Relationship between lean manufacturing implementation and leadership styles

Guilherme Luz Tortorella, Diego de Castro Fettermann, and **Carlos Ernani Fries**
Department of Production and Systems Engineering
Federal University of Santa Catarina
Campus Trindade, C.P. 476, Florianópolis, SC 88040-900, Brazil
gtortorella@bol.com.br, dcfettermann@gmail.com, carlos.fries@ufsc.br

Abstract

Regardless the kind of organization, a successful lean manufacturing (LM) implementation is highly dependent on its people, both leaders and followers. Hence, the way leaders act and behave influence the attitudes and behaviors of the followers, setting the predominant culture within the organization undergoing a lean implementation. This article aims at identifying the leadership styles and contextual variables that best support companies undergoing a LM implementation. To achieve that we apply a clustering method that combines information gathered from a survey carried out with 68 leaders from different companies with different levels of lean implementation. Our approach identifies leadership styles that may contribute to the level of lean practices adoption considering specific contextual variables of the leadership such as age, experience and size of team. We argue that, viewed as an evolutionary process, there is more than one best way to lead teams that are implementing lean. Further, we state that leadership contextual variables are associated with leadership behaviors and the level of LM implementation, indicating that the expected relationship between leaders' styles and LM implementation may not be as suggested in the existing literature.

Keywords
Lean manufacturing implementation; Leadership styles; Leadership characteristics.

1. Introduction

Regardless the kind of organization, a successful lean manufacturing (LM) implementation is highly dependent on its people, both leaders and followers (Sawhney and Chason, 2005). LM is rooted in two key principles: continuous improvement and respect for people (Emiliani and Stec, 2005). The first one embodies the practices and techniques used to improve quality and productivity (Ohno, 1988). The "respect for people" principle comprises leadership behaviors and business practices that must be consistent with efforts to eliminate waste and create value for end-use customers (Toyota, 2001; Treville and Antonakis, 2006).

The transition from traditional mass-production organization to a lean enterprise is about changing both technical and socio-cultural aspects (Tortorella and Fogliatto, 2014). The change of these socio-cultural aspects can be seen as the essence of leadership (Schein, 2004), since the implementation of LM practices creates expectations regarding leaderships' attributes and behaviors (House et al., 2004). Therefore, the way leaders act and behave influence the attitudes and behaviors of the followers, setting the predominant culture within the organization undergoing a lean implementation (Dombrowski and Mielke, 2014).

Leadership in a LM environment is usually a hands-on and ever-present kind of leadership, where leaders are obliged to spend time in operations where customer value is being created, to truly understand what is going on and support their teams (Liker, 2004; Liker and Convis, 2011). Further, a common belief is that leaders in companies undergoing LM implementation must be cooperative, delegators and excellent motivators of personnel (Angelis et al., 2011; Pamfilie et al., 2012). However, detailed descriptions of the desirable attributes and styles of leadership along the evolutionary process of LM implementation have not been provided in the literature. Such gap is reported by authors such as Liker (2004), Mann (2009), Rother (2009), Dibia (2012), Liker and Convis (2011), Marodin and Saurin (2013), and Dombrowski and Mielke (2014). In addition to the leadership styles, researchers emphasize the influence of contextual variables on the performance of leaders, which, depending on their characteristics, may

hinder or favor their leadership towards a leaner company (Deschamps, 2005; Bäckström and Ingelsson, 2015). Thus, we argue that the identification of the context variables and leadership styles in a LM implementation could improve the understanding about the difficulties that companies have to implement lean.

This article aims at identifying the leadership styles and contextual variables that best support companies undergoing a LM implementation. To achieve that we apply a clustering method that combines information gathered from a survey carried out with 68 leaders from different Brazilian companies with different levels of lean implementation. Respondents are asked to fill three sequential questionnaires in the survey: (i) the implementation level of 19 LM practices most frequently evidenced in the literature, (ii) their leadership style and adaptability, which is defined through the application of the SL (situational leadership) questionnaire proposed by Blanchard (2010), and (iii) details about contextual variables pointed in the literature as influential for leadership style adoption. The identification of leaderships' styles and contextual variables in companies at different levels of lean implementation contributes to the existing body of knowledge on LM. Our method is intended to bridge a gap observed in the literature with regards to lean implementation, as it enables the identification of the most usual leadership styles and contexts in which companies are best supported to implement LM. Further, our goal is to complement existing lean roadmaps by considering the proper leadership style as a contingency issue in leadership-related aspects of the lean implementation process. We are not aware of any other method that is comparable regarding its objectives to the present proposition. Moreover, identifying the relationships between styles and contextual variables may contribute to specify the contexts in which LM implementation are expected to occur.

Our research specifically focuses on three contextual variables: (i) leadership experience, (ii) leader's age, and (iii) size of the team (number of followers). First, leaders are supposed to have deemed experience time, entailing a high level of tacit knowledge that leads to more assertive actions and behaviors, especially under conflict situations (Hunt and Baruch, 2003; Pasaribu, 2015). Besides the leadership experience, previous studies have associated the leader's maturity with the leader's age, due to the fact that it may influence the accrued experience and, hence, the likelihood of presenting proper interpersonal skills (Parry et al., 2010; Dombrowski and Mielke, 2014). Further, the number of followers within a team may also influence leader's ability to properly manage and adapt his style to different followers' readiness. Empirical evidence suggests that the larger the size of the team the more complex would be to a leader implement any change process (Castka et al., 2001; Gelei et al., 2015). Finally, the leader's gender is a potential critical variable. Thus, we argue that this variable is influential to leadership style adoption and, hence, to lean implementation.

This rest of this paper is structured as follows. Section 2 gives an overview of the literature on LM implementation and leadership styles. Section 3 describes the proposed method, with results of its application presented in section 4. Section 5 closes the paper presenting conclusions and future research opportunities.

2. Literature review

2.1 Lean manufacturing implementation

LM aims at streamlining the flow of value while continually seeking to reduce the resources required to produce a given set of products (Womack and Jones, 2003). The way LM was conceptualized was an evolutional detachment from the precepts of traditional mass-production manufacturing (Marodin et al., 2015). Several researchers (e.g. Liker and Meier, 2007; LEI, 2010; Productivity Inc., 2010; Crabill et al., 2010) have proposed different and complementary roadmaps for facilitating the LM implementation. Overall, all roadmaps attain the LM through the implementation over time of a combination of synergistic and mutually reinforcing practices, which have been grouped into various complementary bundles or constructs, such as JIT (just-in-time), TQM (total quality management), TPM (total productive maintenance), CI (continuous improvement) and HRM (human resources management) (Shah and Ward, 2003; Netland et al., 2015). However, regardless the fact that LM has been used for decades, generalisable implementation steps have not yet emerged (Marodin and Saurin, 2013; Tortorella et al., 2015).

The selection of appropriate practices for process improvement and identification of their applicability in operations context feature an additional issue for industrial managers and practitioners (Herron and Braiden, 2006; Shah and Ward, 2007). There a large number of available practices that must be applied simultaneously in order to achieve LM (Pavnascar et al., 2003; Treville and Antonakis, 2006). In this sense, Table 1 consolidates the most frequent LM practices evidenced in the literature. Fifteen widely acknowledged researches were selected, highlighting nineteen LM practices as the most cited ones. Overall, all nineteen LM practices have been consistently studied in LM literature and, hence, may be representative to characterize a lean implementation. The approach of measuring the

maturity of LM implementation based on the assessment of the adoption level of pre-defined practices has been extensively used in previous studies (Shah and Ward, 2007; Netland and Ferdows, 2014; Marodin et al., 2015) and seems to be quite effective to comprehend companies' maturity. Therefore, for our study purposes, the adoption level of these nineteen practices is used to represent the level of LM implementation within each studied company.

Table 1. Appearance of LM practices in literature

LM practices	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	Agreement
1-Flexible manpower	X		X			X		X	X	X	X		X	X	X	67%
2-Pull system	X	X		X		X	X	X	X	X	X	X		X	X	80%
3-Takt time	X	X		X		X		X				X		X	X	53%
4-Continuous flow	X	X		X		X	X	X	X	X	X	X		X	X	80%
5-Material supply	X	X	X	X			X	X	X	X	X	X		X	X	80%
6-Zero defects	X	X			X	X	X	X	X	X				X	X	67%
7-Quality assurance	X	X	X	X				X	X	X				X	X	60%
8-Product / process quality planning	X		X	X	X			X	X	X		X		X	X	67%
9-Standardized work	X	X		X	X		X	X	X	X	X	X	X	X	X	87%
10-Production leveling	X			X	X	X	X	X	X	X	X	X		X	X	80%
11-Maintenance system	X	X		X		X	X	X	X	X	X	X		X	X	80%
12-Workplace organization	X	X					X	X	X	X	X	X	X	X	X	73%
13-Goal oriented teams	X					X	X			X	X		X	X	X	53%
14-Cross functional work		X		X	X					X	X			X		40%
15-Organizational design				X	X					X				X		27%
16-Problem solving methods	X		X		X	X	X	X	X	X	X	X	X	X	X	87%
17-Improvement organization			X	X		X				X	X		X	X		47%
18-Prioritization				X		X	X		X	X	X		X	X	X	60%
19-Improvement approach	X			X			X		X	X			X	X	X	53%

Authors: (1) Shah and Ward, 2003; (2) Doolen and Hacker, 2005; (3) 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.

2.2 Leadership styles

The relationship between interpersonal skills and leadership performance began to be studied after the Second World War. Several researchers started to investigate the relationship between company's performance, leadership practices and individual development (Hunt and Baruch, 2003). Fleishman's (1953) seminal work on leadership focused researchers and practitioners alike on the structuring and consideration skills of leaders, whose outcome was leadership style theory. Since then, the influence of leadership style on job performance, satisfaction, stress, and turnover intention has been extensively studied (Goleman, 2000; Chen and Silverthorne, 2005; Wilson and Thompson, 2014). Although leadership style impacts on several aspects of the organization, successful leaders usually do not rely on a single leadership style. Leader's effectiveness is enhanced by the proper match between leadership style and followers' readiness level (Blanchard, 2010). In this sense, situational leadership (SL) theory suggests the existence of four basic leadership styles depending on the relationship and task behaviors of the leader (Hersey and Blanchard, 1969).

Leaders that are highly focused on the tasks and present low relationship intensity with followers are said to be "telling" or "directing" (S1). This style is usually recommended to teams in which followers cannot do the job and are unwilling to try, then the leader takes a highly directive role, telling them what to do but without any concern about the relationship. The second style (S2, selling/coaching), denoted by a concern of the leadership with both the task accomplishment and the relationship level, is suitable for situations in which followers can do the job, at least to some extent, and are motivated about it. In the "participating" or "supporting" style (S3), leaders are less focused on the task but remain concerned with relationship. This style is suggested for followers that are highly competent for performing the tasks, but unwilling or insecure to do so. Finally, style S4 (delegating or observing) presents a low leadership's focus on both task and relationship, being indicated for high performing and motivated followers, denoting high levels of readiness (Blanchard et al., 1985; Hersey et al., 2001; Blanchard, 2010).

Further studies have expanded the discussion regarding the effective leadership styles. Sethuraman and Suresh (2014) complement the SL theory by investigating the influence of leaders' personality type on leadership behavior through the application of Myers Briggs Type Indicator (MBTI). Thompson and Glaso (2015) aimed to quantify the followers' need from three perspectives: (i) measuring followers' competence; (ii) examining the leader-follower

dynamic along a continuum of job levels; and (iii) comparing degree of self-other agreement in follower competence and commitment ratings to identify whether higher correlation more adequately validates the SL model. Additionally, Pasaribu (2015) investigates the influence of SL behavior, organizational culture and implementation of human resources management strategies on productivity at a private training institute. In particular, within the LM implementation context, Gelei et al. (2015) analyze the desirable and undesirable leadership attributes that may contribute to lean operations; while Dombrowski and Mielke (2014) suggest fifteen leadership behaviors that are favorable to the lean implementation. Despite evidences from several previous researches, leadership is yet a highly studied theme and much still needs to be investigated (Sharma and Kirkman, 2015), especially in companies undergoing a lean implementation (Bortolotti et al., 2015).

3. Research method

There are three stages to the research method proposed here: (i) questionnaire development and data collection, (ii) clustering of data, and (iii) data analysis. These stages are detailed in the sections to follow.

3.1 Questionnaire development and data collection

We used the following criteria to select companies and respondents. First, we targeted at companies that were (i) implementing lean, and (ii) geographically located in the south of Brazil, in order to control the effect of environmental factors, such as availability of skilled labour. Non-random selection of companies in surveys on lean is a common approach; examples may be found in Tortorella et al. (2015), Boyle et al. (2011), Eroglu and Hofer (2011), and Taj and Morosan (2011). Second, respondents should have experience in lean and a leadership role in the company, e.g. General Manager, Assistant Manager, Group Leader and Team Leader (Liker, 2004).
Questionnaires were sent by e-mail to former students of executive education courses on lean offered by a large Brazilian University since 2008. The institution is the only one in its region offering short courses on lean. Courses are open to the general public. The same database of respondents was used in previous studies (e.g. Marodin et al., 2015; Tortorella et al., 2015). A first e-mail message containing the questionnaires was sent in April 2015, and two follow-ups were sent in the following weeks.
The final sample was comprised of 68 valid responses (representing a response rate of 39.52%). Most respondents were from large companies (44%); the majority of companies belonged to the automotive supply chain (40%). Most respondents (47%) had up to 5 years of experience with LM implementation, up to 2 years of leadership experience (53%), and equal or less than 30 years old (60%). Further, most respondents were male (60%), and directly lead teams comprised by more than 5 followers (53%). Finally, regarding the job title, there was a predominance of Group Leaders (33%) within the sample.
The questionnaire had three parts. The first part aimed to collect demographic information of respondents and their companies. The contextual variables 'leadership experience' and 'size of team' were categorized. Leadership experience was coded according to Hunt and Baruch (2003) findings, which suggest that leaders with less than two years of experience may be considered beginners and might present lower levels of interpersonal skills and maturity. For size of team, two categories were proposed: (i) teams with more than 5 followers and (ii) teams with five followers or less. This categorization was based on Schaubroeck's et al. (2007) research, which indicates that teams with five followers in average might achieve better results than larger teams. Finally, the variable 'leader's age' was maintained in a discrete scale based on the respondents' answers.
The second part intended to assess the leadership style of respondents. For that, we adapted the LEAD (Leadership Effectiveness & Adaptability Description), originally developed by Hersey and Blanchard (1969) and improved by Blanchard (2010), to be used in an organizational environment undergoing lean implementation. The questionnaire, comprised of 12 questions related to leadership behaviors, is aimed to identify the primary (adopted most frequently) and secondary (adopted as backup) leadership styles, as well as the leader's adaptability level to different styles. Finally, the third part of the questionnaire aimed at measuring the degree of adoption of the nineteen LM practices described in the literature (Table 1). Each question was answered based on a 5-point scale ranging from 1 (not used) to 5 (fully adopted).
Regarding the assessment of the implementation level of LM practices, we tested for non-response bias as proposed by Armstrong and Overton's (1977) using Levene's test for equality of variances and a t test for the equality of means between early (respondents of the first e-mail sent) and late (respondents of the two follow-ups) respondents. Results indicated no differences in means and variation in the two groups, with 95% significance. Thus, there is no statistical evidence that our sample is significantly different from the rest of the population. Further, we tested all

responses related to LM practices for reliability determining their Cronbach's alpha values. An alpha threshold of 0.6 or higher was used (Meyers et al., 2006). LM practices displayed high reliability, with alpha value of 0.980.

3.2 Clustering of data

The next step of the proposed method performs the clustering of observations of both leadership styles and the implementation level of LM practices. Clustering tools are designed to analyze the relationships within a database to determine if it is possible or not describing such data in a summarized form, by a small number of observations of similar classes (Everitt, 1980; Gordon, 1999). According to Rencher (2002), the objects within a cluster must be similar to the other inserted into the same cluster (homogeneity), and different from other objects embedded in other clusters (denoting heterogeneity). Thus, we applied Ward's (1963) hierarchical agglomerative clustering method, which identifies clusters based on the minimal variance of the cluster (Hair et al., 2006). Further, to define the number of clusters to be formed in each set of data, we used dendograms as guiding tools, since its visual analysis has brought important conclusions due to the low number of observations in each group.
For the implementation level of LM practices, two groups were identified with 34 respondents each. Then, by means of a variance analysis (ANOVA) the average difference between both groups was tested, which confirmed a significant difference between the average implementation levels of all 19 LM practices (p-value<0,032). The first group (n = 34), which presented a higher average implementation level of LM practices, was denoted as the 'high level of lean manufacturing implementation' (HLM); while the second group was named as 'low level of lean manufacturing implementation' (LLM).
The same database was used for clustering the observations regarding the leadership styles. The dendogram analysis indicated four different clusters, which presented the average of style preference occurrence according to the four leadership styles (S1, S2, S3 and S4). The primary style of each cluster was defined by the highest average value of style preference occurrence among the four styles in the cluster. Occasionally, each cluster presented a different primary style, indicating that all four SL behaviors were represented in the studied sample (S1, n = 9; S2, n = 18; S3, n = 7; S4, n = 34).

3.3 Data analysis

After the clusters identification according to LM implementation level (LLM and HLM) and leadership styles (S1, S2, S3 and S4), observations among clusters are compared according to the three contextual variables aforementioned. To verify adherence to normal distribution, we used the Kolmogorov-Smirnof (KS) test which indicates that the sample data do not present a normal distribution (p-value<0.05). Thus, it is recommended the application of nonparametric techniques for data analysis (Siegel and Castellan Jr, 1988).
Discrete variables with numerous categories representing a quantitative attribute (e.g. leader's age) may be used as if continuous (Tabachnick and Fidell, 2013). Thus, for 'leader's age' it was applied the Mann-Whitney test to verify the existence of any significant difference among averages of leader's age according to leadership styles and level of lean implementation. The application of this technique is recommended to verify if two independent samples were extracted from the same population and differ from each other. Further, this technique is an alternative to parametric tests, in which homocedasticity and data adherence to normal distribution are required (Siegel and Castellan Jr, 1988).
For variables 'leadership experience' and 'size of team' (denoted by a categorical scale), we applied the chi-square test with contingency tables and adjusted residuals. This test is used to reject the hypothesis that the data frequencies are independent (Everitt, 1980). For this study's purpose, we tested if the frequency of observations for each variable according to leadership styles was associated to the LM implementation levels. Additionally, it was considered significant associations the adjusted residuals values higher than |1.64|.

4. Results and discussion

Table 2 presents the results for the contingency table with the chi-square test between levels of lean implementation (LLM and HLM) according to each leadership style clusters (S1, S2, S3 and S4). From all four leadership styles, results indicate that only the frequency of leaders who tend to present S1 as their primary style is associated with LM implementation levels. Further, the occurrence frequency for this leadership style is significantly higher in companies that fully implement LM practices than companies that have lower levels of LM implementation. This result is somewhat surprising in light of conventional wisdom about lean change. HLM companies are supposed to

present higher levels of maturity and exposure to lean practices, denoting that their followers might be confident and willing for LM implementation (high performance readiness); hence, leaders' behavior might shift to 'delegating' or 'observing' style to effectively manage and lead. However, that was not found in our results. This finding may be justified by the fact that LM practices shall impel highly specified activities as to content, sequence, timing, and outcome, usually developed under the guidance of a senior leader, at the lowest possible level in the organization (Spear and Bowen, 1999; Spear, 2004). Therefore, our findings are consistent with the SL theory (Blanchard, 2010), which determines that 'S1' is mainly characterized by a task behavior, consisting in organizing and defining the roles of followers and explaining what, when, where, and how tasks are to be accomplished. Further, this style is also marked by efforts to establish well-defined patterns of organization and channels of communication (Thompson and Vecchio, 2009), corroborating to our findings.

Table 2. Chi-square test between levels of LM implementation

Leadership style	LLM		HLM		Total frequency
	Frequency	Residual adjusted	Frequency	Residual adjusted	
S1	2	-1.8*	7	1.8*	9
S2	9	0	9	0	18
S3	3	-0.4	4	0.4	7
S4	20	1.5	14	-1.5	34
Total frequency	34		34		

*significant at 10% (residual adjusted>|1.64|), **significant at 5% (residual adjusted>|1.96|) and ***significant at 1% (residual adjusted>|2.58|)

Regarding the contextual variable 'leader's age', Table 3 displays the results for the Mann-Whitney test between both levels of LM implementation according to each leadership style. Despite literature evidences support the idea that leader's age is associated with leader's maturity with regards to technical and interpersonal skills (Dombrowski and Mielke, 2014), our results show that this association may not always happen as expected. No significant difference for leader's age was found between levels of LM implementation, except for leaders who frequently prefer style S3. In companies where LM practices are widely adopted, leaders who present a 'participating' or 'supporting' behavior seem to be significantly younger (p-value=0.032) than leaders with the same style but working in companies that have not broadly implemented lean practices. Although a group of companies have been extensively implementing LM, most respondents (47%) were recently exposed to lean practices (up to 5 years of experience with LM implementation). An explanation for such result would be that older leaders might not be the ones who are more familiar with LM practices, and, hence, are less likely to implement them. This fact may be especially true due to the sample characteristics, which is totally composed by respondents who work in Brazilian companies. Previous researches (Saurin and Ferreira, 2009; Saurin et al., 2010; Jabbour et al., 2013; Freitas et al., 2014) suggest that the extant knowledge about LM in Brazil is still murky and substantially lower comparing to developed countries; which might be potentially worsened by the fact that Brazil has a larger portion of the workforce with low educational level than developed countries. Therefore, it is reasonable to expect that younger leaders might present equal or larger experience with LM than older leaders, entailing more appropriate and favorable behaviors for adopting lean practices.

Table 3. Mann-Whitney test for leader's age (years) between levels of LM implementation

Leadership style	LLM			HLM			Mann-Whitney test (p-value)
	n	Average	Std. dev.	*n*	Average	Std. dev.	
S1	2	26.00	2.82	7	28.28	7.17	0.768
S2	9	33.77	7.55	9	29.66	6.67	0.170
S3	4	37.33	7.71	3	25.75	8.98	0.032**
S4	20	29.00	7.43	14	32.00	6.74	0.225
Total	34	30.82	7.31	34	29.88	6.67	

* significant at 10%/** significant at 5%/*** significant at 1%

Contrary to popular belief, the results show that for smaller teams (≤ 5 followers) leadership styles do not have a significant difference either in HLM or LLM (see Table 4). However, for larger teams' scenario (> 5 followers) the frequency of leaders who demonstrate behaviors consistent with the style S1 is significantly higher in HLM companies than in LLM companies. This result is coherent with findings from Chen and Silverthorne (2005), Bjugstad et al. (2006) and Gelei et al. (2015), which state the difficulty of properly matching the leadership style with followers' readiness, especially whenever leading large teams. To achieve the expected targets and effectively

implement changes, leaders who manage large teams tend to mainly focus on task rather than relationship, since the likelihood of different levels of followers' readiness within the team is strongly increased. Thus, to present the perfect balance between relationship and task behaviors for all followers becomes even harder, which entails a single prevailing leadership behavior and facilitates leaders' job. Overall, in companies where leaders are in charge of a high number of followers, the 'telling' or 'directing' leadership style appears to be associated with the levels of LM implementation, indicating to be a more frequently preferred behavior within such context.

Table 4. Chi-square test among leadership styles and levels of LM implementation according to size of team

Size of team	Leadership style	LLM		HLM		Total frequency
		Frequency	Residual adjusted	Frequency	Residual adjusted	
≤ 5 followers	S1	2	-0.3	3	0.3	5
	S2	4	-0.5	6	0.5	10
	S3	1	-1.3	4	1.3	5
	S4	12	1.4	9	-1.4	21
	Total frequency	19		22		
> 5 followers	S1	0	-2.4**	4	2.4**	4
	S2	5	0.5	3	-0.5	8
	S3	2	1.3	0	-1.3	2
	S4	8	0.6	5	-0.6	13
	Total frequency	15		12		

*significant at 10% (residual adjusted>|1.64|), **significant at 5% (residual adjusted>|1.96|) and ***significant at 1% (residual adjusted>|2.58|)

Finally, with regards to leadership experience, Table 5 shows the results for the contingency table with the chi-square test between levels of lean implementation according to each leadership style. For leaders categorized as beginner (leadership experience ≤ 2 years), results indicate that the adoption of style S4 is significantly more frequent for leaders in LLM than in HLM companies. For the other three styles no significant association was found with LM implementation. However, for more experienced leaders (leadership experience > 2 years), styles S1 and S2 seem to be significantly associated with the levels of LM implementation; while for S3 and S4 no significant association was found. These results suggest an evolutionary behavior pattern along leadership interpersonal skills development (see Figure 1). Initially, when leaders are beginners and LM practices are not substantially implemented within the teams, leaders tend to neglect both the relationship and task behaviors, preferring the style S4. As leaders become more experienced, but still with scarce evidences of LM implementation, behaviors seem to start shifting to S2 ('selling' or 'coaching' style), which indicates that leaders are highly focused on task and relationship concerning lean change. As their LM implementation efforts become consistent and lean practices begin to be systematically adopted within the teams, leaders' preferred behaviors are likely shift to task-oriented (S1) only. Such leadership behavioral evolutionary pattern between levels of LM implementation and leadership experience is somewhat contrary to SL theory, which indicates that, for an effective leadership, leaders' behaviors should move from S1 to S4 as followers' readiness levels increase (Hersey et al., 2001). However, as aforementioned, successful LM implementation assumes that rigid specification is the very thing that makes the flexibility and creativity for continuous improvement possible. According to a few researches (Spear and Bowen, 1999; Spear, 2004; Spear, 2009; Liker and Convis, 2011), the high degree of specification and structure at HLM companies does not promote the command and control environment one might expect. Indeed, this leadership behavior actually stimulates followers to engage in the kind of experimentation that is widely recognized as the cornerstone of a learning organization. Thus, our results corroborate to a better comprehension of this LM system paradox.

Table 5. Chi-square test among leadership styles and levels of LM implementation according to leadership experience

Leadership experience	Leadership style	LLM		HLM		Total frequency
		Frequency	Residual adjusted	Frequency	Residual adjusted	
≤ 2 years	S1	2	-0.8	4	0.8	6
	S2	4	-1.2	8	1.2	12
	S3	1	-1.3	4	1.3	5
	S4	16	2.3**	9	-2.3**	25
	Total frequency	23		25		
> 2 years	S1	0	-2.1**	3	2.1**	3
	S2	5	1.7*	1	-1.7*	6

S3	2	1.3	0	-1.3	2
S4	4	-0.9	5	0.9	9
Total frequency	11		9		

*significant at 10% (residual adjusted>|1.64|), **significant at 5% (residual adjusted>|1.96|) and ***significant at 1% (residual adjusted>|2.58|)

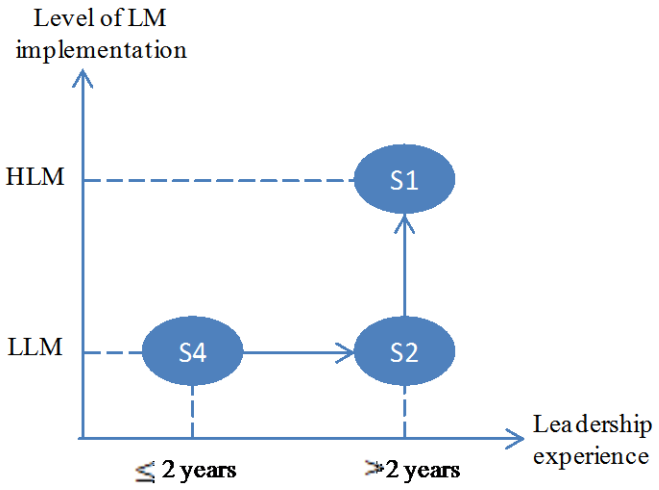

Figure 1. Graphical interpretation for most frequently preferred leadership styles according to leadership experience and level of LM implementation

5. Conclusion

The current research was conducted among leaders of major national and international organizations, but the findings may apply to a wider population. The implications of this study are of considerable importance and relevance for both researchers and lean practitioners.

5.1 Theoretical contribution

This research presents some important theoretical contributions to the state-of-the-art on LM. We propose a new approach to identify leadership styles and contextual variables that may contribute to a successful LM implementation. The specialized literature on LM frequently states that leaders in companies undergoing lean implementation must be cooperative, delegators and excellent motivators of personnel, neglecting detailed descriptions of the desirable attributes and styles of leadership along the evolution of lean implementation. Further, previous studies (Dombrowski and Mielke, 2014; Gelei et al., 2015) which investigated leadership attributes that contribute to (or inhibit) a successful lean implementation perform a post hoc analysis focusing on high maturity companies such as Toyota, and disregard the evolutionary nature of the implementation process, and its resulting demands for adaptive and transient leaderships' attributes and styles.

Our approach identifies leadership styles that may contribute to the level of lean practices adoption considering specific contextual variables of the leadership such as age, experience and size of team. That is accomplished through the establishment of clusters for leadership styles and level of LM implementation among the studied respondents. Using our proposition, researchers may choose proper leadership characteristics with the highest likelihood of contributing to the implementation of LM practices within the company under analysis.

We also provide a deeper understanding on how leaders' behaviors can support the LM practices adoption, allowing companies undergoing lean implementation to better manage their change processes. We argue that, viewed as an evolutionary process, there is more than one best way to lead teams that are implementing lean. Further, we state that leadership contextual variables are associated with leadership behaviors and the level of LM implementation, indicating that the expected relationship between leaders' styles and LM implementation may not be as suggested in the existing literature. For instance, results demonstrate that when considering leadership experience the preferred leadership styles may shift along lean implementation. Such behavioral evolutionary pattern, in opposition to evidences available in the SL literature, suggests that even though the maturity of LM practices adoption increase (indicating high levels of followers' readiness), leaders' preferred behaviors may remain highly focused on task.

5.2 Practical implication

We presented empirical evidences on how leadership styles and levels of LM implementation are associated. For instance, leaders from companies that have been widely adopting lean practices tend to more frequently present behaviors that are consistent with S1 style. However, we have demonstrated that for our study sample, when considering leaders' age, younger leaders seem to prefer the style S3 when leading under contexts with high levels of lean practices implementation. Similarly, the influence of the size of the team appears to be significant only for leaders with large teams, who are more likely to present style S1 when lean practices are more widely adopted. Overall, evidences presented here suggest that the studied leadership styles are significantly associated with LM implementation. Therefore, the comprehension around this leadership style shift may help companies undergoing a lean implementation to set and stimulate the proper behaviors and even establish leaders' development programs accordingly.

5.3 Limitations and future research

There are some limitations due to the nature of the sample used in the survey that must be highlighted. First, respondents were mostly from companies located in Brazil; their answers might thus be linked to national issues. That may be relevant since recent data suggest that LM has been more extensively studied and managerially implemented in developed countries, providing leaders and followers with a more robust understanding regarding the issue (Kull et al., 2014; Bortolotti et al. 2015). Thus, as this limitation restricts the results to this geographic condition it also increases the certainty that they apply to those companies, and to others in regions with similar characteristics.

Regarding the proposed objective, this investigation empirically validated the association between LM implementation and leadership styles. Due to poor evidence in literature on the likelihood of any interdependent influence, further investigation would add more information and help to establish a holistic perspective about the problem. There is no one best way to influence people and leaders need to assess the readiness level and then use the appropriate leadership style to implement LM. Such extension would require a more elaborate data collection and analysis.

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Biography

Guilherme Luz Tortorella is Associate Professor in the Department of Production and Systems Engineering of the Federal University of Santa Catarina (UFSC), Florianópolis, Brazil. His Master in Production Systems and PhD in Production Engineering were earned from UFRGS. He also has twelve years of experience in the automotive industry with international activities in Mexico, England, USA and Uruguay.

Diego de Castro Fettermann is Associate Professor in the Department of Production and Systems Engineering of the Federal University of Santa Catarina (UFSC), Florianópolis, Brazil. Mr. Fettermann holds Master and PhD in Industrial Engineering from Federal University of Rio Grande do Sul. He teaches courses in Statistics and Forecasting Models, Facility Planning, and Project Management. Has experience in the areas of new product development, mass customization, and statistical analysis.

Carlos Ernani Fries is currently Associate Professor in the Department of Production and Systems Engineering at the Federal University of Santa Catarina (UFSC), Florianópolis, Brazil. Mr. Fries holds a Bachelor degree in Civil Engineering as well as a Master and PhD in Production Engineering from UFSC. He has taught courses in Operations Research applied to Manufacturing and Logistics, Decision Theory, Statistics and Forecasting Models among others. His research interests include manufacturing, simulation, optimization, management games, data analysis applied to logistics, and application of big data tools. He is member of IEOM, POMS and INFORMS.