Leadership behaviors during lean healthcare implementation: a review and longitudinal study

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Abstract

Purpose – The purpose of this paper is to examine leadership behaviors associated with lean healthcare (LH) implementation and how they develop throughout the change process.
Design/methodology/approach – After a systematic literature review of 107 peer-reviewed articles on lean leaders' behaviors, the authors undertook a one-year mixed-methods study of 12 leaders within a Brazilian public hospital undergoing LH implementation. Multivariate data analysis techniques were employed.
Findings – The literature review showed some convergence between effective lean leader behaviors in both manufacturing and healthcare work settings, implying that lean leaders' behaviors are generalizable to other contexts than manufacturing. The empirical findings suggest that LH implementation needs leaders to demonstrate a set of task-oriented behaviors, especially if short-term results are mandatory. More mature lean leaders should also continue developing their relations-oriented behaviors.
Research limitations/implications – While the contingency theory assumes that contexts influence (lean) practices adoption, leadership behaviors may not be bound to the work context. The finding resembles the augmentation effect of leadership whereby more mature lean leaders adopt both task- and relations-oriented behaviors.
Originality/value – Longitudinal studies in this field are scarce, regardless of the industrial setting. Many manufacturing and healthcare organizations crave for knowledge about lean leader behaviors throughout the lean implementation journey in order to enhance the effectiveness of their often-struggling lean initiatives. The insights derived from this study could help organizations to adjust their expectations as well as identify behavioral gaps and needs in terms of soft skills development among their leaders.

Keywords Lean manufacturing, Methods, Leadership
Paper type Research paper

1. Introduction

Healthcare organizations increasingly face pressures and challenges to improve their service in terms of quality, time, costs, etc. (Souza and Pidd, 2011). Consequently, many healthcare organizations are applying lean manufacturing (LM) to systematically reduce waste and increase customer value by establishing a culture of continuous, incremental process improvement (Staedele *et al.*, 2019). The adoption of LM in healthcare was coined as lean healthcare (LH) (Womack and Jones, 2003; Graban, 2011; Jones, 2017). Thereby, they reduce poor service quality, lack of patient safety, long waiting times, medical errors and inconsistent medication (Kim *et al.*, 2006; Dickson, Anguelov, Veterick, Eller and Singh, 2009; Dahlgaard *et al.,* 2011). LM's benefits have already been evidenced in organizations from several different sectors, such as manufacturing, administrative processes and services (Danese *et al.*, 2018) and now healthcare. Besides efficiency, LH can stimulate employee's engagement and motivation, reduce incidents and improve financial performance (IOM, 2001; Jimmerson *et al.*, 2005; Souza and Pidd, 2011; Radnor *et al.*, 2012). Despite these benefits, few healthcare organizations have fully adopted lean as their strategic and philosophic way of working (Steed, 2012) whereby only a few areas

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or departments have been impacted without systemically enhancing their processes (Chalice, 2007).

Lean implementation entails an organizational change process that affects all job facets (Kaplan *et al.*, 2014). It does not just involve changes in the technical and physical aspects, but also socio-cultural ones (Tortorella and Fogliatto, 2014; Zhang *et al.*, 2017). Leaders have a decisive role in the establishment of the underlying lean culture (Bhasin and Burcher, 2006; Shook, 2010; Liker and Convis, 2012; Van Dun and Wilderom, 2012). In fact, the behaviors demonstrated by leaders have been claimed as important factors for successful lean implementation (Womack and Jones, 2003; Spear, 2005; Mann, 2009; Angelis *et al.*, 2011; Pamfilie *et al.*, 2012). Van Dun *et al.* (2017) defined lean leaders' behaviors as specific observable verbal and non-verbal actions of managers whenever they interact with followers within the organizational context.

Since LH is a relatively recent phenomenon (D'Andreamatteo *et al.*, 2015; Danese *et al.*, 2018), the quantity and quality of the literature about the leadership behaviors in this context are still limited. Given that healthcare organizations are highly complex with a low tolerance for mistakes, such settings may require particular leadership behaviors (Aij, Aernoudts and Joosten, 2015; Aij, Visse and Widdershoven, 2015). The scarcity of studies makes it difficult for healthcare organizations to establish and reinforce the right leadership behaviors (Poksinska *et al.*, 2013). Various healthcare-oriented training programs, such as TeamSTEPPS and AHRQ (Salas *et al.*, 2018), exist, but healthcare organizations generally do not emphasize the development of leadership skills among their employees (Tortorella, Fogliatto, Anzanello, Marodin, Garcia and Esteves, 2017). Moreover, leaders' behaviors are likely to change during the course of lean implementation; this has been underexplored so far (Camuffo and Gerli, 2018). Hence, our research question is:

RQ1. How do leaders' behaviors change throughout lean implementation in a healthcare organization?

Our exploratory research started with a systematic literature review of lean leaders' behaviors. Since lean implementation is relatively more mature in manufacturing than healthcare environments, we compared the literature with respect to leadership behaviors in both settings. We then conducted a longitudinal mixed-methods study within a Brazilian public hospital that started adopting lean two years beforehand. The findings will enable healthcare organizations to set proper expectations from their leaders' soft skills training development, depending on the stage of their organization's lean adoption.

2. Theoretical background

2.1 Lean healthcare

LH implementation is at an earlier development stage compared with the automotive or discrete manufacturing processes industries (Spear, 2005; Toussaint and Berry, 2013a; Radnor *et al.*, 2012). While initial studies conceptualized LH adoption without empirical validation (Souza, 2009), scientific studies after 2000 began to provide more substantial evidence of LH implementation (e.g. Allway and Corbett, 2002; Bushell and Shelest, 2002) and the first "LH Forum" event for LH diffusion was held in January 2006 in the UK. Despite initial skepticism, healthcare organizations gradually became aware of the potential of LH to solve their operational problems (Feinstein *et al.*, 2002). Publications on the application and the varying results of LH implementation have begun to emerge (e.g. Kim *et al.*, 2006; Dickson, Singh, Cheung, Wyatt and Nugent, 2009; Rutledge *et al.*, 2010; Waring and Bishop, 2010; Radnor *et al.*, 2012).

According to Dahlgaard and Dahlgaard-Park (2006), LH implementation usually emphasizes process and cost control changes thereby losing its focus on the people. Ballé and Régnier (2007) highlighted that LH requires developing a culture in which

employees are engaged and encouraged to improve their work environments. Thus, employees must not only focus on patient care, but also on thinking creatively to improve the provided service (Spear, 2005). Such behaviors entail the development of lean cultural changes but this is often neglected by organizations (Radnor *et al.*, 2012). Accordingly, Holden (2011) advises establishing, among other factors, a cultural transformation, for instance through higher leader's behavioral and financial support for LH.

2.2 Lean leadership

The social learning theory (Bandura, 1977) postulates employees' attitudes are greatly affected by the way leaders act and behave, serving as a behavioral model to achieve a durable continuous improvement culture (Dombrowski and Mielke, 2014; Kim and Toya, 2019). Yet, leaders' lack of commitment to lean is often the main cause of failure in most lean implementation initiatives (Boyle *et al.*, 2011; Liker and Convis, 2012). Mann (2009) suggests that leaders must direct the actual change of their organization toward becoming lean. Some assume that leaders in organizations which have adopted lean should be participative, delegators and excellent people motivators (Pamfilie *et al.*, 2012). Nevertheless, the specific desirable leadership behaviors throughout the various phases of lean implementation still need to be understood better (Camuffo and Gerli, 2018). Although the leader's role in LM is well acknowledged (Womack and Jones, 2003; Angelis *et al.*, 2011), the analysis of leadership behaviors is rarely the focus of LM research.

Some recent empirical studies are exceptions. Van Dun *et al.* (2017) and Tortorella *et al.* (2018) analyzed lean leaders' behaviors in terms of their task and relations orientation. Task-oriented behaviors focus on being highly efficient in resources, processes, personnel and product/service quality; while relations-oriented ones reinforce employees' welfare and good work environments (Yukl *et al.*, 2002). Marksberry (2010) found that operational team leaders supported both social and technical aspects of team members in the Toyota Production System. Toyota's culture was molded on the identities, values and backgrounds of its founders which may differentiate their leadership behaviors from other organizations (Liker, 2004). Effective lean leaders' behaviors can be people oriented, e.g. active listening and agreeing with employee's ideas, fueled by their work values that are self-transcendent in nature, such as honesty, openness, participation and teamwork (Van Dun and Wilderom, 2016; Van Dun *et al.*, 2017). Our research was motivated by the fact that few scholars specified leaders' behaviors during LH implementation (Poksinska *et al.*, 2013; Toussaint and Berry, 2013a; Aij, Aernoudts and Joosten, 2015; Aij, Visse and Widdershoven, 2015).

3. Methods

The research design entailed two stages (Figure 1): a systematic literature review and a longitudinal study.

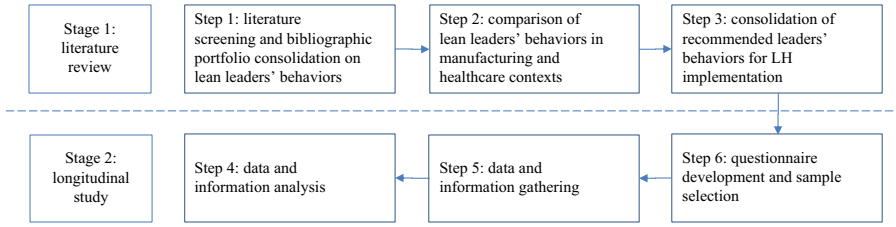

Figure 1. Mixed-methods approach

3.1 Stage 1: systematic literature review

To consolidate and comprehend the existing knowledge better about lean leadership in the context of healthcare organizations, we performed a systematic literature review consisting of three steps (Webster and Watson, 2002).

Step 1: systematic screening of the literature in order to arrive at a relevant portfolio. Table I shows the selected keywords, databases and filtering criteria of the final portfolio. All combinations of the keywords "lean," "leadership," "leader," "manager" and "management" drove the literature search of the titles, abstracts or keywords of the publications. Between May and July 2017, we perused Web of Knowledge (ISI), Science Direct, Engineering Village and Scopus and scanned all the available documents in peer-reviewed journals or conference proceedings written in English, without limiting the time period. EndNote was applied to ease and facilitate the filtering process.

Step 2: since studies of leadership in LH are scarce, we also included lean studies of manufacturing organizations and compared the leadership behaviors in both settings.

Initially, 4,258 articles were found. Removing the duplicates resulted in 3,312 articles. The main author verified the articles' alignments with the research subject based on their titles, keywords and abstracts. We only kept those that mentioned leaders' behaviors in the context of implementing lean. The final portfolio included 107 articles: 65 in manufacturing and 42 in healthcare organizations.

Step 3: a content-analysis of all articles; we classified them and consolidated their findings.

3.2 Stage 2: longitudinal study

Stage 2 involved three further steps to study hospital leaders at three points in time during one year.

Step 4: the sample selection followed a few criteria. As the unit-of-analysis was the leader, we selected leaders from only one healthcare organization undergoing LH implementation. This avoided response biases due to different organizational cultures and LH maturity levels. Moreover, the selected public hospital had collaborated previously with our research. All respondents from this healthcare organization had to have a middle management position, which is claimed to be a key role for innovation in healthcare processes (Birken *et al.*, 2012). Furthermore, they had to be active in implementing LH in their departments. The final study sample comprised 12 Brazilian hospital leaders, whose characteristics are presented in Table II.

The questionnaire had three parts. The first part collected the participant's demographic information. Second, we measured the level of adoption of lean practices in each participant's department. We used pre-defined lean practices to identify the organization's maturity level regarding lean implementation (Shah and Ward, 2007; Netland and Ferdows, 2014; Marodin *et al.*, 2015). However, previous studies did not specify which set of practices address effective LH implementation. Table III consolidates 17 lean practices observed in multiple sectors, not only in manufacturing (Augusto and Tortorella, 2019) but also in healthcare. Thus, the adoption level of these 17 lean practices was used to assess the level of LH implementation within each respondent's department via a five-point Likert scale: 1 denoted "no evidence of implementation" and 5 meant "full implementation." The third part assessed the respondents' adoption frequency of the 15 behaviors found in the literature review (Step 3). We used a Likert scale ranging from 1 "never adopted" to 5 "always adopted."

Step 5: we surveyed each respondent three times over a year, with a six-month interval between each: in June 2017 (t_1), December 2017 (t_2) and July 2018 (t_3). In order to avoid non-response bias, data were collected personally from each leader via printed questionnaires during scheduled meetings. We also conducted semi-structured interviews with them. Qualitative information is recommended so as to triangulate the quantitative findings (Suddaby, 2006). The interviews took approximately 30 min each. Detailed minutes were taken.

Databases	Keywords	Initial results	Filter criteria			Final portfolio studies' context	
			Verification of duplicates	Review of titles, keywords and abstracts	Review of full articles	Manufacturing	Healthcare
Web of Knowledge	"lean" AND "leadership" OR "leader" OR "manager" OR "management"	874					
Science Direct		177					
Engineering Village		2,079					
Scopus		1,128					
Total		4,258	3,312 (−946)	171 (−3,141)	107 (−64)	65	42

Table I.
Literature screening approach

Respondent	Position	Gender	Age	No. of direct subordinates	Total no. of subordinates	Leadership experience (years)
r_1	Nurse	F	46	5	5	3
r_2	Nurse	F	46	4	8	4
r_3	Nurse	F	39	6	10	5
r_4	Nursing Coordinator	F	47	12	180	10
r_5	Nurse	F	40	9	40	6
r_6	Resident	F	28	2	2	1
r_7	Physician	F	37	6	13	7
r_8	Supply Chain Coordinator	F	52	8	36	5
r_9	Planning/Control Coordinator	M	41	3	3	1
r_{10}	Administrative Assistant	F	30	2	3	3
r_{11}	Administrative Assistant	F	37	3	3	1
r_{12}	Administrative Assistant	F	33	6	14	3
Mean			39.7	5.5	26.4	4.1

Table II.
Sample characteristics

Step 6: the data were analyzed by first clustering it according to the adoption level of lean practices. We considered LH implementation as a single dimension based upon the total average scores of each respondent at t_1, t_2 and t_3. Consolidating a set of practices into one single dimension that represents the level of lean implementation is a common approach in the literature (e.g. Marodin *et al.*, 2016), and helps to provide a more holistic perspective of the implementation. The Cronbach's α for the lean practices showed high reliability: 0.974.

In order to enable a more meaningful interpretation of the variations in our data set, we classified the leaders as either high or low lean adopters (HLA or LLA) using ordinary least square regression. Each respondent's total score of LH implementation (dependent variable) was regressed on the time intervals (t_1, t_2 and t_3; independent variable) using SPSS Statistics 23 software. The regressions resulted in unstandardized coefficients associated with each of the twelve respondents (see Table IV). High significant ($p < 0.05$) coefficients represented large leaps toward the adoption of lean practices within the respondent's department. HLA respondents were those whose coefficients were greater than the sample's median of the unstandardized coefficients: 15.5. LLA had coefficients below the median. Five respondents (r_2, r_5, r_6, r_7 and r_{12}) were categorized as LLA. All the other respondents were grouped as HLA except for respondent r_3 who was excluded from the data set since its coefficient was not significant.

We then analyzed the variation in behaviors of each group of respondents (HLA and LLA) over time. Following Yukl *et al.* (2002) and Van Dun *et al.* (2017), the consolidated Step 3 behaviors were grouped according to their main orientation (seven task-oriented behaviors and eight relations-oriented behaviors). The Cronbach's αs indicated a high reliability: $\alpha = 0.999$ for the task-oriented behavior category and $\alpha = 0.809$ for the relations-oriented behavior category.

The Kolmogorov–Smirnov test was used to check if the data followed a normal distribution, and it did not ($p < 0.05$). Hence, the non-parametric Mann–Whitney test was applied to identify differences between the task- and relations-oriented behavior medians, according to the LH implementation level (LLA and HLA) and each data point (t_1, t_2 and t_3). This technique is an alternative to parametric tests that require homoscedasticity and data adherence to a normal distribution (Siegel and Castellan, 1988).

Table III.
Lean practices most cited in the literature

Lean practices	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	Agreement (%)	Evidence of application Healthcare	Evidence of application Manufacturing
l_1 – flexible manpower	X		X			X		X	X	X	X		X	X	X	67	X	X
l_2 – pull system	X	X		X		X	X	X	X	X	X	X		X	X	80	X	X
l_3 – take time	X	X		X		X		X				X		X	X	53		X
l_4 – continuous flow	X	X		X		X	X	X	X	X	X	X		X	X	80	X	X
l_5 – material supply	X	X	X	X			X	X	X	X	X	X		X	X	80	X	X
l_6 – zero defects	X	X			X	X	X	X	X	X				X	X	67	X	X
l_7 – quality assurance	X	X	X	X				X	X	X				X	X	60	X	X
l_8 – product/process quality planning	X		X	X	X			X	X	X		X		X	X	67	X	X
l_9 – standardized work	X	X		X	X		X	X	X	X	X	X	X	X	X	87	X	X
l_{10} – production leveling	X			X	X	X	X	X	X	X	X	X		X	X	80		X
l_{11} – maintenance system	X	X		X		X	X	X	X	X	X	X		X	X	80	X	X
l_{12} – workplace organization	X	X					X	X	X	X	X	X	X	X	X	73	X	X
l_{13} – goal oriented teams	X					X	X			X	X		X	X	X	53	X	X
l_{14} – cross functional work		X		X	X					X	X			X		40	X	X
l_{15} – problem-solving methods	X		X		X	X	X	X	X	X	X	X	X	X	X	87	X	X
l_{16} – policy deployment			X	X		X				X	X		X	X		47	X	X
l_{17} – small group activities				X	X					X				X		27	X	X

Notes: (1) Shah and Ward (2003); (2) Doolen and Hacker (2005); (3) De Treville and Antonakis (2006); (4) Shah and Ward (2007); (5) Furlan *et al.* (2011); (6) Stone (2012); (7) Moyano-Fuentes and Sacristán-Díaz (2012); (8) Marodin and Saurin (2013); (9) Stentoft and Vagn (2013); (10) Netland and Ferdows (2014); (11) Bhamu and Singh Sangwan (2014); (12) Jasti and Kodali (2015); (13) Bortolotti *et al.* (2015); (14) Netland *et al.* (2015); (15) Marodin *et al.* (2015)

4. Results and discussion

4.1 Stage 1: literature review

In total, 88 different author groups were identified from the 107 reviewed articles. Only 12 had at least two publications whereby Dombrowski and Aij stand out as the most prolific ones. Table V shows the main journals and conferences included in the portfolio. The *Journal of Manufacturing Technology Management* and *Total Quality Management & Business Excellence* had the most publications. Figure 2 shows there was a significant increase in the number of publications between 1991 and 2017 of which approximately 30 percent were published during the last three years, indicating the recent increased attention toward the topic. Moreover, there is a discrepancy in the literature between the healthcare and manufacturing contexts: the first publication on lean leadership in a manufacturing context dates from 1991, whereas studies of lean leaders in healthcare organizations were only published after 2000.

In total, 15 behaviors were identified (see Table VI), of which 7 were deemed as task-oriented and 8 as purely relations-oriented. Four behaviors were mentioned in more than 40 percent of the articles, both in the manufacturing and healthcare samples, namely: b_1 (demonstrating commitment and support), b_2 (developing and training employees), b_3 (creating a learning

Table IV. Unstandardized regression coefficients for respondents' lean practices adoption throughout the three data collection moments

Respondents	Unstandardized coefficients	R^2	Adjusted R^2	Group
r_2	9.5*	0.986	0.953	LLA
r_5	14.0*	0.879	0.844	
r_6	11.0*	0.989	0.975	
r_7	14.0*	0.879	0.866	
r_{12}	15.0*	0.871	0.841	
r_1	16.0*	0.988	0.950	HLA
r_4	19.0*	0.944	0.911	
r_8	17.5*	0.956	0.922	
r_9	22.5*	0.980	0.945	
r_{10}	16.5*	0.999	0.980	
r_{11}	24.5*	0.961	0.924	
r_3	1.0	0.250	0.230	Excluded

Note: *Significant at the 0.05 level

Table V. Number of articles on lean and leadership published per journal/conference

Journal/Conference	Total publications
Journal of Manufacturing Technology Management	8
Total Quality Management & Business Excellence	7
Leadership in Health Services	5
Management Decision	5
61st Annual Conference and Expo of the Institute of Industrial Engineers	3
BMC Health Services Research	3
Leadership & Organisation Development Journal	3
Manufacturing Engineering	3
Procedia CIRP	3
ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb	3
Industry Week	2
International Journal of Health Care Quality Assurance	2
International Journal of Human Resources Development and Management	2
International Journal of Operations & Production Management	2
International Journal of Production Research	2
Journal of Health Organisation and Management	2
Quality Management in Health Care	2
Others ($n = 67$)	1

environment) and b_5 (formulating and communicating goals and objectives). The first three are relations-oriented while b_5 is task-oriented. These leadership behaviors might be relevant for successful lean implementation regardless of the context. The other behaviors seem to be more prominent in one or the other context. For instance, there was a large difference in how often b_4 (empowering employees) was mentioned between healthcare and manufacturing contexts (50 and 23 percent, respectively). Successful lean implementation requires leaders to encourage and empower employees to solve problems and improve their workplaces (Poksinska *et al.*, 2013; Dannapfel *et al.*, 2014; Aij, Aernoudts and Joosten, 2015; Aij, Visse and Widdershoven, 2015).

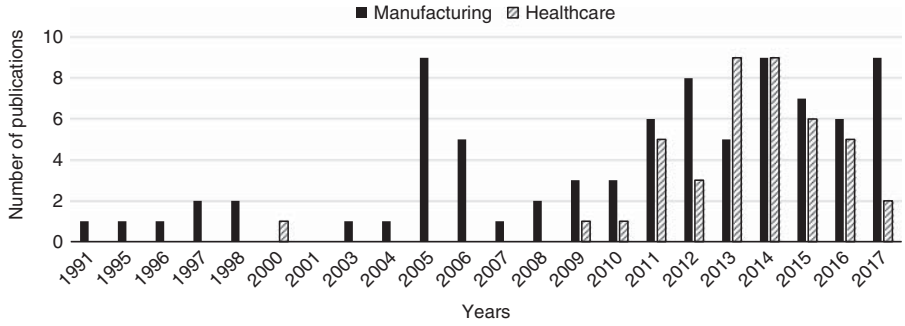

Figure 2.
Number of publications on lean and leadership

Behaviors	Healthcare ($n = 42$) Qty.	Healthcare ($n = 42$) Freq. (%)	Manufacturing ($n = 65$) Qty.	Manufacturing ($n = 65$) Freq. (%)	Behavior orientation[a] Task	Behavior orientation[a] Relations	Early maturity stage HC	Early maturity stage MF	Advanced maturity stage HC	Advanced maturity stage MF
b_1 – Demonstrating commitment and support	31	*74*	34	*52*		X	X			X
b_2 – Developing and training employees	22	*52*	30	*46*		X	X			X
b_3 – Creating a learning environment	21	*50*	24	*40*		X	X			X
b_4 – Empowering employees	21	*50*	15	23		X	X			X
b_5 – Formulating and communicating goals and objectives	18	*43*	27	*42*	X		X	X		X
b_6 – Committing to self-development	17	*41*	15	23	X	X	X	X	X	X
b_7 – visiting the work floor (*gemba* walk)	15	36	14	22	X	X	X	X	X	X
b_8 – getting and giving information	12	29	27	*42*	X			X	X	
b_9 – acting as a role model	11	26	12	18		X	X			X
b_{10} – showing modesty and openness	3	7	6	9		X	X			X
b_{11} – celebrating and recognizing success	3	7	4	6		X	X			X
b_{12} – intellectual stimulation	2	5	6	9		X	X			X
b_{13} – monitoring and evaluating	2	5	4	6	X			X	X	
b_{14} – experimenting	2	5	3	5	X			X	X	
b_{15} – visibly applying lean	1	2	3	5	X			X	X	X

Notes: HC, healthcare context; MF, manufacturing context. Italic numbers indicate citation frequencies above 40 percent. Quantities and frequencies refer to the absolute and relative numbers of behaviors' citation in the reviewed articles
Sources: [a]Yukl *et al.* (2002) and Van Dun *et al.* (2017)

Table VI.
Lean leadership behaviors based upon the reviewed articles

The importance of b_4 in healthcare organizations may be due to the occurrence of rapid changes in patients' clinical conditions, requiring versatility, speed and assertiveness in employees' decision-making processes (Abuhejleh *et al.*, 2016; Aij and Veth, 2017). Similarly, b_6 (committing to self-development) was mentioned more frequently in healthcare studies (41 percent) than in manufacturing ones (23 percent). This finding is surprising because Ballé *et al.* (2017) suggested that lean leaders must be adaptive learners despite the context. In turn, b_8 (getting and giving information) appears to prevail in manufacturing (42 percent compared to 29 percent in healthcare articles). Although sharing information is a key lean leadership behavior (Van Dun and Wilderom, 2016), adequate information sharing may not be always feasible in healthcare organizations due to patient privacy issues and the high workload of doctors and nurses (Jones, 2017).

Thus, from the 15 behaviors listed in Table VI, task-oriented behaviors included: b_5 – formulating and communicating goals and objectives, b_6 – committing to self-development, b_7 – visiting the work floor (*gemba* walk), b_8 – getting and giving information, b_{13} – monitoring and evaluating, b_{14} – experimenting and b_{15} – visibly applying lean. Although self-development and *gemba* walks obviously require good relations with co-workers, their predominant focus is on tasks. Leaders mainly focus on task performance and improvement during *gemba* walks whereas self-development relates to better leader task execution. In turn, relation-oriented behaviors comprised: b_1 – demonstrating commitment and support, b_2 – developing and training employees, b_3 – creating a learning environment, b_4 – empowering employees, b_9 – acting as a role model, b_{10} – showing modesty and openness, b_{11} – celebrating and recognizing success and b_{12} – intellectual stimulation.

It is likely that leadership behaviors will differ between hierarchical levels (DeChurch *et al.*, 2010). However, few studies explicitly reported their sample's hierarchical level: 7 out of 42 healthcare articles and 13 out of 65 manufacturing ones. Other studies approached the theme in a superficial way, without clearly indicating behavioral differences between hierarchical levels. Healthcare studies usually referred to technicians as operational-level leaders since they are actively involved in patient care, emphasizing the need for interpersonal skills' development for quality improvement (Leggat *et al.*, 2010). At a tactical level, middle managers (e.g. nurses and physicians) usually struggle to accept the required socio-cultural changes for successful lean implementation (Fillingham, 2007; Papadopoulos *et al.*, 2011). This might be because they are highly trained professionals who usually work in more than one healthcare organization, implying higher levels of work autonomy which undermines teamwork and collaboration (Spear, 2005). Finally, strategic level leaders seem to be studied more often in manufacturing contexts. Even though senior managers are responsible for reinforcing employees' involvement and guiding the change process, such behaviors are emphasized much less in LH implementations (Ben-Tovim *et al.*, 2007; Carpenter, 2011; Steed, 2012).

Few articles showed how leaders' behaviors differ across the LH maturity stages. Tortorella, Fogliatto, Anzanello, Marodin, Garcia and Esteves (2017), for example, evidenced certain trends in task- and relations-oriented leadership behaviors during lean implementation. Others (Mann, 2009; Testani and Ramakrishnan, 2010) only suggest that it is not possible to consider a single best leadership behavior which supports all the phases of lean implementation. In general, the literature indicates that leaders' behaviors in manufacturing organizations seem to be more task- than relations-oriented at the initial stages of lean implementation. As the implementation advances, leaders might start to emphasize the importance of interpersonal relationships (Found and Harvey, 2007; Found *et al.*, 2009; Martínez-Jurado *et al.*, 2013).

4.2 Stage 2: longitudinal study

Table VII displays the results of the Mann–Whitney test for behavioral variation of the LLA and HLA leaders over time. Both groups showed no significant changes at the beginning of

Respondents' group	Behavior orientation	Moment of data collection t_1 Median	t_1 SD	t_2 Median	t_2 SD	t_3 Median	t_3 SD
LLA ($n=5$)	Task	3.00	0.598	3.67	0.589		
	Relations	3.44	0.592	3.89	0.748		
	Task	3.00**	0.598			4.50**	0.254
	Relations	3.44*	0.592			4.56*	0.420
	Task			3.67*	0.589	4.50*	0.254
	Relations			3.89	0.748	4.56	0.420
HLA ($n=6$)	Task	3.085	0.631	3.915	0.412		
	Relations	3.280	0.551	3.665	0.425		
	Task	3.085**	0.631			4.330**	0.251
	Relations	3.280**	0.551			4.330**	0.209
	Task			3.915*	0.412	4.330*	0.251
	Relations			3.665**	0.425	4.330**	0.209

Notes: *,**Significant at 0.05 and 0.01 levels (2-tailed), respectively

Table VII. Mann–Whitney test for behavioral orientation of LLA and HLA at t_1, t_2 and t_3

the LH implementation (between t_1 and t_2) in terms of task or relations behaviors. Clearly, behaviors take time to develop, as also evidenced by Turner *et al.* (2019).

However, when comparing the early t_1 and late t_3 stages of the LH implementation, both groups of leaders showed a significant increase in task- and relations-oriented behaviors. This suggests that as LH practices become more mature, leaders are more prone to develop their own behaviors, regardless of the pace of the implementation within the department (e.g. LLA and HLA). These behavioral growth trends are clearly illustrated in Figures 3 and 4.

The behavioral changes observed for the LLA and HLA groups differed between t_2 and t_3. LLA leaders only increased their task-oriented behaviors whereas HLA leaders appear to have also significantly increased their relations-oriented behaviors. This outcome somewhat complements Van Dun *et al.* (2017) who found that effective lean middle managers engage significantly more in positive relations-oriented behaviors than in task-oriented ones. In fact, our results indicate that leaders who have implemented LH more extensively might also feel the need to adapt their behaviors in a more versatile fashion by paying similar attention to both task and relations orientations.

This difference was corroborated by the semi-structured interview data. As the hospital had only been implementing LH for two years, isolated improvement initiatives were still observed. The comments in Table VIII show that the HLA leaders realized that in order to

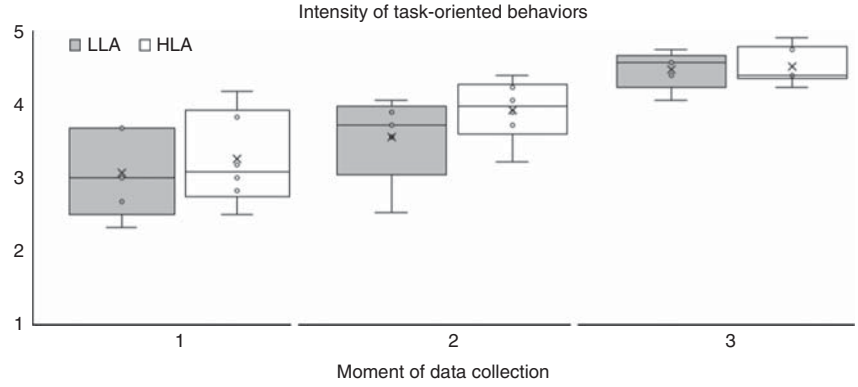

Figure 3. Trend in adoption of task-oriented leadership behaviors and LH implementation

implement LH effectively, they had to display both behavioral relations and task orientations, such as acting as a role model and visibly applying lean, respectively. The LLA leaders, on the other hand, seemed to focus on technical lean trainings (i.e. task-oriented) and relied on senior managers to engage with their employees.

Overall, regardless of the pace or effectiveness of the LH implementation, all the leaders enhanced their adoption of task behaviors between t_2 and t_3. Spear and Bowen (1999), Spear (2004) and Tortorella *et al.* (2018) affirmed that LM implementation requires senior leader's attention to any task aspect: content, sequence, timing and outcome. Leaders' adoption of task-oriented behaviors may contribute to clear organizational standards that support the establishment of continuous improvement initiatives especially in organizations located in developing economies (Shrafat and Ismail, 2019), such as Brazil.

5. Conclusions

Following a systematic literature review and longitudinal mixed-methods study of the relationship between leaders' behaviors and LH implementation, we specify two bundles of task and relations-oriented behaviors that can be adopted by leaders engaging in LH.

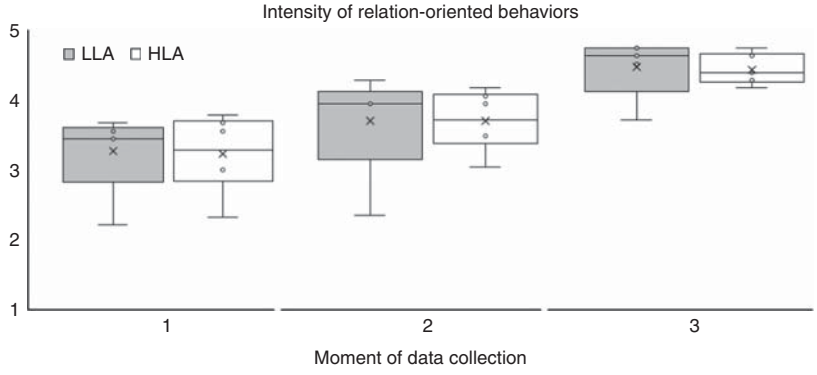

Figure 4.
Trend in adoption of relation-oriented leadership behaviors and LH implementation

Respondents	t_2	t_3
LLA	"I think the most important thing for lean implementation to succeed is the support, engagement and commitment of the management. In general, senior managers tend to base strategies, budgets and daily decisions solely on numbers, without developing a personal and first-hand knowledge of what really goes on in the frontlines where people care for patients"	"When I started implementing lean at the hospital, my first intention was to schedule some trainings so that my employees could start implementing the lean practices. I soon realized that the change process in practice is very different from theory. In fact, only two of my followers actually implemented lean"
HLA	"As a manager, I like to set goals and motivate my employees by emphasizing that all of them can influence the change process but have to take responsibility"	"To convince my employees of the benefits of LH implementation, I had to change my own mindset. In order to reduce the people's resistance, I started to spend more time on the work floor and stimulated them to participate more during the improvement meetings. I realized that I needed to set the example if I wanted to engage my employees in the change process"

Table VIII.
Examples of comments from LLA and HLA respondents throughout the study

5.1 Theoretical implications

Our study's theoretical contributions are twofold. First, on comparing the behavioral lean leadership literature, there is an overlap between manufacturing and healthcare contexts. Leaders' behaviors during lean implementation can be generalizable to other contexts than manufacturing. This contrasts the contingency theory that assumes context influences (lean) practices adoption (Sousa and Voss, 2008; Pereira *et al.*, 2019). Instead, leadership behaviors may not be bound to the work context. Other studies corroborate this: Poksinska *et al.* (2013) noted that although their manufacturing case had higher lean maturity, similar leadership developments were found in their studied healthcare case. This may be due to the fact that lean is built upon a philosophy with strong principles of continuous improvement and respect for people (Bhasin and Burcher, 2006). In fact, Van Dun and Wilderom (2016) found that more effective lean leaders have certain work values, regardless of their industry.

Second, task-oriented behaviors are positively associated with either a more rapid or slower LH implementation. Previous research on LH emphasized the importance of relations-oriented behaviors but did not pay task-oriented ones much attention (see Table VI). Instead, we note that LH implementation necessitates leaders to demonstrate task-oriented behaviors, especially if short-term results are mandatory. More mature lean leaders also develop their relations-oriented behaviors. This finding resembles the augmentation effect of leadership which postulates that effective leaders combine both (task-oriented) transactional and (relations-oriented) transformational leadership styles (Lord *et al.*, 2017). Although lean practices are mainly task-focused and may induce leader's task-oriented behaviors, developing relations-oriented behaviors simultaneously is more likely to lead to more favorable lean results.

5.2 Practical implications

This research can help healthcare organizations that are either undergoing or designing a LH implementation to improve the success of the transformation. Since behavioral shifts usually demand time, hospitals may start to assess leader's training needs and develop matching programs. Hospital middle managers have a significant influence on daily decision-making processes (Abdallah, 2014), which justifies investing in developing them throughout the LH implementation process. Organizations can now build their medical leadership models based upon the leader-behavioral repertoire uncovered by our research which may reduce healthcare leaders' likely resistance to change. It could help healthcare professionals feel "more comfortable with industrial process improvement techniques" such as lean (D'Andreamatteo *et al.*, 2015, p. 1206).

The implications of this research go beyond the healthcare context. As shown by our literature review, evidence on how leadership behaviors develop throughout the lean implementation is still scarce, regardless of the industrial sector. Although Tortorella, Fogliatto, Anzanello, Marodin, Garcia and Esteves (2017), Tortorella, Fettermann, Anzanello and Sawhney (2017) attempted to identify this variation according to lean implementation phases in manufacturing companies, their findings were not built on a longitudinal study. Thus, the indications provided by this study are quite unique and provide arguments about the impact of leaders' behaviors in other industrial sectors, such as manufacturing, enabling a smoother and more effective lean implementation.

5.3 Societal implications

As the demand for higher effectiveness, quality and lower costs are increasingly evident in healthcare organizations across the globe, the proper implementation of improvement approaches, such as LH, gains significant relevance. Since lean implementation is claimed to require a long-term approach (Wickramasinghe and Wickramasinghe, 2017), identifying leader behaviors that relate to more extensive and faster implementation of LH practices contributes to achieving the required improvements for sustainable healthcare systems.

Consequently, if hospitals know about those recommended leader behaviors, they are more likely to address changes in terms of managerial development. Such investments can increase hospital performance further and, hence, the quality and cost of the healthcare. Therefore, besides its theoretical and practical contributions, our work implicitly benefits society at large as the healthcare sector is a vital service that must allocate its scarce resources wisely. Our study implies that hospitals can benefit from manufacturers' operations management techniques; both in Europe and USA various examples of lean knowledge exchanges exist between hospitals and manufacturing contexts.

5.4 Strengths, limitations and future research

We combined two methods: An extensive literature review with a longitudinal comparison study of middle managers of a healthcare institution who had adopted LH practices with varying intensities. We are not aware of a similar mixed-method approach to this topic. It may inspire future studies but, ideally, they should also compare leaders across different industrial settings to understand potential differences better regarding leader-behavioral repertoires throughout the lean implementation.

In terms of limitations, more sophisticated data analyses (e.g. factor analysis) were not possible because of the small sample size. Common method bias was curbed by using a mixed-methods approach, locating the dependent variables distant from the independent variables (as recommended by Podsakoff *et al.*, 2003), adding scale labels, plus assuring respondents' anonymity and confidentiality. Future research must involve data from multiple sources to avoid self-report and should be expanded to a longer period than one year. The outcomes of our exploratory field study provide confidence for developing more robust insights into theory and practice. Such future studies could also investigate how lean practices adoption directly influences leader's behaviors (Liker, 2004), and, in turn, operational performance (Sangwa and Sangwan, 2018a, b).

Finally, four out of the six HLA leaders play an administrative role; i.e. they lead administrative processes that underpin the material, information and patient flows within the hospital. In turn, four of the five LLA leaders were enrolled in technical positions, such as physician. Their different roles may have affected their different LH implementation levels. Hospital leaders with a more technical background are likely to struggle with some abstract concepts and principles inherent to LH implementation (Tortorella, Fogliatto, Anzanello, Marodin, Garcia and Esteves, 2017). Our results corroborate this since the association between the behavioral change and LH implementation was more latent in leaders who perform administrative activities and whose backgrounds do not present a solely healthcare focus. Future research should look into this matter.

Recently, Yukl (2012) introduced two new leader-behavioral categories that coexist with task- and relations-oriented behaviors, namely: change and external orientation. Given that any lean adoption requires the people involved to embrace continuous change as well as an external customer-orientation and collaboration across departments and supply chains, future studies could specify further the behavioral pallet that is required from effective lean leaders across industries and lean maturity stages.

References

*Indicates references included in the portfolio.

*Abdallah, A. (2014), "Implementing quality initiatives in healthcare organizations: drivers and challenges", *International Journal of Health Care Quality Assurance*, Vol. 27 No. 3, pp. 166-181.

*Abuhejleh, A., Dulaimi, M. and Ellahham, S. (2016), "Using lean management to leverage innovation in healthcare projects: case study of a public hospital in the UAE", *BMJ Innovations*, Vol. 2 No. 1, pp. 22-32.

*Aij, K.H. and Veth, M.E. (2017), "Leadership requirements for lean versus servant leadership in health care: a systematic review of the literature", *Journal of Healthcare Leadership*, Vol. 9 No. 1, pp. 1-14.

*Aij, K.H., Aernoudts, R.L. and Joosten, G. (2015), "Manager traits and quality-of-care performance in hospitals", *Leadership in Health Services*, Vol. 28 No. 3, pp. 200-215.

*Aij, K.H., Visse, M. and Widdershoven, G.A. (2015), "Lean leadership: an ethnographic study", *Leadership in Health Services*, Vol. 28 No. 2, pp. 119-134.

Allway, M. and Corbett, S. (2002), "Shifting to lean service: stealing a page from manufacturers playbooks", *Journal of Organizational Excellence*, Vol. 21 No. 2, pp. 45-54.

*Angelis, J., Conti, R., Cooper, C. and Gill, C. (2011), "Building a high-commitment lean culture", *Journal of Manufacturing Technology Management*, Vol. 22 No. 5, pp. 569-586.

Augusto, B.P. and Tortorella, G.L. (2019), "Literature review on lean healthcare implementation: assessment methods and practices", *International Journal of Services and Operations Management*, Vol. 32 No. 3, pp. 285-306.

Ballé, M. and Régnier, A. (2007), "Lean as a learning system in a hospital ward", *Leadership in Health Services*, Vol. 20 No. 1, pp. 33-41.

Ballé, M., Jones, D.T., Fiume, O.J. and Chaize, J. (2017), *The Lean Strategy: Using Lean to Create Competitive Advantage, Unleash Innovation, and Deliver Sustainable Growth*, McGraw-Hill Education, New York, NY.

Bandura, A. (1977), *Social Learning Theory*, Prentice Hall, Englewood Cliffs, NJ.

Ben-Tovim, D.I., Bassham, J.E., Bolch, D., Martin, M.A., Dougherty, M. and Szwarcbord, M. (2007), "Lean thinking across a hospital: redesigning care at the flinders medical centre", *Australian Health Review*, Vol. 31 No. 1, pp. 10-15.

Bhamu, J. and Singh Sangwan, K. (2014), "Lean manufacturing: literature review and research issues", *International Journal of Operations & Production Management*, Vol. 34 No. 7, pp. 876-940.

Bhasin, S. and Burcher, P. (2006), "Lean viewed as a philosophy", *Journal of Manufacturing Technology Management*, Vol. 17 No. 1, pp. 56-72.

Birken, S.A., Lee, S.Y.D. and Weiner, B.J. (2012), "Uncovering middle managers' role in healthcare innovation implementation", *Implementation Science*, Vol. 7 No. 1, pp. 28-40.

*Bortolotti, T., Boscari, S. and Danese, P. (2015), "Successful lean implementation: organizational culture and soft lean practices", *International Journal of Production Economics*, Vol. 160 No. 1, pp. 182-201.

Boyle, T., Scherrer-Rathje, M. and Stuart, I. (2011), "Learning to be lean: the influence of external information sources in lean improvements", *Journal of Manufacturing Technology Management*, Vol. 22 No. 5, pp. 587-603.

Bushell, S. and Shelest, B. (2002), "Discovering lean thinking at progressive healthcare", *The Journal for Quality and Participation*, Vol. 25 No. 2, pp. 20-25.

Camuffo, A. and Gerli, F. (2018), "Modeling management behaviors in lean production environments", *International Journal of Operations & Production Management*, Vol. 38 No. 2, pp. 403-423.

Carpenter, D. (2011), "Transforming health care", *Hospitals & Health Networks*, Vol. 85 No. 5, pp. 46-50.

Chalice, R. (2007), *Improving Healthcare using Toyota Lean Production Methods: 46 Steps for Improvement*, ASQ Quality Press, Milwaukee, WI.

Dahlgaard, J. and Dahlgaard-Park, M.S. (2006), "Lean production, six sigma quality, TQM and company culture", *The TQM Magazine*, Vol. 18 No. 3, pp. 263-281.

*Dahlgaard, J.J., Pettersen, J. and Dahlgaard-Park, S.M. (2011), "Quality and lean health care: a system for assessing and improving the health of healthcare organisations", *Total Quality Management & Business Excellence*, Vol. 22 No. 6, pp. 673-689.

*D'Andreamatteo, A., Ianni, L., Lega, F. and Sargiacomo, M. (2015), "Lean in healthcare: a comprehensive review", *Health Policy*, Vol. 119 No. 9, pp. 1197-1209.

Danese, P., Manfè, V. and Romano, P. (2018), "A systematic literature review on recent lean research: state-of-the-art and future directions", *International Journal of Management Reviews*, Vol. 20 No. 2, pp. 579-605.

*Dannapfel, P., Poksinska, B. and Thomas, K. (2014), "Dissemination strategy for lean thinking in health care", *International Journal of Health Care Quality Assurance*, Vol. 27 No. 5, pp. 391-404.

DeChurch, L., Hiller, N., Murase, T., Doty, D. and Salas, E. (2010), "Leadership across levels: levels of leaders and their levels of impact", *The Leadership Quarterly*, Vol. 21 No. 6, pp. 1069-1085.

De Treville, S. and Antonakis, J. (2006), "Could lean production job design be intrinsically motivating? Contextual, configurational, and levels-of-analysis issues", *Journal of Operations Management*, Vol. 24 No. 2, pp. 99-123.

*Dickson, E.W., Anguelov, Z., Veterick, D., Eller, A. and Singh, S. (2009), "Use of lean in the emergency department: a case series of 4 hospitals", *Annals of Emergency Medicine*, Vol. 54 No. 4, pp. 504-510.

Dickson, E.W., Singh, S., Cheung, D.S., Wyatt, C.C. and Nugent, A.S. (2009), "Application of lean manufacturing techniques in the emergency department", *The Journal of Emergency Medicine*, Vol. 37 No. 2, pp. 177-182.

*Dombrowski, U. and Mielke, T. (2014), "Lean leadership: 15 rules for a sustainable lean implementation", *Procedia CIRP*, Vol. 17 No. 1, pp. 565-570.

Doolen, T. and Hacker, M. (2005), "A review of lean assessment in organizations: an exploratory study of lean practices by electronics manufacturers", *Journal of Manufacturing Systems*, Vol. 24 No. 1, pp. 55-67.

Feinstein, K.W., Grunden, N. and Harrison, E.I. (2002), "A region addresses patient safety", *American Journal of Infection Control*, Vol. 30 No. 4, pp. 248-251.

Fillingham, D. (2007), "Can lean save lives?", *Leadership in Health Services*, Vol. 20 No. 4, pp. 231-241.

*Found, P.A. and Harvey, R. (2007), "Leading the lean enterprise", *IET Engineering Management*, Vol. 17 No. 1, pp. 40-43.

*Found, P.A., Van Dun, D.H. and Fei, F. (2009), "Multi-level management and leadership skills in lean organizations", paper presented at POMS 20th Annual Conference, May 1–4, Orlando, FL, available at: www.pomsmeetings.org/ConfPapers/011/011-0035.pdf (accessed March 29, 2019).

Furlan, A., Vinelli, A. and Dal Pont, G. (2011), "Complementarity and lean manufacturing bundles: an empirical analysis", *International Journal of Operations & Production Management*, Vol. 31 No. 8, pp. 835-850.

Graban, M. (2011), *Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement*, CRC Press, Boca Raton, FL.

Holden, R.J. (2011), "Lean thinking in emergency departments: a critical review", *Annals of Emergency Medicine*, Vol. 57 No. 3, pp. 265-278.

Institute of Medicine (2001), *Crossing the Quality Chasm*, IOM, Washington, DC.

Jasti, N. and Kodali, R. (2015), "Lean production: literature review and trends", *International Journal of Production Research*, Vol. 53 No. 3, pp. 867-885.

Jimmerson, C., Weber, D. and Sobek, D.K. (2005), "Reducing waste and errors: piloting lean principles at intermountain healthcare", *The Joint Commission of Journal on Quality and Patient Safety*, Vol. 31 No. 5, pp. 249-257.

Jones, D.T. (2017), "Lean healthcare", in Netland, T.H. and Powell, D.J. (Eds), *The Routledge Companion to Lean Management*, Routledge, New York, NY, pp. 261-270.

*Kaplan, G.S., Paterson, S.H., Ching, J.M. and Blackmore, C.C. (2014), "Why lean doesn't work for everyone", *BMJ Quality & Safety*, Vol. 23 No. 12, pp. 970-973.

*Kim, C.S., Spahlinger, D.A., Kin, J.M. and Billi, J.E. (2006), "Lean health care: what can hospitals learn from a world-class automaker?", *Journal of Hospital Medicine*, Vol. 1 No. 3, pp. 191-199.

Kim, S. and Toya, K. (2019), "Leadership style required for the transition to servitization in Japan", *Journal of Manufacturing Technology Management*, Vol. 30 No. 2, pp. 335-352.

Leggat, S.G., Bartram, T., Casimir, G. and Stanton, P. (2010), "Nurse perceptions of the quality of patient care: confirming the importance of empowerment and job satisfaction", *Health Care Management Review*, Vol. 35 No. 4, pp. 355-364.

Liker, J.K. (2004), *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer*, McGraw-Hill, New York, NY.

Liker, J.K. and Convis, G.L. (2012), *The Toyota Way to Lean Leadership*, McGraw-Hill, New York, NY.

Lord, R.G., Day, D.V., Zaccaro, S.J., Avolio, B.J. and Eagly, A.H. (2017), "Leadership in applied psychology: three waves of theory and research", *Journal of Applied Psychology*, Vol. 102 No. 3, pp. 434-451.

*Mann, D. (2009), "The missing link: lean leadership", *Frontiers of Health Services Management*, Vol. 26 No. 1, pp. 15-26.

Marksberry, P. (2010), "A new approach in analysing social-technical roles at Toyota: the team leader", *International Journal of Human Resources Development and Management*, Vol. 10 No. 4, pp. 395-412.

Marodin, G. and Saurin, T. (2013), "Implementing lean production systems: research areas and opportunities for future studies", *International Journal of Production Research*, Vol. 51 No. 22, pp. 6663-6680.

Marodin, G., Saurin, T., Tortorella, G. and Denicol, J. (2015), "How context factors influence lean production practices in manufacturing cells", *The International Journal of Advanced Manufacturing Technology*, Vol. 79 Nos 5-8, pp. 1389-1399.

Marodin, G.A., Frank, A.G., Tortorella, G.L. and Saurin, T.A. (2016), "Contextual factors and lean production implementation in the Brazilian automotive supply chain", *Supply Chain Management: An International Journal*, Vol. 21 No. 4, pp. 417-432.

*Martínez-Jurado, P.J., Moyano-Fuentes, J. and Gomez, P.J. (2013), "HR management during lean production adoption", *Management Decision*, Vol. 51 No. 4, pp. 742-760.

Moyano-Fuentes, J. and Sacristán-Díaz, M. (2012), "Learning on lean: a review of thinking and research", *International Journal of Operations & Production Management*, Vol. 32 No. 5, pp. 551-582.

Netland, T. and Ferdows, K. (2014), "What to expect from a corporate lean program", *MIT Sloan Management Review*, Vol. 55 No. 4, pp. 83-89.

Netland, T., Schloetzer, J.D. and Ferdows, K. (2015), "Implementing corporate lean programs: the effect of management control practices", *Journal of Operations Management*, Vol. 10 No. 2, pp. 99-123.

*Pamfilie, R., Petcu, A.J. and Draghici, M. (2012), "The importance of leadership in driving a strategic lean six sigma management", *Procedia – Social and Behavioral Sciences*, Vol. 58 No. 12, pp. 187-196.

Papadopoulos, T., Radnor, Z. and Merali, Y. (2011), "The role of actor associations in understanding the implementation of lean thinking in healthcare", *International Journal of Operations & Production Management*, Vol. 31 No. 2, pp. 167-191.

Pereira, V.R., Kreye, M.E. and Carvalho, M.M. (2019), "Customer-pulled and provider-pushed pathways for product-service system: the contingent effect of the business ecosystems", *Journal of Manufacturing Technology Management*, Vol. 30 No. 4, pp. 729-747.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879-903.

*Poksinska, B., Swartling, D. and Drot, E. (2013), "The daily work of lean leaders: lessons from manufacturing and healthcare", *Total Quality Management & Business Excellence*, Vol. 24 Nos 7/8, pp. 886-898.

Radnor, Z.J., Holweg, M. and Waring, J. (2012), "Lean in healthcare: the unfilled promise?", *Social Science & Medicine*, Vol. 74 No. 3, pp. 364-371.

Rutledge, J., Xu, M. and Simpson, J. (2010), "Application of the Toyota Production System improves core laboratory operations", *American Journal of Clinical Pathology*, Vol. 133 No. 1, pp. 24-31.

Salas, E., Zajac, S. and Marlow, S.L. (2018), "Transforming health care one team at a time: ten observations and the trail ahead", *Group & Organization Management*, Vol. 43 No. 3, pp. 357-381.

Sangwa, N.R. and Sangwan, K.S. (2018a), "Leanness assessment of organizational performance: a systematic literature review", *Journal of Manufacturing Technology Management*, Vol. 29 No. 5, pp. 768-788.

Sangwa, N.R. and Sangwan, K.S. (2018b), "Development of an integrated performance measurement framework for lean organizations", *Journal of Manufacturing Technology Management*, Vol. 29 No. 1, pp. 41-84.

Shah, R. and Ward, P. (2003), "Lean manufacturing: context, practice bundles, and performance", *Journal of Operations Management*, Vol. 21 No. 2, pp. 129-149.

Shah, R. and Ward, P. (2007), "Defining and developing measures of lean production", *Journal of Operations Management*, Vol. 21 No. 2, pp. 129-149.

Shook, J. (2010), "How to change a culture: lessons from NUMMI", *MIT Sloan Management Review*, Vol. 51 No. 2, pp. 62-69.

Shrafat, F. and Ismail, M. (2019), "Structural equation modeling of lean manufacturing practices in a developing country context", *Journal of Manufacturing Technology Management*, Vol. 30 No. 1, pp. 122-145.

Siegel, S. and Castellan, N. Jr (1988), *Nonparametric Statistics for the Behavioral Sciences*, 2nd ed., McGraw-Hill, New York, NY.

Sousa, R. and Voss, C.A. (2008), "Contingency research in operations management practices", *Journal of Operations Management*, Vol. 26 No. 6, pp. 697-713.

Souza, L.B. (2009), "Trends and approaches in lean healthcare", *Leadership in Health Services*, Vol. 22 No. 2, pp. 121-139.

Souza, L.B. and Pidd, M. (2011), "Exploring the barriers to lean health care implementation", *Public Money and Management*, Vol. 31 No. 1, pp. 59-66.

Spear, S. (2004), "Learning to lead at Toyota", *Harvard Business Review*, Vol. 82 No. 5, pp. 78-91.

Spear, S. (2005), "Fixing health care from the inside today", *Harvard Business Review*, Vol. 83 No. 9, pp. 78-91.

Spear, S. and Bowen, H.K. (1999), "Decoding the DNA of the Toyota production system", *Harvard Business Review*, Vol. 77 No. 5, pp. 96-106.

Staedele, A., Ensslin, S. and Forcellini, F. (2019), "Knowledge building about performance evaluation in lean production: an investigation on international scientific research", *Journal of Manufacturing Technology Management*.

*Steed, A. (2012), "An exploration of the leadership attributes and methods associated with successful lean system deployments in acute care hospitals", *Quality Management in Healthcare*, Vol. 21 No. 1, pp. 48-58.

Stentoft, A. and Vagn, F. (2013), "Evidence of lean: a review of international peer-reviewed journal articles", *European Business Review*, Vol. 25 No. 2, pp. 174-205.

Stone, K. (2012), "Four decades of lean: a systematic literature review", *International Journal of Lean Six Sigma*, Vol. 3 No. 2, pp. 112-132.

Suddaby, R. (2006), "From the editors: what grounded theory is not", *Academy of Management Journal*, Vol. 49 No. 4, pp. 633-642.

*Testani, M.V. and Ramakrishnan, S.S. (2010), "The role of leadership in sustaining a lean transformation", paper presented at Industrial Engineering Research Conference, June 5–9, Cancun.

*Tortorella, G. and Fogliatto, F. (2014), "Method for assessing human resources management practices and organisational learning factors in a company under lean manufacturing implementation", *International Journal of Production Research*, Vol. 52 No. 15, pp. 4623-4645.

*Tortorella, G., Fettermann, D., Anzanello, M. and Sawhney, R. (2017), "Lean manufacturing implementation, context and behaviors of multi-level leadership: a mixed-methods exploratory research", *Journal of Manufacturing Technology Management*, Vol. 28 No. 7, pp. 867-891.

Tortorella, G.L., de Castro Fettermann, D., Frank, A. and Marodin, G. (2018), "Lean manufacturing implementation: leadership styles and contextual variables", *International Journal of Operations & Production Management*, Vol. 38 No. 5, pp. 1205-1227.

*Tortorella, G.L., Fogliatto, F.S., Anzanello, M., Marodin, G.A., Garcia, M. and Esteves, R.R. (2017), "Making the value flow: application of value stream mapping in a Brazilian public healthcare organization", *Total Quality Management & Business Excellence*, Vol. 28 Nos 13/14, pp. 1544-1558.

*Toussaint, J.S. and Berry, L.L. (2013a), "The promise of lean in health care", *Mayo Clinic Proceedings*, Vol. 88 No. 1, pp. 74-82.

Turner, J.R., Thurlow, N., Baker, R., Northcutt, D. and Newman, K. (2019), "Multiteam systems in an agile environment: a realist systematic review", *Journal of Manufacturing Technology Management*, Vol. 30 No. 4, pp. 748-771.

Van Dun, D.H. and Wilderom, C.P.M. (2012), "Human dynamics and enablers of effective lean team cultures and climates", in Hodgkinson, G.P. and Ford, J.K. (Eds), *International Review of Industrial and Organizational Psychology*, John Wiley and Sons, Chichester, pp. 115-152.

*Van Dun, D.H. and Wilderom, C.P.M. (2016), "Lean-team effectiveness through leader values and members' informing", *International Journal of Operations & Production Management*, Vol. 36 No. 11, pp. 1530-1550.

*Van Dun, D.H., Hicks, J.N. and Wilderom, C.P.M. (2017), "Values and behaviors of effective lean managers: mixed-methods exploratory research", *European Management Journal*, Vol. 35 No. 2, pp. 174-186.

*Waring, J.J. and Bishop, S. (2010), "Lean healthcare: rhetoric, ritual and resistance", *Social Science & Medicine*, Vol. 71 No. 7, pp. 1332-1340.

Webster, J. and Watson, J.T. (2002), "Analyzing the past to prepare for the future: writing a literature review", *MIS Quarterly & The Society for Information Management*, Vol. 26 No. 2, pp. 13-23.

Womack, J.P. and Jones, D.T. (2003), *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*, Simon & Schuster, New York, NY.

Wickramasinghe, G.L.D. and Wickramasinghe, V. (2017), "Implementation of lean production practices and manufacturing performance: the role of lean duration", *Journal of Manufacturing Technology Management*, Vol. 28 No. 4, pp. 531-550.

Yukl, G. (2012), "Effective leadership behavior: what we know and what questions need more attention", *Academy of Management Perspectives*, Vol. 26 No. 4, pp. 66-85.

Yukl, G., Gordon, A. and Taber, T. (2002), "A hierarchical taxonomy of leadership behavior: integrating a half-century of behavior research", *Journal of Leadership and Organizational Studies*, Vol. 9 No. 1, pp. 15-32.

Zhang, L., Narkhede, B.E. and Chaple, A.P. (2017), "Evaluating lean manufacturing barriers: an interpretive process", *Journal of Manufacturing Technology Management*, Vol. 28 No. 8, pp. 1086-1114.

Further reading

*Achanga, P., Shehab, E., Roy, R. and Nelder, G. (2006), "Critical success factors for lean implementation within SMEs", *Journal of Manufacturing Technology Management*, Vol. 17 No. 4, pp. 460-471.

*Aij, K.H. and Teunissen, M. (2017), "Lean leadership attributes: a systematic review of the literature", *Journal of Health Organization and Management*, Vol. 31 Nos 7/8, pp. 713-729.

*Aij, K.H., Simons, F.E., Widdershoven, G.A. and Visse, M. (2013), "Experiences of leaders in the implementation of lean in a teaching hospital–barriers and facilitators in clinical practices: a qualitative study", *BMJ Open*, Vol. 3 No. 10, pp. 3605-3613.

*Alänge, S. and Steiber, A. (2009), "The board's role in sustaining major organizational change: an empirical analysis of three change programs", *International Journal of Quality and Service Sciences*, Vol. 1 No. 3, pp. 280-293.

*Al-Balushi, S., Sohal, A.S., Singh, P.J., Al Hajri, A., Al Farsi, Y.M. and Al Abri, R. (2014), "Readiness factors for lean implementation in healthcare settings: a literature review", *Journal of Health Organization and Management*, Vol. 28 No. 2, pp. 135-153.

*Alefari, M., Salonitis, K. and Xu, Y. (2017), "The role of leadership in implementing lean manufacturing", *Procedia CIRP*, Vol. 63 No. 1, pp. 756-761.

*Anand, G., Chhajed, D. and Delfin, L. (2012), "Job autonomy, trust in leadership, and continuous improvement: an empirical study in health care", *Operations Management Research*, Vol. 5 Nos 3/4, pp. 70-80.

*Andersen, H. and Røvik, K.A. (2015), "Lost in translation: a case-study of the travel of lean thinking in a hospital", *BMC Health Services Research*, Vol. 15 No. 1, pp. 401-410.

*Antony, J., Gijo, E. and Childe, S. (2012), "Case study in six sigma methodology: manufacturing quality improvement and guidance for managers", *Production Planning & Control*, Vol. 23 No. 8, pp. 624-640.

*Bäckström, I. and Ingelsson, P. (2015), "Is there a relationship between lean leaders and healthy co-workers?", *Quality Innovation Prosperity*, Vol. 19 No. 2, pp. 123-136.

*Ballé, M. (2005), "Lean attitude", *IEE Manufacturing Engineer*, Vol. 84 No. 2, pp. 14-19.

*Ballé, M., Chaize, J. and Jones, D. (2015), "Inclusive versus exclusive learning: the secret ingredient to creating a truly 'lean' and 'learning' culture", *Development and Learning in Organizations: An International Journal*, Vol. 29 No. 1, pp. 20-23.

*Barnas, K. (2011), "ThedaCare's business performance system: sustaining continuous daily improvement through hospital management in a lean environment", *The Joint Commission Journal on Quality and Patient Safety*, Vol. 37 No. 9, pp. 387-399.

*Berlec, T., Kleindienst, M., Rabitsch, C. and Ramsaue, C. (2017), "Methodology to facilitate successful lean implementation", *Journal of Mechanical Engineering*, Vol. 63 Nos 7/8, pp. 457-466.

*Bhasin, S. (2011), "Improving performance through lean", *International Journal of Management Science and Engineering Management*, Vol. 6 No. 1, pp. 23-36.

*Bhasin, S. (2012), "An appropriate change strategy for lean success", *Management Decision*, Vol. 50 No. 3, pp. 439-458.

*Boak, G., Dickens, V., Newson, A. and Brown, L. (2015), "Distributed leadership, team working and service improvement in healthcare", *Leadership in Health Services*, Vol. 28 No. 4, pp. 332-344.

*Bodek, N. (2008), "Leadership is critical to lean", *Manufacturing Engineering Magazine*, Vol. 140 No. 3, pp. 145-153.

*Booker, C., Turbutt, A. and Fox, R. (2016), "Model of care for a changing healthcare system: are there foundational pillars for design?", *Australian Health Review*, Vol. 40 No. 2, pp. 136-140.

*Boyer, K.K. (1996), "An assessment of managerial commitment to lean production", *International Journal of Operations & Production Management*, Vol. 16 No. 9, pp. 48-59.

*Boyer, M. and Sovilla, L. (2003), "How to identify and remove the barriers for a successful lean implementation", *Journal of Ship Production*, Vol. 19 No. 2, pp. 116-120.

*Brännmark, M. and Benn, S.A (2012), "Proposed model for evaluating the sustainability of continuous change programmes", *Journal of Change Management*, Vol. 12 No. 2, pp. 231-245.

*Caldwell, G. (2014), "Is leadership a useful concept in healthcare? An essay", *Leadership in Health Services*, Vol. 27 No. 3, pp. 185-192.

*Camuffo, A. and Micelli, S. (1997), "Mediterranean lean production supervisors, teamwork and new forms of work organization in three European car makers", *Journal of Management & Governance*, Vol. 1 No. 1, pp. 103-122.

*Dahlgaard-Park, S.M. (2011), "The quality movement: where are you going?", *Total Quality Management & Business Excellence*, Vol. 22 No. 5, pp. 493-516.

*Dahlgaard-Park, S.M., Chen, C., Jang, J. and Dahlgaardal, J.J. (2013), "Diagnosing and prognosticating the quality movement: a review on the 25 years quality literature (1987–2011)", *Journal Total Quality Management & Business Excellence*, Vol. 24 Nos 1/2, pp. 1-18.

*Dibia, I.K., Dhakal, H.N. and Onuh, S. (2014), "Lean leadership People Process Outcome (LPPO) implementation model", *Journal of Manufacturing Technology Management*, Vol. 25 No. 5, pp. 694-711.

*Dombrowski, U. and Mielke, T. (2012), "Lean leadership: sustainable management in holistic production systems", *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*, Vol. 107 No. 10, pp. 697-701.

*Dombrowski, U. and Mielke, T. (2013), "Lean leadership: fundamental principles and their application", *Procedia CIRP*, Vol. 7 No. 1, pp. 569-574.

*Dombrowski, U., Belz, T. and Jäger, F. (2014), "Shopfloor management in the loop control of the implementation of lean production systems (LPS): supporting lean leadership with corporate-wide and standardized performance measurement systems", *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*, Vol. 109 Nos 1/2, pp. 20-25.

*Dombrowski, U., Ebentreich, D. and Krenkel, P. (2016), "Impact analyses of lean production systems", *Procedia CIRP*, Vol. 57 No. 1, pp. 607-612.

*Dombrowski, U., Mielke, T. and Scheele, E. (2014), "Lean leadership: on the way from the hand to the head work", *ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb*, Vol. 109 No. 10, pp. 699-703.

*Dombrowski, U., Mielke, T. and Schulze, S. (2011), "Employee participation in the implementation of lean production systems", in ElMaraghy, H.A. (Ed.), *International Conference on Changeable, Agile, Reconfigurable and Virtual Production (CARV2011) in Montreal, Canada, 2011*, *Springer*, *Berlin*, pp. 428-433.

*Emiliani, M.L. (1998), "Lean behaviors", *Management Decision*, Vol. 36 No. 9, pp. 615-631.

*Emiliani, M.L. (2003), "Linking leaders' beliefs to their behaviors and competencies", *Management Decision*, Vol. 41 No. 9, pp. 893-910.

*Emiliani, M.L. (2008), "Standardized work for executive leadership", *Leadership & Organization Development Journal*, Vol. 29 No. 1, pp. 24-46.

*Emiliani, M.L. and Emiliani, M. (2013), "Music as a framework to better understand lean leadership", *Leadership & Organization Development Journal*, Vol. 34 No. 5, pp. 407-426.

*Emiliani, M.L. and Stec, D.J. (2004), "Using value-stream maps to improve leadership", *Leadership & Organization Development Journal*, Vol. 25 No. 8, pp. 622-645.

*Erskine, J., Hunter, D.J., Small, A., Hicks, C., McGovern, T., Lugsden, E., Whitty, P., Steen, N. and Eccles, M.P. (2013), "Leadership and transformational change in healthcare organisations: a qualitative analysis of the North East Transformation System", *Health Services Management Research*, Vol. 26 No. 1, pp. 29-37.

*Fine, B.A., Golden, B., Hannam, R. and Morra, D. (2009), "Leading Lean: a Canadian healthcare leader's guide", *Healthcare Quarterly*, Vol. 12 No. 3, pp. 32-41.

*Gelei, A., Losonci, D. and Matyusz, Z. (2015), "Lean production and leadership attributes: the case of Hungarian production managers", *Journal of Manufacturing Technology Management*, Vol. 26 No. 4, pp. 477-500.

*Ghosh, M. and Sobek, D.K. II (2015), "A problem-solving routine for improving hospital operations", *Journal of Health Organization and Management*, Vol. 29 No. 2, pp. 252-270.

*Goodridge, D., Westhorp, G., Rotter, T., Dobson, R. and Bath, B. (2015), "Lean and leadership practices: development of an initial realist program theory", *BMC Health Services Research*, Vol. 15 No. 1, pp. 362-377.

*Halling, B. and Renström, J. (2014), "Lean leadership: a matter of dualism", *International Journal of Human Resources Development and Management*, Vol. 14 No. 4, pp. 242-253.

*Hwang, P., Hwang, D. and Hong, P. (2014), "Lean practices for quality results: a case illustration", *International Journal of Health Care Quality Assurance*, Vol. 27 No. 8, pp. 729-741.

*Kane, M., Chui, K., Rimicci, J., Callagy, P., Hereford, J., Shen, S. and Pickham, D. (2015), "Lean manufacturing improves emergency department throughput and patient satisfaction", *Journal of Nursing Administration*, Vol. 45 No. 9, pp. 429-434.

*Keiser, J.A. (2012), "Leadership and cultural change: necessary components of a lean transformation", paper presented at 20th Annual Conference of the International Group for Lean Construction, July 18–20, San Diego, CA, available at: https://iglcstorage.blob.core.windows.net/papers/attachment-5615411c-4f25-44be-97e1-a85369bf3e59.pdf (accessed May 23, 2018).

*Koenigsaecker, G. (2005), "Leadership and the lean transformation: it's the most important job facing today's managers", *Manufacturing Engineering*, Vol. 135 No. 5, pp. 7-11.

*Kruskal, J.B., Reedy, A., Pascal, L., Rosen, M.P. and Boiselle, P.M. (2012), "Quality initiatives: lean approach to improving performance and efficiency in a radiology department", *RSNA Radio Graphics*, Vol. 32 No. 2, pp. 573-588.

*Laureani, A. and Antony, J. (2016), "Leadership: a critical success factor for the effective implementation of lean six sigma", *Total Quality Management & Business Excellence*, Vol. 29 Nos 5/6, pp. 502-523.

*Laureani, A. and Antony, J. (2017), "Leadership characteristics for lean six sigma", *Total Quality Management & Business Excellence*, Vol. 28 Nos 3/4, pp. 405-426.

*Laureani, A., Brady, M. and Antony, J. (2013), "Applications of lean six sigma in an Irish hospital", *Leadership in Health Services*, Vol. 26 No. 4, pp. 322-337.

*Lewis, D.W. (1991), "Eight truths for middle managers in Lean times", *Library Journal*, Vol. 116 No. 14, pp. 157-158.

*Liker, J. and Ballé, M. (2013), "Lean managers must be teachers", *Journal of Enterprise Transformation*, Vol. 3 No. 1, pp. 16-32.

*Manville, G., Greatbanks, R., Krishnasamy, R. and Parker, D.W. (2012), "Critical success factors for lean six sigma programmes: a view from middle management", *International Journal of Quality & Reliability Management*, Vol. 29 No. 1, pp. 7-20.

*Marksberry, P. and Hughes, S. (2011), "The role of the executive in lean: a qualitative thesis based on the Toyota Production System", *International Journal of Lean Thinking*, Vol. 2 No. 2, pp. 1-18.

*Marksberry, P., Badurdeen, F. and Ken Kreafle, B. (2010), "Management directed kaizen: Toyota's jishuken process for management development", *Journal of Manufacturing Technology Management*, Vol. 21 No. 6, pp. 670-686.

*Marksberry, P., Badurdeen, F. and Maginnis, M.A. (2011), "An investigation of Toyota's social-technical systems in production levelling", *Journal of Manufacturing Technology Management*, Vol. 22 No. 5, pp. 604-620.

*Mutwiri, B., Wit, C., Denysek, C., Halferdahl, S. and Mcleod, K.M. (2016), "Development and implementation of the Saskatchewan leadership program leading for healthcare transformation", *Healthcare Management Forum*, Vol. 29 No. 1, pp. 23-27.

*Novac, C. and Mihalcea, A. (2014), "The relationship between leadership, organizational culture and managerial culture through Lean strategy in a multinational company", paper presented at International Academic Conference, Management, Finance, and Ethics, October 2–3, Bucharest, available at: https://s3.amazonaws.com/academia.edu.documents/36576491/Strategica_Conference_2014_-_Management__Finance_and_Ethics.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1553879516&Signature=Qti1NZzXuFMCsDr8c1l6kxwA7lI%3D&response-content-disposition=inline%3B%20filename%3DBusiness_ethics_and_gender_equality_the.pdf#page=343 (accessed March 29, 2019).

*Orr, C. (2005), "Lean leadership in construction", paper presented at 13th International Group for Lean Construction Conference, July 19–21, Sydney, available at: https://iglcstorage.blob.core.windows.net/papers/attachment-430f3c6e-adf4-4b86-a975-2c4d1cf10b41.pdf (accessed March 29, 2019).

*Rinke, M.L., Mock, C.K., Persing, N.M., Sawyer, M., Haut, E.R., Neufeld, N.J. and Nagy, P. (2016), "The Armstrong institute resident/fellow scholars: a multispecialty curriculum to train future leaders in patient safety and quality improvement", *American Journal of Medical Quality*, Vol. 31 No. 3, pp. 224-232.

*Simon, R.W. and Canacari, E.G. (2012), "A practical guide to applying lean tools and management principles to health care improvement projects", *AORN Journal*, Vol. 95 No. 1, pp. 85-103.

*Sureerattanan, C., Napompech, K. and Panjakhajornsak, V. (2014), "Model of leadership and the effect of lean manufacturing practices on firm performance in Thailand's auto parts industry", *Research Journal of Business Management*, Vol. 8 No. 2, pp. 104-117.

*Testani, M.V. and Ramakrishnan, S.S. (2011), "Lean transformation leadership model: leadership's role in creating lean culture", paper presented at Industrial Engineering Research Conference, May 21–25, Reno, NV, available at: https://search.proquest.com/openview/01aa58b16d654b81710 3b36b1e719a73/1?pq-origsite=gscholar&cbl=51908 (accessed March 29, 2019).

*Testani, M.V. and Ramakrishnan, S.S. (2012), "Lean leadership readiness for change: a methodology for lean change readiness and continuous improvement", paper presented at 62nd IIE Annual Conference and Expo 2012, May 12–23, Orlando, FL, available at: www.tib.eu/en/search/id/BLCP: CN087201180/Lean-Leadership-Readiness-for-Change-A-Methodology (accessed March 29, 2019).

*Tortorella, G. and Fogliatto, F. (2017), "Implementation of lean manufacturing and situational leadership styles: an empirical study", *Leadership & Organization Development Journal*, Vol. 38 No. 7, pp. 946-968.

Tortorella, G.L. and Fettermann, D. (2018), "Implementation of Industry 4.0 and lean production in Brazilian manufacturing companies", *International Journal of Production Research*, Vol. 56 No. 8, pp. 2975-2987.

*Tortorella, G.L., Marodin, G., Miorando, R. and Seidel, A. (2015), "The impact of contextual variables on learning organization in firms that are implementing lean: a study in Southern Brazil", *The International Journal of Advanced Manufacturing Technology*, Vol. 78 Nos 9-12, pp. 1879-1892.

*Toussaint, J.S. and Berry, L.L. (2013b), "Leadership lessons from lean", *Trustee Magazine*, Vol. 66 No. 10, pp. 21-24.

*Trenkner, M. (2016), "Implementation of lean leadership", *Management*, Vol. 20 No. 2, pp. 129-142.

*Ulhassan, W., Von Thiele, S.U., Thor, J. and Westerlund, H. (2014), "Interactions between lean management and the psychosocial work environment in a hospital setting: a multi-method study", *BMC Health Services Research*, Vol. 14 No. 1, pp. 480-491.

*Ulhassan, W., Von Thiele, S.U., Westerlund, H., Sandahl, C. and Thor, J. (2015), "How visual management for continuous improvement might guide and affect hospital staff: a case study", *Quality Management in Health Care*, Vol. 24 No. 4, pp. 222-228.

*Van Der Merwe, K. (2016), "Leadership behaviours and lean culture attainment in automotive component manufacturers", *Journal for New Generation Sciences*, Vol. 14 No. 3, pp. 259-278.

*Vänje, A. and Brännmark, M. (2017), "Walking around the pyramids: managers' shop-floor activities in lean-inspired organizations", *Economic and Industrial Democracy*, Vol. 38 No. 3, pp. 495-512.

*Van Rossum, L., Aij, K.H., Simons, F.E., Van der Eng, N. and Ten Have, W.D. (2016), "Lean healthcare from a change management perspective: the role of leadership and workforce flexibility in an operating theatre", *Journal of Health Organization and Management*, Vol. 30 No. 3, pp. 475-493.

*White, M., Wells, J. and Butterworth, T. (2013), "Leadership, a key element of quality improvement in healthcare. Results from a literature review of 'Lean Healthcare' and the productive ward: releasing time to care initiative", *The International Journal of Leadership in Public Services*, Vol. 9 Nos 3/4, pp. 90-108.

*Womack, J.P. (2005), "Getting started on the lean journey: first, take a walk!", *Die Casting Engineer*, Vol. 49 No. 3, pp. 50-51.

*Worley, J.M. and Doolen, T.L. (2006), "The role of communication and management support in a lean manufacturing implementation", *Management Decision*, Vol. 44 No. 2, pp. 228-245.

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