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A review and perspective on Lean in higher education

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Abstract

Purpose – The purpose of this paper is to synthesize the accumulated body of research on Lean in higher education, draw conclusions to help guide successful Lean implementations and propose future research directions to establish a rich base of knowledge that informs both practice and research.

Design/methodology/approach – This literature review examines the academic literature regarding the use of Lean in higher education across 64 publications. EBSCO definitions were used to assess and present the synthesized results, which are detailed at the department/unit level and at the organizational level.

Findings – Overall, Lean appears to have significant and measurable value when used to improve academic and administrative operations in higher education. Such improvements are effective at the department/unit level or throughout the entire institution. However, implementing Lean within an institution is a serious undertaking that is most impactful if it involves long-term, strategic planning.

Research limitations/implications – The groundwork has been established for the development of conceptual frameworks to further guide Lean initiatives in higher education. Such frameworks, together with further integration of organizational development and change management literature will define best practices when implementing Lean locally and throughout the institution.

Originality/value – At the time of this writing, there has been no systematic review or integration of the published literature about Lean in higher education. This review provides a highly useful starting point for researchers interested in further developing theory about quality in academic institutions.

Keywords Continuous improvement, Leadership, Quality, Efficiency, Lean, Lean higher education

Paper type Literature review

Introduction

Lean is a set of principles and practices developed over several decades by the Toyota Motor Company to establish operational excellence as a strategic cornerstone. The "Toyota Way" (Liker, 2004), emphasized continuous improvement and respect for employees as key to strategic business philosophy to enhance product quality. These two leadership tenets were consistently applied to eliminate waste and improve the flow of manufacturing processes (Byrne, 2013; Womack and Jones, 1996, 2005). Recognizing the benefits of product quality,

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employee engagement, customer satisfaction and company profits, Toyota extended Lean thinking to all aspects of its business, including product development, supply chain logistics, finance and customer service (Womack *et al.*, 1990).

Over the past decades, Lean principles and practices have been incorporated worldwide in public and private sector organizations. Lean Higher Education (LHE) (Balzer, 2010) has enabled post-secondary institutions to seek similar improvements in response to the demands of the higher education marketplace: exceeding the expectations of students, faculty and other constituents; reducing expenses in an age of rising costs and declining financial resources; meeting demands for public accountability in terms of efficiency and effectiveness; and, most importantly, strategically leveraging all available institutional resources to fulfill the educational, scholarship and outreach missions of higher education (Balzer, 2010; Behm *et al.*, 2010; Holm and Waterbury, 2010; Waterbury and Holm, 2011).

Numerous case studies describe LHE implementations across the continuum from local through institution-wide. Studies typically present small (5-8 persons) project teams participating in multi-day workshops to apply steps to improve underperforming or unsatisfying processes. Common areas of improvement are student admissions, hiring faculty, purchasing supplies, offering a new major, remodeling a research lab, adding or dropping a course, approving a grant submission, advising students or communicating with donors.

Project teams achieved process improvements through a general five-step process:

- identifying constituents who benefit from the process and what they value;
- applying Lean tools and techniques to analyze the current process to surface wasted steps, efforts and inefficient flow among the process steps;
- redesigning the process using Lean techniques that eliminate waste, improve flow and better meet constituents' needs;
- implementing and regularly evaluating the updated processes using metrics that reflect what constituents expect from the process; and
- continually improving the process with the ultimate goal of achieving perfection in the eyes of all constituents.

Over the past 15 years, LHE has demonstrated its potential for realizing improvements in the delivery of higher education and its supporting services. Examples of improvement noted in the literature include:

- the creation of a "walk in" service at a student counseling center that reduced student wait time from an average of 21 to 0 days without adding any new staff;
- reducing the reply time for a request for information from prospective students from two to three weeks to 1 h;
- reducing backlogged repairs of campus facilities from an average of 24 work days to an average of less than 3 work days, with 80 per cent of repairs completed the same day they were requested;
- reducing the number of steps in an administrative staff hiring process by more than half, resulting in a reduced hiring time from 22 to 8 weeks; and
- accumulating over $27.2m in financial improvements at a US public university over a four-year period (Balzer, 2010; Balzer *et al.*, 2015; Krehbiel *et al.*, 2015).

Worldwide, colleges and universities have achieved successes from LHE initiatives, with many institutions documenting issues related to LHE conceptualizations and implementations in academic journals, technical reports, trade publications and conference presentations. Although many institutions have reported progress related to improvement, some have concomitantly described challenges to improvement, such as incorrect understandings of LHE tools and methodologies, aspects of organizational culture (e.g. resistance to change) and a lack of leadership support (Emiliani, 2015b, 2015c; Radnor and Bucci, 2011; Wiegel and Brouwer-Hadzialic, 2015).

At the time of this writing, there has been no systematic review or integration of the published LHE literature. The purpose of this paper is to synthesize the accumulated body of research on LHE, draw conclusions on its impact and limitations to help successfully implement LHE and offer recommendations to challenge and guide the development of future LHE research.

Early beginnings

In the 1990s, global interest in total quality management (TQM) led many colleges and universities to apply quality principles within their institutions. These principles foreshadowed Lean, in particular, the principle of continuous improvement (i.e. Kaizen). Zimmerman claimed that it is:

> […] important to recognize that competition will demand that higher education institutions become flexible, flat, and fast organizations. Consideration should be given to adopting the philosophy of Kaizen, continuous improvement of products, processes, and people (Zimmerman, 1991, p. 10).

Gains from Kaizen included maintaining a balanced financial performance, achieving planned growth, improving research performance, promoting a shared sense of purpose, improving teaching/learning performance, recruiting/retaining outstanding staff and maximizing benefits from information technology infrastructure (Clayton, 1995).

The late 1990s brought skepticism toward TQM, although the growing interest in Kaizen led to an expanded curiosity about Lean. The first direct reference to the use of Lean in higher education is found in Dahlgaard and Østergaard (2000), which extended the TQM approach presented by the lead author in Dahlgaard and Madsen (1999) by adding Lean and focusing on relationships between quality and cost. The authors proposed that Lean thinking can benefit higher education but warned that the manufacturing sector differs significantly from education, a frequent observation over the last 15 years.

In the 1990s and 2000s, Six Sigma became popular, first in industry and then in services, healthcare and education. More recently, Six Sigma and Lean have been integrated into quality and productivity initiatives under the umbrella term of Lean Six Sigma (Snee, 2010). Currently, LHE initiatives reflect the evolution of the field, and incorporate aspects of TQM and Six Sigma into the foundational elements of Lean principles and practices, and its systematic application of the pursuit for continuous improvement and respect for employees. As the first LHE publication in 2000 (Dahlgaard and Østergaard, 2000), research in this area has continued to mature. The early literature on LHE implementations was typically limited to case studies and technical reports. Recently, more publications about LHE appear in academic journals, with expanded conceptualization of LHE and rigor in its application. A comprehensive review of LHE at this formative point in the development of the field provides both a

reflection on current practice and suggestions for further study, advancing the understanding of the promise and limitations of LHE institutional improvement efforts.

Research methodology

Literature search process

Five databases were searched for LHE publications for the years 2000-2015: Business Source Complete, Professional Development Collection; Education Full Text (H.W. Wilson), Education Research Complete and Education Resource Information Center. Articles were removed about teaching Lean as a subject as opposed to using Lean to improve operations, support services or core academic processes. Examples using Lean Six Sigma, where Lean was determined to be a significant component of the methodology applied, are included. Publications examining traditional Six Sigma methods without integrating Lean are not included in our literature review. Similarly, not included are publications focusing on TQM applications in the absence of Lean.

EBSCO definitions were used to select all articles published in academic journals, trade publications, magazines/periodicals or books. The reference list from each manuscript was evaluated to look for more references that met the definition of LHE. Conference proceedings, technical reports and white papers were also reviewed to examine their potentially significant findings. Although no conference proceedings or white papers are included in this review, their reference lists were examined for any additional relevant articles. The rationale for excluding conference and white papers was that relevant findings from conferences and reports can be re-published in the academic literature and the preference to focus on material more likely to be vetted by a rigorous peer or editorial review process. After reviewing numerous technical reports, a select number of technical reports deemed most informative were included.

In total, 64 publications comprise our literature review. Using the EBSCO definitions, 41 publications were in peer-reviewed academic journals, 7 publications appeared in magazines/periodicals and five were published in trade publications. Four books, one book chapter and six technical reports were included.

Departmental and institutional views of Lean Higher Education

The review is organized into two categories representing the organizational level of LHE interventions. First, *department-level publications* describe experiences at the individual or organizational unit level. Examples include faculty members who design a course using Lean thinking and methodologies or a university payroll department conducting a series of Lean projects to improve operations. *Institution-wide publications* describe organizational experiences (for faculty, staff, administrators and students) across the entire higher education institution or are conceptual papers whose main contributions offer a high-level, conceptual perspective of how LHE can and cannot be effective and suggest future directions not previously expressed in the literature. These publications also may introduce new frameworks related to LHE or related fields of inquiry, such as organizational design, cultural considerations or organizational learning.

Department-level publications

Publications examining a case study analysis of an individual project or an initiative within an organizational unit are summarized in Table I.

Table I.
LHE 2000-2015: department-level publications

Author(s)	Year	EBSCO type	Contribution type	Brief publication summary
Alagaraja	2010	Academic journal	Conceptual	Suggested that Lean can be used for enhancing course development and the overall student experience
Alexander and Williams	2005	Academic journal	Case	Described the use of Boeing's accelerated improvement workshops (AIWs) to improve operational flow in an academic library
Bade and Haas	2015	Trade publication	Case	Reported on university capital and building improvement projects that used Lean methods
Bargerstock and Richards	2015	Academic journal	Case	Presented a case study of an application of DMAIC to university academic assessment processes
Behm *et al.*	2010	Report	Case	Described situated examples of improvements in a business school and risk factors to consider when planning or implementing LHE
Betzinger and Wood	2013	Trade publication	Case	Described a Lean project in university dining services as a pilot project for further institutional change initiatives
Buster-Williams	2009	Trade publication	Case	Applied Lean methods to reduce waste in university student recruitment
Dey	2007	Academic journal	Case	Described improvements to a graduate business school program Focus was on improvements to course content and means of delivery
Doman	2011	Academic journal	Case	Described how undergraduate business students used Lean to improve a grade-entry process at their institution
El-Sayed *et al.*	2011	Academic journal	Case	Presented Lean from the perspective of the Toyota model to define value for the multiple stakeholders of an institution
Emiliani	2004a	Academic journal	Case	Described use of Lean methodology to improve a university course
Emiliani	2005b	Academic journal	Case	Described improvement effort to enhance quality of ten graduate level management courses
Emiliani	2015a	Book	Conceptual and Case	Described how faculty members could be the drivers of LHE organizational changes
Emiliani	2015c	Academic journal	Conceptual	Described waste in higher education and discussed the relationship between faculty and administrators regarding improvement efforts
Finn and Geraci	2012	Report	Case	Reported on the use of Lean in the financial departments of four North American universities
Fisher *et al.*	2011	Academic journal	Case	Described how value stream mapping aided improvements for the academic advising function of a university

(*continued*)

Author(s)	Year	EBSCO type	Contribution type	Brief publication summary
Isa and Usman	2015	Academic journal	Case	Described use of Lean Six Sigma and DMAIC to improve university facility management
Kress	2008	Academic journal	Case	Described a project to improve transactional library services (i.e. shelving) using a variety of Lean tools
Lawn	2011	Magazine/Periodical	Case	Presented a capability maturity model used to improve the efficiency of university dining services
Lorenzetti	2014	Magazine/Periodical	Case	Described training efforts to enhance a distance-learning program by embedding LHE across work functions
MacIntyre *et al.*	2009	Trade publication	Case	Described a Kaizen blitz approach for improving facilities management and cutting greenhouse gases
Murphy	2009	Academic journal	Case	Described transactional efficiency enhancements to a virtual library project
Pavlović *et al.*	2014	Academic journal	Case	Noted how various Lean tools were used to enhance university operations and academic services (i.e. managing test scores)
Pedersen *et al.*	2015	Academic journal	Case	Advocated a train-the-trainer approach to building capacity in LHE. Provided examples of LHE improvements across different departments
Sandmann *et al.*	2006	Academic journal	Case	Summarized benefits of Kaizen blitz approach to improvements in a continuing education department
Tatikonda	2007	Academic journal	Conceptual	Offered hypothetical examples of applying Lean and non-Lean tools to a variety of academic operations
Tuai	2006	Academic journal	Case	Described library improvements to electronic reserves articulated via Womack and Jones' five tenets of Lean

Table I.

These applications represent a bottom-up approach where individuals or pockets of individuals have applied LHE thinking and methodologies without broad institutional support.

Teaching, curriculum and assessment. LHE can be used to design and deliver courses, plan academic programs, improve grading systems and improve assessment practices for learning. Emiliani (2015a, 2015c) claimed that through small process changes, consistent with Lean principles and practices, faculty members could reduce teaching errors, ensure steady student workload and flow and standardize curricular resources. Lean tools, such as value stream mapping, cause-and-effect diagrams and Pareto charts, have been shown to improve the development of teaching materials (Alagaraja, 2010; Pavlovic´ *et al.*, 2014; Tatikonda, 2007). While reporting the advantages of waste reduction, ensuring flow and preventing content errors through the use of Lean methods and tools, Alagaraja (2010) warned that a potential limitation is that the approach could lead to unsustainable increased workloads on faculty.

Updates to curriculum are performed either systematically or through years of singular updates performed by faculty members. Emiliani (2004a, 2005b, 2006, 2015a, 2015c) has been critical of such processes, as he believes that firm metrics should track how the syllabus, required reading, assignments and examinations should develop and improve. He described the need to incorporate student feedback and systematically ensure student access to the appropriate materials necessary for enhanced recall of course concepts. Dey (2007) claimed that updating and improving an MBA curriculum through the application of Lean tools and thinking led to increased value for the employers of their graduating students, and Tatikonda (2007) hypothesized that Lean could result in significant improvements to accountancy courses and the overall curriculum.

Regarding the assessment of learning, Bargerstock and Richards (2015) described LHE, Lean Six Sigma and the define-measure-analyze-improve-control (DMAIC) improvements when launching an institutional improvement training initiative. El-Sayed *et al.* described how LHE can improve assessment processes where "objectives, outcomes, and performance criteria for all of the courses in the program should flow from the program-level specifications and should be aligned with it" (El-Sayed *et al.*, 2011, p. 71).

Administrative and student-support processes. Many publications exist that describe LHE improvements to administrative and student support departments. Institutional accounting and financial offices are common application areas because of the transactional nature of processes (Behm *et al.*, 2010; Finn and Geraci, 2012). LHE advances were also noted for food services (Betzinger and Wood, 2013; Lawn, 2011), conference planning and implementation processes (Sandmann *et al.*, 2006) and physical facilities design and maintenance operations (Bade and Haas, 2015; Isa and Usmen, 2015; MacIntyre *et al.*, 2009). Although most reported improvements are in terms of fewer errors, increased speed or higher customer satisfaction, Behm *et al.* (2010) described pitfalls individuals or departments need to avoid:

- underestimating the effort required;
- creating undefined ownership;
- creating undefined metrics;
- implementing poor project selection criteria; and
- using Lean to justify eliminating positions.

Libraries have used LHE to improve book stack management, sales of used books, virtual referencing and inter-library loan services (Alexander and Williams, 2005; Kress, 2008; Murphy, 2009; Tuai, 2006). LHE improvements to student support services include advising (Fisher *et al.*, 2011) and admissions (Buster-Williams, 2009). Distance education has benefitted from LHE in terms of student recruitment, student orientation and event management, leading to financial savings and added overall qualitative value (Lorenzetti, 2014; Pedersen *et al.*, 2015).

In an interesting twist of pedagogy, students themselves have used LHE to improve educational experiences. At one institution, an effort led by students using Lean tools and thinking improved their own grade entry system. The project was completed in eight weeks and later adopted by university administrators responsible for grade-change issues and other electronic processes (Doman, 2011).

Institution-level publications

Publications where the primary focus was an analysis of institution-wide LHE applications or providing related conceptual frameworks and recommendations are summarized in Table II:

Several of the publications described existing initiatives and experiences that could be generalized to other institutions. In general, these publications demonstrated examples of top-level support for LHE implementations across a wide spectrum of departments and divisions and a need to accommodate cultural changes during such implementations.

Executive leadership. A common theme in the literature is the importance of sustained top-management support and commitment when introducing Lean initiatives (Comm and Mathaisel, 2005a; Antony *et al.*, 2012; Hines and Lethbridge, 2008; Krehbiel *et al.*, 2015; Paris, 2007; Radnor and Bucci, 2011). The provision of training was viewed as crucial (Comm and Mathaisel, 2005b; Krehbiel *et al.*, 2015; Radnor and Bucci, 2011; Svensson *et al.*, 2015), and Cristina and Felicia (2012) emphasized the importance of using a central office to direct LHE initiatives. Notably, strategy and Lean thinking serve as catalysts for each other and help drive longer-term, institution-wide improvements (Antony *et al.*, 2012; Emiliani, 2005a).

The executive layer within higher education has been criticized in some cases for ignoring the Lean movement altogether or for poorly implementing and supporting LHE initiatives. Emiliani (2004b, 2015b) has advocated for Lean leadership to come from individual faculty members, as they directly control the teaching and learning experience and can apply LHE more easily than administrators in many cases.

Institutional readiness. Developing organizational readiness, including linking improvement to the institution's strategy, establishing a customer focus and selecting the right people, is important when implementing LHE (Antony *et al.*, 2012; Antony, 2014). Radnor and Bucci (2011, p. 9) reported that leaders working on LHE improvements in UK business schools believed the three most important enablers were:

> […] creating an understanding of the need to change, revising processes and practices which had been untouched for years, and engaging staff to enable them to challenge and question their working practices.

Sinha and Mishra (2013) advised that categorizing inefficiencies is the first step for planning improvements, and that LHE should account for how people work, how people

Table II.
LHE 2000-2015: institution-level publications

Author(s)	Year	EBSCO type	Contribution type	Brief publication summary
Antony	2014	Academic journal	Conceptual	Suggested readiness factors for higher education institutions considering the use of Lean or Six Sigma
Antony	2015	Academic journal	Conceptual	Claimed that academic counselling/support areas are good starting points for improvement. LHE presents organizational, technical and individual challenges
Antony *et al.*	2012	Academic journal	Conceptual	Studied UK universities; claimed Lean and Six Sigma should be used together for the most effective results
Baker	2012	Magazine/Periodical	Conceptual	Provided an overview of UK universities report on efficiency and the work of Radnor and Bucci
Balzer	2010	Book	Conceptual and case	Presented case studies and conceptual framework for LHE. Emphasized institutional readiness, including leadership and institutional culture, to support effective implementation
Balzer *et al.*	2015	Academic journal	Conceptual	Built on LHE experiences and literature to propose a systems approach based on organizational change management literature to implement and sustain institution-wide LHE
Barton and Yazdani	2013	Academic journal	Conceptual	Noted success factors of transparency, clear levels of reporting, clear ownership of improvement projects and linking Lean to accreditation efforts
Bryman	2007	Report	Conceptual and case	Summarized key findings related to leadership styles, approaches and behaviors associated with effectiveness in higher education settings
Comm and Mathaisel	2003	Academic journal	Conceptual	Proposed continuous improvement for sustainability of higher education via Lean framework based on nine principles
Comm and Mathaisel	2005a	Academic journal	Empirical	Studied administrator perceptions about process improvement at New England universities, compared with framework in previous article
Comm and Mathaisel	2005b	Academic journal	Empirical	Examined New England university administrators' views on process improvement

(*continued*)

Table II.

Author(s)	Year	EBSCO type	Contribution type	Brief publication summary
Cristina and Felicia	2012	Academic journal	Case	Provided three case studies of LHE implementations at different institutions
Dahlgaard and /Ostergaard	2000	Book chapter	Conceptual	Described integration of TQM and Lean, as well as differences in implementation between public and private sectors
Douglas *et al.*	2015	Academic journal	Conceptual	Translated the eight wastes of Lean to LHE situations
Emiliani	2004b	Academic journal	Conceptual	Described categories of waste within higher education settings. Advised that management schools tend to teach high-waste approaches to leadership and should change
Emiliani	2005a	Magazine/Periodical	Conceptual	Described an initiative to enhance the quality of management graduate education courses and also claimed that LHE can be a basis for strategic planning
Emiliani	2006	Academic journal	Conceptual	Focused on how program design could be enhanced with Lean methods for an MBA program
Emiliani	2015b	Book	Conceptual	Described history of continuous improvement in LHE and further explored a faculty member's role in improvement
Fearn	2010	Magazine/Periodical	Case	Described various LHE implementations in UK universities and colleges
Flumerfelt and Banachowski	2011	Academic journal	Empirical	Presented a qualitative study of higher education administrators to identify areas of their highest concern when undertaking institutional improvement initiatives
Francis	2014	Academic journal	Conceptual	Presented a view where organizational learning was linked to LHE from a systems perspective
Hines and Lethbridge	2008	Academic journal	Case	Presented metaphor for LHE, emphasizing the link between Lean projects and institutional strategy
Holm and Waterbury	2010	Magazine/Periodical	Case	Described an Educational Lean Improvement Model (ELIM) and illustrated eight examples of waste that directly impact students
Kang and Maryonge	2014	Academic journal	Conceptual	Described how improvements affect students, research and staff. Specific examples were provided that addressed different types of waste

(*continued*)

Table II.

Author(s)	Year	EBSCO type	Contribution type	Brief publication summary
Krehbiel *et al.*	2015	Academic journal	Case	Described a university-wide, multiyear initiative to implement LHE. Progress was reported in terms of efficiency gains, cost savings and environmental sustainability
Morgan and Baker	2011	Magazine/Periodical	Conceptual	Provided an opinion on Universities UK report regarding the use of outsourcing as a means of achieving efficiency
Paris	2007	Report	Case	Studied how 30 different institutions set up quality improvement departments and governed Lean projects
Radnor and Bucci	2011	Report	Case	Provided a case study of four UK university business schools that implemented Lean
Sinha and Mishra	2013	Academic journal	Case	Described higher education challenges in India with recommendations on how to implement Lean based on how people work, connect and operate
Svensson *et al.*	2015	Academic journal	Case	Described staff training and LHE improvement progress in terms of streamlined processes and quicker service turnarounds
Thirkell and Ashman	2014	Academic journal	Empirical	Used interviews to assess perceptions about LHE at two UK universities. Also noted how LHE should integrate with human resources functions
Thomas *et al.*	2015	Academic journal	Empirical	Compared LHE implementations at different institutional types to assess organizational dynamics and usefulness of tools
Universities UK	2011	Report	Case	Reported on LHE progress and future possibilities presented by the efficiency and modernization task group of Universities UK
Vyas and Campbell	2015	Magazine/Periodical	Conceptual	Claimed that higher education industry is finally at the end of a long cycle of inefficiency; drastic changes are required to become competitive again
Waterbury	2015	Academic journal	Empirical	Analyzed administrators who attended Lean training workshops to assess how improvement projects were to be planned and launched
Waterbury and Holm	2011	Book	Conceptual and case	Described the history of quality initiatives in LHE, the history of Lean and the ELIM
Wiegel *et al.*	2015	Academic journal	Conceptual	Claimed that Lean methods are not properly adjusted for the organization-type, resulting in sub-par results

connect and how processes operate. They concluded that LHE succeeds when connected to the longer-term plans of an organization, using smaller-scale Lean projects as precedents for wider initiatives. Balzer (2010) noted that assessing institutional readiness is a key consideration before embarking on a significant, institution-wide effort to introduce LHE.

Organizational learning. Colleges and universities (who are in the business of learning) would do well to examine organizational learning as a means of promoting sustained improvement. Flumerfelt and Banachowski (2011) emphasized the importance of systems-based learning and warned leaders to heed Bryman's advice that administrators must avoid:

> […] failing to consult, not respecting existing values, actions that undermine collegiality, not promoting the interests of those for whom the leader is responsible, being uninvolved in the life of the department or institution, undermining autonomy and allowing the department/institution to drift (Bryman, 2007, p. 2).

Organizational learning has been proposed as a collateral support for LHE. Francis (2014) argued that as organizational learning and LHE both follow a systems model, promoting wider understandings of these approaches positively affects organizational outcomes. He described specific LHE success factors, such as strong executive leadership, training and development, developing knowledge management, harnessing information technology and ensuring good project governance. Antony broadly endorsed similar supports to address "organizational, technical, and individual challenges" (Antony, 2015, p. 893).

Institutional culture considerations. Institutional culture is highly correlated with LHE's prospects for success. Balzer (2010) emphasized that LHE required an appreciation for and, in some cases, changes to organizational culture for employees to embrace Lean principles and practices. Hines and Lethbridge (2008) warned that a number of factors related to organizational culture can make LHE implementation difficult, the most prominent being institutional reluctance to wide-scale change initiatives. They offered that the most successful change initiatives require a high level of faculty and employee engagement and emphasized the importance of linking LHE with an institution's strategic plan and using clear improvement goals to maximize stakeholder engagement.

There is some evidence that organizations have an incorrect understanding of Lean principles and often emphasize improvements over promoting a supportive Lean culture (Radnor and Bucci, 2011; Thomas *et al.*, 2015). These authors suggested that employees want to see Lean as adding value to processes, benefiting themselves and other employees, rather than merely a formalized approach to methods and training.

Survey reviews. LHE implementations across 30 US and Canadian institutions were summarized in a National Consortium for Continuous Improvement study (Paris, 2007). A key finding was high variances among institutions with respect to LHE practices. For example, some institutions used centralized departments to lead and promote LHE initiatives, whereas others opted for a decentralized approach, and about half of the responding institutions provided LHE project management and leadership training, whereas the others used external resources. Respondents identified key LHE enablers as the involvement of senior leadership, links to institutional strategic planning, the use of cross-functional and inclusive approaches, aligning with higher education culture and

accreditation initiatives. Respondents viewed negative faculty and staff attitudes and a lack of overall resources as LHE barriers. Other inhibiting factors included institutional inertia, organizational size/complexity, decentralization and a tendency for faculty and staff to protect their "turf".

Higher education in the UK has been analyzed across the sector to derive modernization and efficiency trends (Baker, 2012; Fearn, 2010; Morgan and Baker, 2011; Universities UK, 2011). Lean was described in the context of one method of continuous improvement that has shown promise within UK institutions, primarily as a means to ensure quality in times of reduced budgets. A UK task group noted that the post-secondary sector has "hidden the progress" (Universities UK, 2011, p. 5) of achieved improvements to some extent. This advocacy group claimed that obtaining better institutional data, simplifying and sharing services and re-examining procurement approaches would benefit the next phases of improvement in higher education.

Conceptual frameworks. Conceptual frameworks have been proposed to systematically establish improvement priorities, enhance governance models and formally assess quality (Comm and Mathaisel, 2003). These authors claimed that frameworks could help build a Lean consortium, target stakeholders, decide the research agenda, test the research approach, find best-in-class approaches (benchmarks), analyze and assess findings, implement concepts and establish controls to evaluate desired results. They proposed a Lean enterprise framework based on operating principles adapted from Nightingale (1999) and concluded that as public and government expectations of post-secondary education have increased, the use of clear metrics and an analysis of customer (i.e. student) expectations were essential for institutional improvement. Balzer (2010) provided a conceptual framework and practical advice to prepare for and implement LHE institution-wide. He highlighted where LHE could improve efficiency (i.e. enrolment and retention, the student experience and faculty and staff support services). Balzer concluded that robust support for Lean in other industry sectors (e.g. manufacturing and healthcare) provided a strong basis for LHE as a strategic organizational model for dramatic improvements in every process contributing to the institution's mission.

Systems approach to improvement. A cyclical approach to improvement (the Education Lean Improvement Model) has been proposed that emphasizes understanding of Lean and the systems approach (Holm and Waterbury, 2010; Waterbury and Holm, 2011). When envisioning institution-wide improvement, Waterbury (2015) posed important questions for institutional leaders:

Q1. Who will oversee the Lean initiative?

Q2. How will human and financial resources be allocated?

Q3. When and how will professional development activities be offered?

Q4. How will facilitators continue to develop their skills?

Q5. How will projects be selected?

Q6. How will Lean thinking be introduced into academic departments?

Several authors argued that transparency in communication enhances the systems approach to improvement (Antony *et al.*, 2012; Barton and Yazdani, 2013). Kang and Manyonge (2014) reviewed systems of Lean principles from a variety of manufacturing

settings and provided examples of various types of waste in higher education settings. Most recently, Balzer *et al.* (2015) presented a systems approach to guide successful LHE implementations and more broad consideration of the literature regarding organizational change management to support it. The authors recommended institution-wide implementation of LHE through several key steps:

- assessing the existing workplace climate;
- improving leadership awareness, understanding and support for LHE;
- using pilot demonstration projects to gain visibility and credibility;
- creating and strengthening organizational structures to launch and support LHE; and
- facilitating an institution-wide transition to LHE grounded in respect for employees and continuous improvement.

Particularity of higher education. Some authors have proposed that Lean has been introduced into institutions of higher education without adjusting the models used in manufacturing settings, thus limiting improvements (Thirkell and Ashman, 2014; Wiegel and Brouwer-Hadzialic, 2015). Douglas *et al.* observed that LHE had largely been applied to administrative operations and support services and warned, "if Lean is to avoid the fate of TQM, it must also be applied to academic processes" (Douglas *et al.*, 2015, p. 979). With some notable exceptions (Emiliani, 2006), LHE applications on the core processes of teaching, learning and research remain largely elusive. Arguments that these processes are more art than science and difficult to standardize have been made – and addressed – in other professional disciplines such as Lean healthcare and Lean law (Graban, 2016; MacDonagh, 2014).

The particularity of higher education as it relates to improvement can be argued from the other direction; that is, perhaps higher education models themselves must adapt to ensure improvement. In fact, this was mentioned in the first LHE publication (Dahlgaard and Østergaard, 2000), which claimed that higher education would require new organizational structures when implementing Lean thinking to ensure improvements.

An additional element of higher education institutions absent within industry is academic freedom. Waterbury noted that "academic freedom and autonomy will continue to challenge Lean implementation. This debate will likely be the catalyst to further the knowledge base of Lean thinking in higher education" (Waterbury, 2015, p. 948). Colleges and universities are complex organizations, and it is not clear which boundaries academic freedom permeates. "Academic freedom, the most sacred of all values in higher education, is appropriate for academics, not administrative operations" (Vyas and Campbell, 2015, p. 20).

Conclusions

Overall, LHE appears to have significant and measurable value when used to improve academic and administrative operations. Such improvements are effective at the department/unit level or throughout the entire institution. However, the literature is limited (as noted below), and practitioners face challenges relating to aspects of culture, communication and executive-level support that can lead to incorrect or sub-optimal application of Lean principles and methodology, thus moderating the improvements.

Implementing LHE within an institution is a serious undertaking that is most impactful if it involves long-term, strategic planning. This requires committed executive management, organizational learning across all institutional levels and significant cultural changes within the workplace. Local initiatives may serve as a grassroots means of encouraging the wider adoption of LHE throughout an institution.

Our literature review identified numerous case-based examples of organizational improvements that have benefitted academic and administrative operations. However, compelling, evidenced-based conclusions of the overall impact and effectiveness of LHE initiatives are missing from the current body of literature. The groundwork certainly has been established for the development of conceptual frameworks to further guide LHE initiatives. Such frameworks, together with further integration of organizational development and change management literature, will define best practices when implementing LHE locally and throughout the institution.

Directions for future research

Clear themes emerged in the LHE literature relating to organizational design and culture, a systems view of organizational learning and improvement and adhering to core Lean principles when seeking institutional change. As the specialized application of Lean principles and practices in higher education continues to mature and thrive, several recommendations are offered to challenge and guide the development future LHE research.

Formalize Lean Higher Education definitions and frameworks

The LHE literature indicates the absence both of conceptual and operational definitions of LHE. Balzer *et al.* (2009) noted that sectors outside of higher education similarly lack similar conceptualizations regarding Lean. In lieu of clear definitions, studies can be unreliable (i.e. inconsistent across studies), deficient (i.e. not fully representative of the construct) or contaminated (i.e. include other components broader than the original construct). We recommend that researchers develop a common conceptual LHE framework to define, design and evaluate LHE programs. Bayou and de Korvin (2008) and Shah and Ward (2003) offer frameworks for determining the degree of "leanness" across differing Lean programs, which might offer practical approaches for assessing the wide variability among the many different programs. However, not all LHE researchers believe that a conceptual definition of LHE is needed (Emiliani, 2015b).

Expand measures of Lean Higher Education's impact

LHE measures typically involved changes in processes (e.g. time to complete, number of steps and reduced errors) or were expressed in terms of financial impact. Fewer studies (Dey, 2007; Pavlovic´ *et al.*, 2014) directly examined the impact of the improved processes on the individuals who were supposed to benefit. Given that the two fundamental principles of Lean are "continuous improvement" and "respect for employees", it is concerning that no published studies have developed measures to assess these LHE outcomes. For example, employees' participation in LHE projects might affect their perceptions of control over their work (level of autonomy and project prioritization), cognitive demands (expanded problem solving) and accountability (responsibility for the process). Future researchers should expand the measures they use to assess LHE impact. For example, Lawrence and Cairns (2015) provided a useful conceptual framework for choosing measures in business process improvement

initiatives, and Harrington (1987) offered a comprehensive framework for considering Lean impact on one measure: cost.

Further develop evidence-based support for Lean Higher Education

Case studies were the most common approach LHE publication type. Although useful, case studies do not provide the evidence-based support necessary to confidently conclude that LHE interventions resulted in institutional change or generalized results. We recommend that LHE practitioners and researchers develop more rigorous quasi-experimental and experimental research designs to reach evidence-based conclusions on the effectiveness and generalizability of LHE, as well as the value-added benefit of combining Six Sigma, DMAIC and other quality concepts with traditional Lean principles and practices. Cook *et al.* (1990) and Cook and Campbell (1979) provided excellent primers for constructing Lean studies based on the principles of scientific thinking (e.g. ruling out alternative explanations for findings, demonstrating causality, etc.).

Widen prospects for Lean Higher Education research

The results of LHE research will be received and interpreted very differently by different organizational actors. LHE practitioners and researchers should write for outlets that best translate LHE to the language of the individuals and groups interested in promoting organizational improvement. Writing should be as jargon-free as possible to encourage common understandings within groups seeking an interpretation of LHE results. The results of LHE applications to teaching and learning processes, faculty and student-driven research and other creative activity in our institutions are surely rich prospects for future inquiry.

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