- (2) search the literature (explores and catalogues);
- (3) develop the argument (organises and forms);
- (4) survey the literature (documents and discovers);
- (5) critique the literature (advocates and defines); and
- (6) write the review (addresses the topic).

EndNote bibliography software (www.endnote.com) was utilized to organise and categorise articles throughout the literature review process. Search terms restricted to the “title” and/or “abstract” were: lean manufacturing, lean production, lean thinking, lean and review, lean and TPS, lean assessment, lean culture, lean transformation. The databases accessed through EBSCO were: Academic Source Premier, Business Source Premier, ERIC, and PsycINFO. Table I presents criteria used during step 2 of the six-step process and established to frame and bound the literature selection process.

The initial search of literature resulted in 234 articles meeting the minimum search criteria after adjustment for duplicates. The first round of article scanning resulted in

169 articles more clearly meeting the criteria (as noted in Table I) and relevant to the problem statement. As a result of the scanning process, an additional 83 articles were added to the EndNote library. Many of these articles were located through the use of databases and interlibrary loans not available to the author initially and were heavily referenced as relevant in lean research literature. Additional literature outside of the original date range was included in this review due to their influential role in the early research and definition of lean practices (Krafcik, 1988a; Upadhyhy, 1992; Sugimori *et al.*, 1977). Three additional sources for articles were the Massachusetts of Technology (MIT) “Dspace” library, Lean Advancement Initiative (LAI) hosted through MIT, and the Lean Enterprise Research Centre (LERC) hosted by Cardiff University. Continuing to follow the process promoted in Machi and Mcevoy (2009), the second round of the literature review process consisted of skimming each abstract and article identified during the first round of the scan resulting in 193 articles and books being chosen for the final review of literature.

As shown in Table II, the past four decades of lean research literature has evolved from the initial discovery of “Japanese management” techniques (Drucker, 1971) to the current interest in determining performance outcomes (Bayou and De Korvin, 2008) and their impact on lean transformations. Since introducing the term “lean” (Krafcik, 1988b) and “lean production” (Womack *et al.*, 1990), the majority of research literature stems from operations management and industrial engineering disciplines with few from social sciences or applied psychology (see the Appendix for a complete list of journals).

Discovery phase: 1970-1990

Drucker (1971) noted many “Japanese management” practices such as: decisions by consensus, action orientated problem solving, workforce generalization and flexibility, and a focus on constant change and process improvement. He compared and contrasted differences between Western and Japanese management practices common to the lean thinking paradigm and described later in the Toyota Way (Liker, 2004). Although not explicitly stated, Drucker’s (1971) article is one of the earliest documenting the Japanese influence on what later became known as lean (New, 2007). Another influential article contributing to the discovery of lean in the USA is Sugimori *et al.* (1977), the first English article describing the TPS and its sub-component called Kanban, a system of “just-in-time” production control. John Krafcik, current CEO of Hyundai and member of the MIT’s IMVP, published his Masters thesis (Krafcik, 1988a) and an article

Must have	Metric
Citations	> 3
Peer review	Yes, dissertations and theses allowed
Scope	History/origins/examples/assessment
Methodology	Qualitative: case study Quantitative: empirical
Industry	Manufacturing/production <i>Not</i> . Accounting, product development, services, healthcare
Page length	> 4
Year range	January 1990-December 2009

Table I.
Literature review
article criteria

Table II.
Four decades of
scholarly lean literature

Years	1970-1990	1991-1996	1997-2000	2001-2005	2006-2009
Phase	Discovery	Dissemination	Implementation	Enterprise	Performance
Primary activities	1973 oil crisis spurs interest in Japanese methods. Results of MIT's IMVP published	Lean principles deployed within US as TQM, JIT, etc.	Lean thinking elevated to strategic implementation	Value stream methods expand use beyond manufacturing to service sectors	Measuring leanness, Toyota Way articulates human resource and culture development aspects
Number of scholarly "lean" publications	11	31	28	56	67
Literature examples	Krafcik (1988a, b), Drucker (1971), Sugimori <i>et al.</i> (1977), Womack <i>et al.</i> (1990), Shingo and Dillon (1989), Schonberger (1986)	Warnecke and Huser (1995), Upadhyay (1992), Berkley (1992), Green (1994), Shadur <i>et al.</i> (1995), Womack and Jones (1996b, 1994)	Kippenberger (1997), Spear and Bowen (1999), Yingling <i>et al.</i> (2000), Macduffie and Helper (1997), Cappelli and Rogovsky (1998)	Fairris and Tohyama (2002), Doolen and Hacker (2005), Emiliani and Stec (2005), Sawhney and Chason (2005), Paez <i>et al.</i> (2005), Hines <i>et al.</i> (2004), Gough and Fastenau (2004), Liker (2004), Nightingale and Mize (2002)	Takeuchi <i>et al.</i> (2008), Baines <i>et al.</i> (2006), Conti <i>et al.</i> (2006); Emiliani (2006), Liker and Morgan (2006), Mehri (2006), Graff (2007), Saurin and Ferreira (2009), Wan and Chen (2008), Bayou and De Korvin (2008)

Note: Books included were either seminal works or considered instrumental in scholarly literature

in *Sloan Management Review* (Krafcik, 1988b) being the first to use the term “lean” in scholarly literature.

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A number of books published during this discovery phase typically described the concepts around the TPS. Shingo and Bodek (1988) and Shingo and Dillon (1989) captured the working principles directly from Toyota while Womack *et al.*'s (1990) book titled *The Machine that Changed the World* summarized the results of a five year research initiative hosted by MIT's IMVP started in 1985. The IMVP was the continuation of MIT research focused on differences between automotive manufacturing around the world after the oil crisis in the mid-1970s. Holweg (2007, p. 425) stated the IMVP “research remit was to not only describe the gap between the Western World and Japan, but also to measure the size of the gap”. The term “lean production” first coined by Womack *et al.* (1990) was used to describe manufacturing techniques developed by the founders of Toyota Motor Company originating in the late 1800s (Baines *et al.*, 2006; Emiliani, 2006; Holweg, 2007).

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Dissemination phase: 1991-1996

After the publication of Womack *et al.* (1990), and the addition from other Japanese seminal works describing TPS (Shingo and Dillon, 1989; Ohno, 1988; Monden, 1983), discovery themes continued with a notable increase of articles associated with dissemination of the concepts from the TPS. Scholars began deciphering techniques described in Sugimori *et al.* (1977) and Womack *et al.* (1990) such as Kanban, JIT, and quality circles. The predominate industry adopting lean principles was automotive and its suppliers contributing to literature associated with labour relations specifically targeting threats to rigid unionized organisations by more flexible non-unionized Japanese manufacturers (Taira, 1996; Macduffie, 1994; Schonberger, 1994; Yanarella and Green, 1994; Camuffo and Volpato, 1995; Shadur *et al.*, 1995; Babson, 1993). Interestingly, the few scholarly articles found during this literature review from Dr James Womack, one of the seminal researchers of lean, is a rebuttal to Taira's (1996, p. 97) article describing the transition from mass production to lean production as “controversial and traumatic”. In his response, Womack (1996) restated the objectives of lean production and stressed the importance of continued research to better understand the psychology underlying worker satisfaction and motivation. In addition to Womack's (1996) rebuttal, others contributed to the debate stirred by Taira (1996) as well (Wakabayashi, 1996; Antoni, 1996).

The dissemination of lean concepts and the transition from ideology to jargon was starting to become apparent in the literature language. Some referred to lean as the MIT model (Babson, 1993) while others used world class manufacturing (Oliver *et al.*, 1994) and TQM along with agile manufacturing and JIT synonymously with lean (Rago, 1996; Kidd, 1994; Boyer, 1996). Articles began to state “lean production” as “lean management” (Warnecke and Huser, 1995) and noted benefits of applying lean principles to “lean product development” (Kosonen and Buharist, 1995). Internationally, lean was being noted within scholarly literature and contributed much to the dissemination of concepts outlined in seminal works of the 1980s and early 1990s (Niepce and Molleman, 1996; Karlsson and Ahlstrom, 1996; Katayama and Bennett, 1996; Oliver *et al.*, 1996; Sohal, 1996; Forza, 1996).

The dissemination phase of lean was quickly followed by an intense implementation phase spurred by the early successes of lean transformation within

notable organisations. Another influential book published by Womack and Jones (1996b) highlighted a few of these transformations such as: Lantech, Wiremold, Pratt and Whitney, and Porsche. *Lean Thinking* (Womack and Jones, 1996b) articulated the tenets of lean, provided examples from industry, and suggested lean principles as the framework for organisations interested in transforming from traditional mass production techniques.

Implementation phase: 1997-2000

Womack and Jones (1996a, p. 140) captured the challenges echoed in lean literature from the 1990s stating “managers are struggling to combine lean techniques into a coherent system”. *Lean Thinking* (Womack and Jones, 1996b) was noted in many articles spanning the late 1990s as influential and helping organisations understand the strategic approach of planned change throughout the organisation and enterprise (Yingling *et al.*, 2000; Hines and Taylor, 2000; Kippenberger, 1997; Storch and Lim, 1999; Detty and Yingling, 2000; Lewis, 2000). In addition to implementation of lean, numerous articles continued to explore resistive forces and critiques of implementation, primarily regarding labour relations of organised workforces and worker stress created by the ambiguity of less structured job design typical of lean environments (Cappelli and Rogovsky, 1998; Kochan and Lansbury, 1997; Mersha and Merrick, 1997; Conti and Gill, 1998; Niepce and Molleman, 1998; Stewart, 1998; Landsbergis *et al.*, 1999; Storey and Harrison, 1999; Hummels and De Leede, 2000).

During this phase, empirical studies started to emerge from the literature employing quantitative and qualitative research methods contributing to the much needed knowledge base of lean thinking (Hines, 1998; Bamber and Dale, 2000; Lewis, 2000; Perez and Sanchez, 2000; Brown, 1998). While most of the extant literature from this decade (1990-2000) remained conceptual and descriptive of lean thinking and lean principles, the amount of empirical research specific to lean was still minimal. Niepce and Molleman (1998) and Hummels and De Leede (2000) contributed to theory building by connecting aspects of lean to well-known organisational theory, such as sociotechnical systems.

Enterprise phase: 2001-2005

At the dawn of the twenty-first century, lean literature continued to be of interest within scholarly research primarily from operations management and engineering disciplines with a small contingent emerging from other disciplines such as economics and Human Resource Development (HRD) (see the Appendix for a complete distribution of journal articles). Womack and Jones (1996b) inspired many organisations to expand lean interventions from shop floor activities to the boardroom and beyond, including the enterprise. Rother and Shook (1999) published *Learning to See: Value Stream Mapping to Create Value and Eliminate Muda* providing a roadmap for organisations to connect their enterprise in a manner similar to Rummler and Brache’s (1995) successful relationship mapping methodology. The focus during the late 1990s and early 2000s was shifting from implementing lean exclusively on the manufacturing shop floor (Carnes and Hedin, 2005; May, 2005; Paez *et al.*, 2005) to other areas of the enterprise such as: product development, marketing, sales, service, accounting, and other white collar jobs (Salaheldin, 2003; Holton, 2003; Hyer and Weemerlov, 2002; Holweg and Pil, 2001;

Mann, 2002; Scaffede, 2002; Brandenburg and Ellinger, 2003; Crute *et al.*, 2003; Seitz, 2003; Comm and Mathaisel, 2005).

One of the few examples of a literature review specific to lean can be found in Hines *et al.* (2004) addressing origins and phases of lean in a somewhat systematic manner based on books with few mentions of peer-reviewed journal articles. Critiques and issues of lean continued to emerge as a testament to the veracity of the implementation of lean thinking within industry (Bruno and Jordan, 2002; Parker, 2003; Yong-Sook, 2003; Seppala and Klemola, 2004). An article by Spithoven (2001, p. 725) even suggested lean production in Dutch organisations has contributed to an increase in “mental disorders” caused by worker stress. Articles published on topics closely related to HRD began to surface as well highlighting the importance in organisational change and performance transformations (Lascola *et al.*, 2002; Brandenburg and Ellinger, 2003; Genaidy and Karwowski, 2003; Holton, 2003; Harter *et al.*, 2004; Sawhney and Chason, 2005).

An increase of articles across disciplines and healthy debates are good indicators of the development and advancement of successful ideologies. Through the enterprise phase, the diversity and depth of research demonstrated a growing interest as opposed to a weakening discussion. Nightingale and Mize’s (2002) research centred around determining measures of leanness along with Doolen and Hacker (2005), Hallam (2003), Paxton (2004), Pavnaskar *et al.* (2003) and Seitz (2003). Research focused on the assessment of lean transformations helped to established the agenda for the next phase of research in lean performance outcomes.

Performance phase: 2006-2009

The decision to split the fourth decade into two phases was primarily influenced by an increase in the quantity of published lean articles in 2006, which produced 26 journal articles. Prior years, the most published was 2004 with 15 articles, 2003 with 14 articles and 1996 with 13 articles (Table III).

The increase in literature during 2006 is likely attributed to the rise of Toyota Motor Company as the leading automotive manufacturer in the world displacing General Motors (Towill, 2006; New, 2007; Takeuchi *et al.*, 2008). A number of Toyota executives and consultants intimately familiar with their organisational structure published numerous books allowing unprecedented exposure to the inner-workings and insights

Year	Quantity	Year	Quantity	Year	Quantity
2009	3	1999	7	1989	0
2008	19	1998	7	1988	2
2007	16	1997	6	1987	0
2006	26	1996	13	1986	0
2005	12	1995	6	1985	1
2004	15	1994	6	1984	0
2003	14	1993	2	1983	0
2002	8	1992	2	1982	0
2001	5	1991	0	1981	0
2000	5	1990	0	1980	0
Total	123	Total	49	Total	3

Note: 2009 data includes articles through May

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Table III.
Lean journal articles
published over three
decades

into Toyota's management practices, HRD, and the production system known as TPS (Shimokawa and Fujimoto, 2009; Liker, 2004, 2007; Liker and Hoseus, 2008; Osono, 2008). Journal articles supplemented the books allowing further exploration of research within lean organisations all trying to capture and duplicate the success demonstrated by Toyota (Dahlgaard and Dahlgaard-Park, 2006; Bendell, 2006; Bonavia and Marin, 2006; Jang *et al.*, 2006; Liker and Morgan, 2006; Ndahi, 2006; Roth, 2006; Sakai and Amasaka, 2006; Black, 2007; Lander and Liker, 2007; Stewart and Raman, 2007).

Developing performance outputs of lean transformations dominated the literature attempting to increase the credibility of traditional measures of lean performance typically expressed in forms associated with quality, cost, delivery, and safety (Wan and Chen, 2008; Doolen *et al.*, 2006; Cumbo *et al.*, 2006; Meade *et al.*, 2006; Shah and Ward, 2007; Bayou and De Korvin, 2008; Kennedy and Widener, 2008; Shan, 2008; Taj, 2008). MIT's research continued to establish a foundation in the area of measuring "leanness" of organisations by using their Lean Enterprise Self-Assessment Tool (LESAT) (Lean Advancement Initiative, 2001). Utah State University offers a managed-assessment system called the Shingo Prize for Operational Excellence to measure lean performance (Utah State University, 2009).

Literature reviews of lean have become common to most current articles published with a general consensus regarding the contributions from many within Toyota, Henry Ford, and the influence of W. Edwards Deming in the early stages of TPS development. Baines *et al.* (2006), Emiliani (2006) and Holweg (2007) offer historical perspectives of lean further developing the depth of knowledge supporting the lean paradigm. Shimokawa and Fujimoto (2009) provide transcripts of interviews with key contributors to the development of the TPS continuing to bring clarity to the genealogy and historical context in the *Birth of Lean*. Critiques of lean continue with more studies based on sound research practices (Conti *et al.*, 2006; Schonberger, 2007; Treville and Antonakis, 2006; Vidal, 2007) and less on personal opinion (Mehri, 2006). Human resource and organisational development research continues the connection between existing theory and lean thinking (Balle *et al.*, 2006; Roth, 2006; Worley and Doolen, 2006; Graff, 2007) with Seddon and Caulkin's (2007) article establishing logical links to systems thinking and action research methods.

Core knowledge from lean literature

From the early mention of "Japanese management" practices (Drucker, 1971) to the discovery and dissemination of the TPS into the lean paradigm (Womack *et al.*, 1990), it became clear the mass production methods proven successful since the early 1900s were being outperformed by the more modern and flexible aspects of lean production. While lean is not void of issues and controversy, the benefits appear to outweigh the investment required to transform from traditional mass production operational methods to a lean thinking paradigm. The literature reviewed revealed the following "knowledge" about lean:

- lean thinking has evolved from the manufacturing environment to be applicable throughout an organisation and in industries outside manufacturing;
- the term "lean" and its association with "Japanese management" techniques has caused confusion and difficulty when addressing the topic outside of the manufacturing context;

- interest in research and implementation of lean continues to increase and heavily influenced by Toyota Motor Company;
- employing lean principles have dominated the “how-to-do” lean literature;
- the majority of research has historically been from engineering and operations management disciplines with a recent increase of interest from disciplines associated with human resource and organisational development; and
- lean transformations appear to be more successful when strategically aligned throughout the enterprise.

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Knowledge voids within lean literature

The most apparent void within the body of knowledge eschewing from lean literature was the lack of theoretical connections often associated with planned organisational change and HRD interventions. Seddon and Caulkin (2007) noted the importance of systems thinking and its applicability to lean, while certain studies connected the sociotechnical aspects (Hummels and De Leede, 2000), human performance (Genaidy and Karwowski, 2003), and motivating job characteristics (Treville and Antonakis, 2006) to lean transformations. While these articles, along with a few others, opened dialog around aspects important to lean transformations, a majority of the nearly 200 articles reviewed centred on “how-to-do” lean principles and critiques of the consequences.

Another void surrounds the aspects of planned organisational change absent from lean literature and well articulated in Kippenberger’s (1998) article which highlighted the legacy of Kurt Lewin’s research. Kippenberger reiterated the foundation of change and the ideology around shifting the “status quo” through force field organisational diagnostics. In addition, Burke (2008, p. 21) unpacked many concepts around different types of organisational change such as: revolutionary versus evolutionary, discontinuous versus continuous, episodic versus continuous flow, transformational versus transactional, strategic versus operational, and total system versus local option. Burke stated:

95% of organizational changes are evolutionary [...] consist[ing] of improvements, incremental steps to fix a problem or change a part of the larger system. Most organizational change in Japan, for example, is referred to as *kaizen*, meaning continual improvement.

This acknowledgement by Burke of one of the many lean principles (*kaizen*) associated with a type of organisational change (evolutionary) is one possible connection between theory and the lean thinking paradigm that could be further explored in lean research.

The final void within lean literature was the “human” factor, a common theme amid some articles. However, most were critiques associated with human resource management or labour relation issues. Using Swanson and Holton’s (2001, p. 4) definition of HRD, “a process for developing and unleashing human expertise through organization development and personnel training and development for the purpose of improved performance”, revealed scant research within lean literature. Brandenburg and Ellinger (2003) offered suggestions for improving the “just-in-time” nature of HRD interventions while Holton (2003) challenged the HRD profession and its processes to become more cognizant of cycle time, a common theme echoed in lean thinking. Nevertheless, much of the connections between HRD and lean remain outside scholarly literature suggesting an opportunity for additional collaboration between practitioners and scholars (Mann, 2005; Liker, 2007; Liker and Hoseus, 2008; Harris and Harris, 2007).

Conclusion

The initial purpose of the review of four decades of lean literature was to inform and substantiate the creation of a conceptual lean transformation model (Stone, 2012) in order to study why lean succeeds in some instances and not in others. This literature review has synthesized and categorized four decades of scholarly literature along with influential books from credible researchers and practitioners of lean in an effort to decipher the lean thinking paradigm from jargon to a commonly shared language. Knowledge from lean literature was identified along with the most obvious voids between theoretical foundations of organisational change and HRD that could prove to benefit lean transformations. All of these aspects of discovery, definition, and synthesis of lean will contribute to the knowledge base reinforcing the creation and dissemination of practical theory for use by change agents and HRD professionals engaged in lean transformations.

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(The Appendix follows overleaf.)

About the author

Kyle B. Stone, PhD, is the Director of the Management Development Centre and an Assistant Professor at Fort Hays State University (FHSU) in the College of Business and Leadership and has been working in the North American manufacturing industry since 1990. His 20-year career spans industries including automotive, healthcare, chemical, pulp and paper, and heavy steel fabrication primarily focused in process improvement, operations management, human resource and organisational development. He has led over 200 *Kaizen* events and continues to lead Lean Transformations. He holds a PhD in Organisational Performance and Change and M.Ed in Adult Education and Training from Colorado State University (web site: www.fhsu.edu/management/stone/). Kyle B. Stone can be contacted at: kbstone13@me.com

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Table AI.

Lean literature published
in scholarly journals over
four decades

Appendix. Four decades of lean literature: listed by journal

Journal name	1970-1990	1991-1996	1997-2000	2001-2005	2006-2009
Totals	5	25	26	49	57
<i>Academy of Management Executive</i>				1	
<i>Academy of Management Perspectives</i>					2
<i>Action Learning: Research and Practice</i>					1
<i>Advances in Developing Human Resources</i>			1	1	
<i>Antidote (The)</i>					
<i>Applied Psychology: An International Review</i>		4			
<i>British Journal of Management</i>		2			
<i>Business Horizons</i>					1
<i>California Management Review</i>		1	1		
<i>Canadian Journal of Civil Engineering</i>					1
<i>Critical Sociology</i>					1
<i>Economic & Industrial Democracy</i>			2	2	
<i>Employee Geography</i>				1	
<i>Employee Relations</i>			2		
<i>Engineering Management Journal</i>				1	2
<i>Environmental Quality Management</i>				1	
<i>Forest Products Journal</i>				2	2
<i>Harvard Business Review</i>	1		1	1	2
<i>Human Factors and Ergonomics in Manufacturing</i>				4	
<i>Human Relations</i>		1	1		
<i>Human Resource Development Review</i>					
<i>IIE Solutions</i>			2	1	
<i>Industrial & Labor Relations Review</i>			1		
<i>Industrial Management</i>				1	
<i>Industrial Management & Data Systems</i>				1	
<i>Information Knowledge Systems Management</i>			1	1	
<i>International Journal of Advanced Manufacturing Technology</i>					1
<i>International Journal of Employment Studies</i>			1	1	
<i>International Journal of Human Resource Management</i>		1			
<i>International Journal of Industrial Ergonomics</i>					1
<i>International Journal of Logistics: Research & Applications</i>				1	

(continued)

Journal name	1970-1990	1991-1996	1997-2000	2001-2005	2006-2009
<i>International Journal of Operations & Production Management</i>		9	2	4	2
<i>International Journal of Production Economics</i>		2			1
<i>International Journal of Production Research</i>	1		1	2	8
<i>International Journal of Productivity & Performance Management</i>				1	1
<i>International Journal of Social Economics</i>				1	
<i>International Journal of Sustainability in Higher Education</i>					1
<i>International Journal of Technology Management</i>					2
<i>Journal of Advanced Manufacturing Systems</i>				1	
<i>Journal of Applied Psychology</i>			1		
<i>Journal of Business Ethics</i>					
<i>Journal of Engineering and Technology Management</i>					1
<i>Journal of Management History</i>					1
<i>Journal of Management in Engineering</i>				1	1
<i>Journal of Manufacturing Systems</i>					1
<i>Journal of Manufacturing Technology Management</i>					1
<i>Journal of Marketing Management</i>			1		
<i>Journal of Occupational Health Psychology</i>			2		
<i>Journal of Operations Management</i>	1			1	5
<i>Journal of Organizational Excellence</i>				4	
<i>Labor Law Journal</i>		1			
<i>Labor Studies Journal</i>		2			
<i>Leadership & Organization Development Journal</i>				1	
<i>Management Accounting Quarterly</i>				1	
<i>Management Accounting Research</i>					1
<i>Management Decision</i>				1	1
<i>Management Services</i>				1	1
<i>Manufacturing Engineer</i>					2
<i>Materials & Manufacturing Processes</i>					1
<i>Mineral Resources Engineering</i>			1		
<i>Performance Improvement Quarterly</i>				1	
<i>Personnel Review</i>					1
<i>Production & Inventory Management Journal</i>			1		

(continued)

Table AI.

Table AI.

Journal name	1970-1990	1991-1996	1997-2000	2001-2005	2006-2009
<i>Production and Operations Management</i>			1		
<i>Production Planning & Control</i>			2		
<i>Progress in Human Geography</i>				1	
<i>Psychology and Education: An Interdisciplinary Journal</i>					1
<i>Public Administration Review</i>		1			
<i>Public Money & Management</i>					2
<i>Quality Progress</i>				1	
<i>Reflections</i>					2
<i>Robotics & Computer-Integrated Manufacturing</i>					1
<i>Sloan Management Review</i>	1				1
<i>Sloan School of Management</i>	1			3	3
<i>Strategic Direction</i>					
<i>Studies in Continuing Education</i>				1	
<i>Technology Teacher</i>					1
<i>Technovation</i>			1	2	
<i>TQM Magazine</i>					2
<i>Work Employment Society</i>			1		
<i>WorkingUSA</i>				1	

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