# Continuous improvement behaviors in work teams: Developing and validating a team-level survey

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## Abstract
There is a need for knowledge on the behaviors that support Lean work-floor teams. Rooted in the larger group and team-effectiveness theory, this study designed, pretested and validated a survey instrument on these team behaviors. We report the results, based on a sample of Lean teams, including survey data from 431 team members. Moreover, both department heads ($n$ = 39) and each team leader ($n$ = 34) rated each team's performance. Construct validity was established. Our findings indicate that those teams that scored high on performance monitoring received the highest performance ratings, especially if they applied Lean longer.

**Keywords:** Continuous improvement, Work-floor behaviors, Team performance survey

### Introduction
Increasingly, work-floor teams become Lean and apply principles of Continuous Improvement (CI). Lean has been defined as *"an integrated socio-technical system whose main objective is to* [continuously] *eliminate waste* [in operational processes] *by concurrently reducing or minimizing supplier, customer, and internal variability"* (Shah, et al., 2007, p. 791). As Lean strives to extract employee ideas in order to further optimize processes, effective adoption of Lean entails the internalization of a certain 'CI mentality' by a majority of the employees and managers within a firm that strives to become Lean (Yokozawa, et al., 2010). Knowing that sustaining the CI habit and mentality is a tough task for work teams (Mackelprang, et al., 2010; Yokozawa *et al.*, 2010), it is crucial to learn more about the team behaviors that enable the internalization of Lean. A literature review on team behaviors that help to sustain Lean on the longer term, performed by Van Dun and Wilderom (2012), already paved our path to further analyze these behaviors in real-life work teams. In this study, we report on the development of a systematic survey tool with which to assess the behaviors and performance of Lean work-floor teams. This paper offers a) the theoretical roots for such a team-behavioral self-assessment, and b) the empirical progress made thus far.

*Lean self-assessment surveys*

Various scholars have developed Lean assessment tools: see for instance the EuroCINet survey in Boer, et al. (2000); they assessed Leanness at the organizational level. Others developed a tool that may be used at the company, division or department level (Caffyn, 1999), or at the team leader level (Jørgensen, et al., 2003). Our critical examination of these tools is twofold: firstly, the available tools are directed towards managers or internal Lean consultants. Strikingly, employees are hardly consulted in determining a firm's Leanness, whereas Lean principles would consider shop floor employees as most knowledgeable (Bicheno, et al., 2009; De Lange-Ros, et al., 2001). In our view, tools that assess a firm's Leanness must accurately reflect the actual shop-floor practices.

Our second concern entails the lack of explicit theoretical focus on the team behavioral side of Lean. Indeed, the literature review by Van Dun and Wilderom (2012) established that most Lean studies focus on organizational level factors. Yet, many Lean efforts fail and often scholars have discussed that Lean team cultural content may be considered a key aspect to long term Lean sustainability (Ballé, 2005). Clearly, a Lean team-level orientation is needed to advance the field. Consequently, our study aims to add to the emerging Lean team-behavioral theory as we asked members of Lean shop-floor teams to rate *their own* team-specific Lean behaviors, thereby providing a bottom-up view on actual Lean team behaviors.

*Lean work team behaviors*

So what are the key Lean behavioral factors that are likely to be present in shop-floor Lean teams? A review of known affective, behavioral and cognitive Lean team-effectiveness factors performed by Van Dun and Wilderom (2012) defined a set of nine team factors. Affective factors included: 'psychological safety,' 'team cohesion,' 'team member support,' and 'conflict management.' Lean team behavioral factors are suggested to be: 'information sharing,' 'performance monitoring,' 'innovating' and 'team leadership.' One cognitive factor included 'organizational goal commitment.' Some of these factors have also been mentioned before in other Lean studies (e.g. Bessant, et al., 2001, pp. 72-73), although in different terms. First of all, 'conflict management' might be compared to a behavior mentioned by Bessant *et al.* (2001): *'when something goes wrong the natural reaction of people at all levels is to look for reasons why etc. rather than to blame individual(s).'* The factor 'information sharing' can be found in: *'individuals and groups at all levels share (make available) their learning from all work experiences.'* 'Performance monitoring' is described as: *'individuals and groups monitor/measure the results of their improvement activity and the impact it has on strategic or departmental objectives.'* 'Innovating' has been mentioned as: *'people (as individuals and/or groups) initiate and carry through CI activities – they participate in the process.'* Finally, team leadership may be similar to what Bessant *et al.*'s (2001, p. 72) call managers' ability to *'lead the way.'* Finally, 'organizational goal commitment' might be linked to Bessant *et al.*'s: *'individuals and groups use the organisation's strategic goals and objectives to focus and prioritise improvements everyone understands (i.e. is able to explain) what the company's or department's strategy, goals and objectives are.'* Interestingly, except for 'conflict management,' the majority of the affective factors have not yet been associated to Lean, while these are suggested to play a key role in a Lean team's success (Van Dun *et al.*, 2012). Moreover, the behavioral factors mentioned so far in Lean-behavioral studies are not mutually exclusive. In order for these factors to be incorporated in a shop-floor self-assessment survey, well-established, specific constructs are needed. The larger group

and team-effectiveness literature provides these measures. In sum, in this study we focus on the four behavioral factors plus one affective factor 'conflict management' as well as one cognitive factor 'organizational goal commitment', which have also been mentioned by Bessant *et al.* (2001). Hence, this study examines six hypotheses:

*Hypothesis 1: Conflict management positively relates to Lean team performance.*
*Hypothesis 2: Information sharing positively relates to with Lean team performance.*
*Hypothesis 3: Performance monitoring positively relates to Lean team performance.*
*Hypothesis 4: Innovating positively relates to Lean team performance.*
*Hypothesis 5: Team leadership positively relates to Lean team performance.*
*Hypothesis 6: Team members' organizational goal commitment positively relates to Lean team performance.*

## Methods

Based on our earlier instrument (Van Dun, et al., 2011), we designed a survey that measures six Lean team factors in relation to team performance. We now describe sampling, procedure of data collection and ways of data analysis.

### *Sampling*

Table 1 summarizes the main sample characteristics of the pretest and main study. The pretest was held amongst members of seven work teams with differing Lean experience. All teams had adopted Lean and applied various Lean tools to improve their operations, i.e. daily performance monitoring routines and employee suggestion systems.

In our main study, respondents included team members ($n$ = 431), team leaders ($n$ = 34) and department heads ($n$ = 39) of 31 shop-floor teams with differing Lean experience (a total of $n$ = 504). The 31 shop-floor teams covered a diverse set of 15 organizations, namely: public sector, banking, health care and production firms. The average response rate was 84%. Teams were recruited through presenting our call for teams at Lean implementation seminars, local Lean company networks, via various websites and online social media, as well as via Lean consultants of a management consulting firm specialized in Lean. Similar to the pretest, all teams in our main study had adopted a Lean strategy, striving towards continuously improving their operations from a customers' perspective, based on employee ideas. The majority of the teams had installed Lean tools, such as employee suggestion systems, daily performance monitoring routines and process mapping. Some of the teams had just started Lean practices for just two months, while other teams practiced Lean for more than eight years. On average, the teams had worked with Lean for 3 years. The respondents' average age was 41 years (ranging from 19 to 62 years). The sample contained more male (59%) than female respondents; some work teams employed mainly men, while some were mainly composed of women. Most respondents worked fulltime (70%).

*Table 1 – Sample characteristics per research round*

| | | | | | | Gender | | Employment | |
|---|---|---|---|---|---|---|---|---|---|
| | **No. of teams** | **No. of individual responses** | **Response Rate** | **Average Lean maturity** | **Average age** | **M** | **F** | **Part-time** | **Full-time** |
| 1. Pretest | 7 | 78 | 88% | 5 months | 42 years | 42% | 58% | 47% | 53% |
| 2. Main Study | 31 | 501 | 84% | 3 years | 41 years | 59% | 41% | 30% | 70% |

### *Measures*

We first pre-tested our survey (an adapted version of the survey reported in Van Dun *et al.*, 2011) to ensure that the used constructs and survey scales were sufficiently valid

and reliable for the main study. We adapted the survey, based on statistical results and participants' feedback ($n$ = 78). We performed factor and reliability analyses. Subsequently, we deleted or replaced redundant items, and added items if necessary. As a final check, we had all scales retranslated from English to Dutch by an independent expert. Differences were examined and discussed. A professional translator retranslated the measures from Dutch to English following the translation/back-translation method.

The main study's survey consisted of two parts: a part on team behavior and another on team performance. Correlations among the variables, reliabilities, means and standard deviations are in Table 6. Respondents in both parts of the main study responded on 7-point Likert scales. The first part included nine constructs that together measure the six hypothesized Lean team factors (we added three related variables for exploratory purposes): conflict management (Tekleab, et al., 2009), feedback behavior (Morgan, et al., 1986), performance monitoring (De Jong, et al., 2010), team learning (Edmondson, 1999), adaptability (Angle, et al., 1981), information sharing (De Vries, et al., 2006), team innovativeness (Calantone, et al., 2002), Leader-Member Exchange (Graen, et al., 1982), and organizational goal commitment (Aubé, et al., 2005). We added four control variables: educational level, gender, team size, and months working with Lean. We rephrased all the scales for the team level of analysis by using the 'referent-shift consensus composition' (Chan, 1998, p. 238). An example is the original 'information sharing' item: 'When I need certain knowledge, I ask my colleagues about it' (De Vries *et al.*, 2006, p. 131). We rephrased this item into: 'When team members need certain knowledge, they ask other team members for it'.

The second part of the survey included a measure on general performance, which was assessed through the department heads' evaluation of: 1) team performance (Aubé *et al.*, 2005); 2) a customer satisfaction measure consisting of two items of Edmondson's scale (Edmondson, 1999) and two items from the Wong and Tjosvold (2002); and 3) a set of self-designed 'general Leanness' questions on the team's orientation towards Lean. Moreover, we had team leaders assess: 1) the same 'general Leanness' questions; and 2) 'group performance'(Van den Bossche, et al., 2006).

*Procedure*

The main study instrument included an online survey. In most of the teams, team leaders distributed the links to each of their team members and department heads, so that they could fill out the survey on their own workstation. To some the survey was distributed on paper, depending on their access to computers at their workplace.

*Data-analysis*

First, we checked the individual-level data in terms of skewness and skurtiosis and eliminated those items greater than 2 or higher (Foster, et al., 2006). We discarded 13 items in the team member survey, three items in team leaders' rating of team performance, as well as one department head item. Based on a bivariate correlation matrix with each individual item, we decided not to omit any variables from the exploratory factor analysis. We then performed a series of principal component analyses with varimax rotation to test for construct validity, as well as a reliability analysis. All scales showed reliability ranging from acceptable (0.68) to good (0.90). Next, we checked for inter-team member agreement among the scores in order to justify data aggregation. Following James (1982) and Bliese (2000), we first assessed inter-team member agreement among the scores through two intraclass correlation coefficients (ICCs): ICC(1) and ICC(2). ICC(1) indicates the level of agreement among ratings from team members within the same team. ICC(2) indicates whether teams can be

differentiated on the variables of interest. After aggregating the individual level data, stepwise regression analysis were conducted in order to examine the relation between the independent and dependent variables, as well as potential moderators (educational level, male/female ratio, team size, and months working with Lean).

**Results**

We first report the survey's psychometric qualities, before we test the hypotheses.

*Exploratory factor analyses*

A principal component analysis with varimax rotation was conducted for 31 items. The analysis resulted in ten factors with an eigenvalue above 1.0, which together explained 65% of total variance. In one step, a total of five items were eliminated because they did not contribute to a simple factor structure and had a primary factor loading of below 0.4 or above, did not load significantly on the original construct, or had cross-loadings. Further, the following four constructs were combined in two constructs, since they loaded on the same factor: 'team learning' and 'innovativeness,' and 'information sharing' and 'adaptability.' The reduced set of 26 items resulted in six factors with strong loadings, which together explained 70% of total variance. Factor loadings for the final solution are presented in Table 2.

With regard to the department head's rating of team performance, an exploratory factor analysis was conducted using varimax rotation on all eleven items. Three items were eliminated. A second factor analysis with the remaining eight items resulted in two factors with an eigenvalue above 1.0, which explained 48% and 17% percent of total variance. We renamed the second factor into 'general performance' as it consisted of items from the original 'team performance,' 'customer satisfaction,' and 'general Leanness' scales. Table 3 presents the factor loading matrix for this final solution.

*Inter-team member agreement*

Table 4 reports on the inter-team member agreement with regard to the independent variables. For ICC(1), each of the variables scored between 0.01 and 0.14, which indicates satisfactory agreement among individual team members. In terms of ICC(2), five of the six variables score equal to or higher than 0.50, which makes it appropriate to analyze these variables at the team level. Yet, 'information sharing and adaptability' (0.42) scored below the ICC(2) 0.5 cut-off point. Therefore, this variable was not aggregated to the team level, and not included in further team-level hypotheses-testing.

*Hypotheses-testing*

Means, standard deviations, and correlations of the aggregated variables are reported in Table 5. The dependent variables 'general performance (department head)', 'general Leanness (department head)' and 'general Leanness (team leader)' did not correlate with the independent variables, which leads us to reject all our team-level hypotheses.

However, some of the independent variables did correlate significantly. Conflict management positively correlated with team learning and innovativeness ($r$=.53, $p$<.05), and team leadership ($r$=.70, $p$<.01). Also, team leadership correlated with team learning and innovativeness ($r$=.53, $p$<.05). The high intercorrelations between the abovementioned predictors may indicate some multicollinearity. We thus centered the independent variables prior to calculating the interaction terms. Moreover, we found that 'general Leanness' as rated by the department head positively correlated to the team leaders' rating on the same variable ($r$=.73, $p$<.05). Finally, team size positively correlated to 'general performance' ($r$=.61, $p$<.05) and 'general Leanness' ($r$=.57,

$p$<.05) rated by the department head. An exploratory step-wise regression analysis did not result in a predictive model.

*Table 2 – Varimax rotation patterns for Lean team behavioral subscales (N=431)*

| Subscales | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Team Learning 1 | .69 | | | | | |
| Team Learning 2 | .73 | | | | | |
| Team Learning 3 | .58 | | | | | |
| Team Learning 5 | .70 | | | | | |
| Innovativeness 1 | .77 | | | | | |
| Innovativeness 2 | .78 | | | | | |
| Innovativeness 3 | .49 | | | | | |
| Performance Monitoring 1 | | .77 | | | | |
| Performance Monitoring 2 | | .81 | | | | |
| Performance Monitoring 3 | | .76 | | | | |
| Performance Monitoring 4 | | .86 | | | | |
| Performance Monitoring 5 | | .85 | | | | |
| Adaptability 2 | | | .70 | | | |
| Adaptability 3 | | | .71 | | | |
| Adaptability 4 | | | .74 | | | |
| Information Sharing 2 | | | .58 | | | |
| Information Sharing 4 | | | .63 | | | |
| Conflict Management 1 | | | | .77 | | |
| Conflict Management 2 | | | | .77 | | |
| Conflict Management 3 | | | | .76 | | |
| Conflict Management 4 | | | | .70 | | |
| Feedback Behavior 1 | | | | | .72 | |
| Feedback Behavior 3 | | | | | .84 | |
| Team Leadership 3 | | | | | | .82 |
| Team Leadership 5 | | | | | | .84 |
| Team Leadership 7 | | | | | | .85 |

Note. Factor loadings <.4 are suppressed. Extraction method: principal component analysis with eigenvalue greater than 1.0 extraction criteria. Rotation converged in one iteration.

*Table 3 – Varimax rotation patterns for department head's team performance subscales*

| Subscales | 1 | 2 |
|---|---|---|
| Team Performance 1 | .76 | |
| Team Performance 2 | .75 | |
| Customer Satisfaction 1 | .80 | |
| Customer Satisfaction 2 | .91 | |
| Customer Satisfaction 4 | .63 | .51 |
| General Leanness 2 | .62 | |
| General Leanness 1 | | .92 |
| General Leanness 3 | | .92 |

Note. $n$ = 39. Factor loadings <.4 are suppressed. Extraction method: principal component analysis with eigenvalue greater than 1.0 extraction criteria. Rotation converged in two iterations.

*Table 4 – Inter-team member agreement*

| Variable | ICC(1) | ICC(2) |
|---|---|---|
| 1. Conflict Management | 0,14 | 0,67 |
| 2. Performance Monitoring | 0,09 | 0,58 |
| 3. Feedback Behavior | 0,01 | 0,52 |
| 4. Team Learning and Innovativeness | 0,13 | 0,67 |
| 5. Team Leadership | 0,14 | 0,68 |
| 6. Information Sharing and Adaptability | 0,05 | 0,42 |

Note. ICC(1) determines the level of agreement among ratings from team members within the same team. ICC(2) estimates the reliability of mean differences across teams (between group variance).

*Table 5 – Means, standard deviations, and correlations, based on aggregated data*

| Variables | M | s.d. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Conflict Management | 4.68 | .57 | (.87) | | | | | | | | | | |
| 2. Performance Monitoring | 4.30 | .69 | .08 | (.90) | | | | | | | | | |
| 3. Feedback Behavior | 4.88 | .51 | .35 | .50 | (.50)[b] | | | | | | | | |
| 4. Team Learning and Innovativeness | 5.09 | .55 | .53* | .27 | 0,27 | (.85) | | | | | | | |
| 5. Team Leadership | 5.03 | .57 | .70** | .30 | 0,42 | .53* | (.87) | | | | | | |
| 6. General Performance (Department Head) | 5.24 | .74 | -.10 | .13 | 0,04 | -.03 | .19 | (.80) | | | | | |
| 7. General Leanness (Department Head) [c] | 3.14 | .88 | .02 | .22 | 0,25 | -.06 | .30 | .47 | (.68) | | | | |
| 8. General Leanness (Team Leader) [c] | 3.68 | .63 | .15 | .28 | 0,08 | .22 | .30 | .42 | .73* | (.86) | | | |
| 9. Educational Level | 1.33 | .28 | -.04 | .25 | -0,07 | .41 | .07 | .01 | -.12 | .02 | – | | |
| 10. Male/Female Ratio | 0.69 | .31 | -.11 | -.30 | -0,35 | -.06 | -.14 | -.20 | -.11 | -.37 | .35 | – | |
| 11. Team Size | 13.53 | 6.64 | -.05 | .45 | 0,10 | .11 | .21 | .61* | .57* | .40 | .13 | .06 | – |
| 12. Months working with Lean | 47.56 | 47.88 | -.07 | -.15 | -0,05 | -.41 | -.01 | .33 | .20 | .16 | -.01 | -.16 | -.21 |

Notes. [a] Diagonal entries represent scale reliabilities (Cronbach's alphas). $n = 31$ Lean work teams.
Correlations were significant (2 tailed) at the following levels: $*p < .05$; $**p < .01$.
[b] We calculated Pearsons correlation as the 'feedback behavior' scale consisted of two items only.
[c] General Leanness was measured on a 5-point scale: all the other non-control variables were assessed on a 7-point scale.

*Table 6 – Means, standard deviations, and correlations, based on individual level data*

| Variables | M | s.d. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Conflict Management | 4.65 | 1.15 | (.87) | | | | | | | | | | | |
| 2. Performance Monitoring | 4.55 | 1.22 | .31** | (.90) | | | | | | | | | | |
| 3. Feedback Behavior | 4.87 | 1.15 | .42** | .28** | (.50)[b] | | | | | | | | | |
| 4. Team Learning and Innovativeness | 5.00 | 1.00 | .51** | .40** | .42** | (.85) | | | | | | | | |
| 5. Team Leadership | 5.27 | 1.22 | .39** | .29** | .31** | .42** | (.87) | | | | | | | |
| 6. Information Sharing and Adaptability | 5.46 | .85 | .55** | .36** | .46** | .71** | .39** | (.84) | | | | | | |
| 7. General Performance (Department Head) | 5.39 | .69 | -.01 | .09 | .09 | .08 | .10 | .05 | (.80) | | | | | |
| 8. General Leanness (Department Head)[c] | 3.56 | .99 | .02 | .12 | .06 | -.05 | .10 | -.08 | .29** | (.68) | | | | |
| 9. General Leanness (Team Leader)[c] | 3.67 | .56 | .10 | .08 | .02 | .06 | .01 | -.04 | .24** | .54** | (.86) | | | |
| 10. Educational Level | 2.27 | .73 | -.03 | .03 | -.05 | -.06 | -.07 | -.07 | -.21** | .06 | .07 | | | |
| 11. Male/Female Ratio | 0.40 | .49 | -.02 | -.01 | .04 | .11 | -.06 | .09 | .01 | -.17** | -.11 | .07 | | |
| 12. Team Size | 19.76 | 1.65 | -.06 | .10 | -.01 | -.14* | .15* | -.03 | .44** | .29** | -.09 | -.23** | -.14** | |
| 13. Months with Lean | 35.14 | 34.48 | -.11 | .00 | .01 | .15* | -.02 | .14* | .33** | -.05 | -.20** | -.18** | .22** | .02 |

Notes. [a] Diagonal entries represent scale reliabilities (Cronbach's alphas). $n = 31$ Lean work teams, consisting of 431 team members, 34 team leaders, and 39 managers.
Correlations were significant (2 tailed) at the following levels: $*p < .05$; $**p < .01$.
[b] We calculated Pearsons correlation as the 'feedback behavior' scale consisted of two items only.
[c] General Leanness was measured on a 5-point scale: all the other non-control variables were assessed on a 7-point scale.

*Individual-level data exploration*

Since no significant team-level correlations were found between the independent and the dependent variables, we decided to further explore the data beyond our initial hypotheses: by examining the variables at the individual level. We included again the construct 'information sharing and adaptability,' since inter-team member agreement scores are irrelevant at the individual level. Table 6 shows the means, standard deviations and correlations. Similar to what we had found at the team-level of analysis, we found no correlations between the independent and the dependent variables. Yet, all independent variables were significantly and positively correlated, with an $r$ between .31 and .71 ($p$<.01). We thus controlled for multicollinearity and centered the independent variables prior to conducting a new stepwise regression analysis.

A stepwise regression analysis indicated that general performance (department head score) was significantly predicted by two main effects, and one interaction effect ($R^2_{adj}$=.23, F(3,330)=33.96, $p$<.001): team size ($\beta$=.02, t(330)=7.34, $p$<.001), months working with Lean ($\beta$=.01, t(330)=6.24, $p$<.001), and months working with Lean * performance monitoring ($\beta$=.00, t(330)=2.89, $p$<.001). Thus, months working with Lean moderated the impact of performance monitoring on the department head's rating of general performance. Nonetheless, the betas for these effects are very small.

**Discussion**

We developed a team-level self-assessment that aims to tap into Lean teams' affective, behavioral and cognitive factors at the shop-floor level. Based on exploratory factor analyses the final instrument consists of 26 items, covering a set of six Lean team affective and behavioral factors: conflict management, performance monitoring, feedback behavior, team learning and innovativeness, team leadership, and information sharing and adaptability. Although the instruments' psychometric properties are satisfactory, based on the aggregated dataset we could not examine our hypotheses. This was due to a clear restriction of range. For exploratory purposes, we did perform some statistical analyses; some of the independent variables did intercorrelate significantly whereas other did not. In the Results section we tried to interpret the observed pattern, in an exploratory fashion. Further we explored the individual-level data beyond our team-performance hypotheses. Noteworthy is that at this level all the substantive independent variables correlated significantly. Given that we had established construct validity at the team level, we interpret this pattern of significant intercorrelations as Lean teams having a relatively high level of intra-team trust.

**Limitations**

As we had derived hypotheses at the team level, our initial sample of 501 individual survey responses was aggregated to a much smaller sample of 31 work teams. This sample of Lean teams appeared to show too little behavioral variation. Hence, our findings did not show any of the expected relations. Although some teams were more mature in terms of Lean adoption compared to others, all teams had acknowledged their issues and had decided to improve their performance (some even with the help of external consultants). Hence, our data is likely to suffer from a restriction of range and we were unable to accept our hypotheses. Larger-scale studies, including a more diverse set of teams, i.e. both Lean and non-Lean work teams, may allow for the testing of the specified hypotheses, starting at the individual level.

Furthermore, whilst team members' self-report could be regarded as a strength of this study, it is also a limitation because of the differences amongst the team members in their level of awareness in regard to the team's performance (i.e., we found a low inter-team member agreement on the 'general performance' scale, which may indicate that individual team members within the same teams rate performance on the basis of different criteria).

Fortunately, we also collected more objective expert scores on team performance: from the team leaders and department heads. And it is of interest that the higher these heads rate the team's performance, the higher the level of performance monitoring that is perceived within the teams. This could be seen as an indication of increased performance awareness among team members. Furthermore, after analyzing the data we prepared team-specific reports, which we discussed with each of the individual team leaders during a face-to-face meeting. We presented the team-specific outcomes to the team leaders and asked them to what extent they thought the survey findings reflected their day-to-day team dynamics. Their positive responses illustrate the ecological or practical validity of our survey instrument.

Another limitation concerns the fact that each organization applies their own bundle of Lean tools (Shah, et al., 2003). Given that we did not explicitly investigate the specific Lean bundles installed among the studied teams, this may blur the outcomes. Nevertheless, previous studies found that Lean tools 'typical' to manufacturing may be applied similarly in pure service contexts (Piercy, et al., 2009). A follow-up study might also control for the set of Lean tools applied by the focal teams, in order to check whether the differences in Lean tools applied may influence the existence of Lean behaviors on the shop floor.

## Conclusion

The two key contributions of our study are the following: 1) from the large and long-established Group and Team-effectiveness theory we derived a practically relevant survey with a focus on Lean team behaviors; and 2) we report the initial validation of this reliable tool that, once fully validated, will help assess the degree of behavioral maturity that is widely seen as a prerequisite for effective Lean work teams. The obtained knowledge of this study, and especially the insights gleaned after testing the hypotheses at the individual level, may enrich and further specify the current Lean maturity models and self-assessment tools that have already been developed by other scholars (see e.g., Bessant *et al.*, 2001; Boer *et al.*, 2000; Jørgensen *et al.*, 2003). Moreover, this tool may serve teams and/or consultants to rate teams' Lean behaviors and guide them in developing the next steps in becoming more effective. We welcome large-scale longitudinal studies that will help unravel the mundane yet intricate behavioral dynamics at play in ongoing Lean teams as well as their use in reaching high Lean-team performance. To conclude, our results uncover that intra-team performance monitoring is important in becoming a high-performing Lean team; those teams that scored high on performance monitoring received the highest performance ratings, especially if they applied Lean longer.

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