

# **Kaizen event effectiveness and problem-solving style awareness: A video-based field examination**

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## **Abstract**

Effective lean adoption requires running Kaizen events (KE) effectively. Yet, the behavioural tendencies of each of the team members involved in such events often hamper KE outcomes. This longitudinal study examines whether team members' awareness of their own and team members' problem-solving styles impacts KE effectiveness. After a survey about these styles, we video-filmed two events of nine kaizen teams: One prior to and the other after a team workshop intervention that boosted members' awareness of these tendencies. Our finding is that being aware of one's own and team members' problem-solving styles has an impact on KE effectiveness and behaviours.

**Keywords:** Lean/Kaizen, Problem-solving style, Team effectiveness

## **Introduction**

A key aspect of lean management is the mastery of kaizen. Kaizen stands for 'improving for the better' and is a fundamental mind-set of the lean philosophy (Liker, 2004). Moreover, a Kaizen event (KE) (Bicheno and Holweg, 2000) is defined as "a structured project performed by a multi-disciplinary team with the aim of improving a targeted work area or process in a given timeframe" (Bortolotti *et al.*, 2018, p. 555). Being able to solve problems and implement improvements through KEs is critical for the effective adoption of lean (Bessant *et al.*, 2001). Typically, KEs are one-hour, half-day, full-day or, occasionally, five-day group events (Glover *et al.*, 2013). Effective KEs improve work-floor operations, stimulate employees' problem-solving capabilities and create a positive attitude towards continuous improvement (Bortolotti *et al.*, 2018).

However, if a KE does not lead to improvements, employees might get frustrated and resist participating in future KEs (Glover *et al.*, 2013). But why are some kaizen teams effective in solving problems whilst others are struggling? Farris *et al.* (2009) distinguished various team (input-process-output type) determinants of effective KEs. An

important team-process factor is intra-team member interaction (Farris *et al.*, 2009). The behaviours involved in such an interaction are known to affect (the emergence of) team processes (Kozlowski, 2015). One specific individual characteristic that may contribute to the effectiveness of behavioural interactions during KEs is team-member's problem-solving style (Buffinton *et al.*, 2002). The current study started by assuming that people's awareness of their own and peers' problem-solving styles can help (kaizen) teams increase their effectiveness (Gardner and Martinko, 1996). This paper offers an initial result of our examination of the question: *How does team-members' awareness of their own and peers' individual problem-solving style affect individual behaviour, the process and outcome of Kaizen events?*

### Theory: Kaizen Phases and Personal Styles

Most kaizen studies consider kaizen to be a whole event (e.g., Bortolotti *et al.*, 2018; Farris *et al.*, 2009; Glover *et al.*, 2013). In practice, however, kaizen is a structured, phased team approach to problem solving. Table 1 summarizes a selection of popular problem-solving instruments. Each instrument uses different labels, and the number of phases range from four to nine. After content analyses of each of these and other seminal sources, six basic phases of kaizen were distinguished (Table 1: left column).

*Table 1 – Overview of the Phases of Popular Kaizen Instruments*

	Scientific thinking mechanism (Shingō, 2007, p. 94)	Kaizen Workshops (Liker, 2004, p. 256)	PDCA (Latzko and Saunders, 1996)	DMAIC (De Mast and Lokkerbol, 2012)	Rational manager approach (Kepner and Tregoe, 1965)	Kaizen circle (McKinsey&company, 2003)
1. Define the problem	1. Principle of division and problem awareness 2. Pursuit of purpose	1 Initial problem perception 2 Clarify the problem 3. Locate Area, point of cause	1. Plan	1. Define	1. Problem analysis and decision making	1. Problem definition
2. Analyse the current situation	3. Understanding the status quo 4. Better methods 5. Lock on to problems	4. Five times why investigation of root cause		2. Measure	2. Potential problem analysis	2. Root cause analysis
3. Generate ideas	6. Idea generation 7. Judgement			3. Analyse		3. Brainstorm
4. Plan implementation	8. Propose				3. Set contingency actions	4. Implementation plan
5. Implement the change	9. Implement	5. Counter measure	2. Do	4. Improve	4. Remove cause	5. Implement
6. Check and sustain		6. Evaluate 7. Standardize	3. Check 4. Act	5. Control	5. Set controls	6. Check and sustain

All reviewed instruments emphasize that to be most effective, the KE phases should be performed in a particular order. Hence, KE effectiveness is widely assumed to depend on the ability of the team to perform each subsequent phase in an orderly manner (Kepner and Tregoe, 1965; Liker, 2004). Orderly here means that the team, after reaching consensus about the result of each phase, continues to the next phase, without the need to return to a previous one. Each kaizen phase has a particular goal (Table 2). Although open team-member discussion is key during a KE, a specific orientation and related core question ought to be addressed during each phase (Kepner and Tregoe, 1965; Liker, 2004; Shingō, 2007). Asking and answering phase-specific questions appropriately requires

each team member to have specific KE capabilities. Team members' individual behavioural contributions, in terms of knowledge and skill, to each KE phase can thus be seen as crucial for KE's effectiveness (Hackman and Morris, 1975; Wageman *et al.*, 2005). The general team-effectiveness literature acknowledges the influence of team member's personal styles on the effective composition of teams (Mathieu *et al.*, 2017). Different personality types or styles develop different capabilities, skills and preferences that can show up in team behaviour (Jung *et al.*, 1964). The effectiveness of a KE is thus likely to be dependent on members' problem-solving styles and the consequent behavioural display in each phase (Buffinton *et al.*, 2002).

To link personal problem-solving behavioural tendencies to the kaizen phases, we used the Myers and Briggs model which operationalises Jung's seminal theory of psychological types (Gardner and Martinko, 1996). The four dichotomies denoted in the Myers-Briggs Type Indicator (MBTI) are: source of energy (extraversion vs. introversion), mode of taking in information (sensing vs. intuition), decision making (thinking vs. feeling), and lifestyle (judging vs. perceiving) (Gardner and Martinko, 1996). While the model has been critiqued for its explanatory value (Stein and Swan, 2019) it is widely used for increasing people's awareness of their own personal preferences at work (Gardner and Martinko, 1996). The different preferences within MBTI's four dichotomies seem to be closely related to the key questions in the kaizen phases (Hirsh and Hirsh, 2007). Although KE team members typically embody a (random) variety of MBTI preference styles, part of this research explores to what extent certain MBTI preferences ought to be more dominant in each kaizen phase. Given the predominance of task-orientation during KEs, only three of the four MBTI categories were mapped with the KE phases: taking in information, decision making, and lifestyle. Source of energy is not taken into account in Table 2 as it is assumed that both people with a more extraversion style and a more introversion style are just as good at showing the key capabilities described in Table 2. We expect that if people are aware of their problem-solving styles, the process and outcome of KE improves. Moreover, we expect that individuals will feel more capable in particular KE phases: those that match their own problem-solving style best.

*Table 2 – The Goals of Each Kaizen Phase Linked to MBTI Styles*

Kaizen phase	Goal	Orientation and core question	Intention of individual contributions	Key capability	MBTI style
1. Define the problem	Understand objective situation and future impact	What is the expected impact of this problem?	Exploring the context of the problem	Weigh options in terms of the possible consequences Seeing the potential Seek logical clarity	Intuition and thinking (NT)
2. Analyse the current situation	Explore the root causes	What causes this problem?	Discussing and weighting the causes	Weigh options in terms of the bottom line Prefer to know what is Seek logical clarity	Sensing and thinking (ST)
3. Generate ideas	Creatively develop possible solutions	Which ideas may help to remove the root cause?	Elaborating on ideas	Prefer flexibility Like to see what turns up Enjoy surprises	Perceiving (P)
4. Think about how to implement	Develop a plan of what is needed to	What should be done to	Exploring the commitment to change	Weigh options in terms of people's aspirations Seeing the potential	Intuition and feeling (NF)

	realise change	create change?		Know when support is required	
5. Implement the change	Execute the plan	Can you accept the change and perform the new standard?	Observing and discussing responses to the change	Weigh options in terms of individual's needs Have in interest in people Know when support is required	Sensing and feeling (SF)
6. Check and sustain	Set the new standard	Did the new way of working solve the problem?	Discussing the extent to which the problem is solved and the solution is standardized	Want things to be settled and ordered Draw conclusions Like goals and results	Judging (J)

### Design/methodology/approach

We video-filmed KE team members' contributions to two KEs about real-life problems within their team. Figure 1 displays the time points, over a period of two months, in which we collected the survey data and engaged in the awareness-raising intervention.

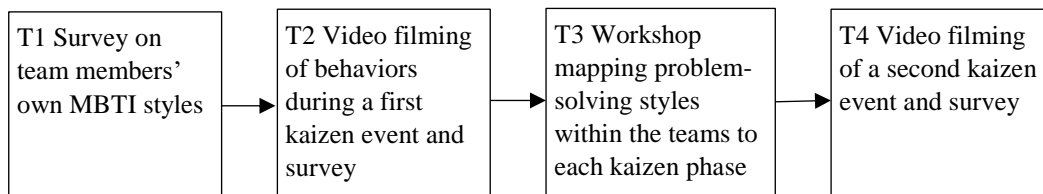


Figure 1 – Longitudinal Research Design, including the Workshop Intervention

### Sampling

After a pilot, ten kaizen teams within two Dutch knowledge-intensive organizations were approached, based on convenience sampling (Barratt *et al.*, 2011). Nine teams (in total 42 members) participated in the study: on average five members per team, see Table 3.

Table 3 – Teams' Characteristics

No.	Industry	Team tenure	No. of team members (Male/Female)	Average years of work experience
1	University Design Lab	< 1 month	4 (2/2)	<1
2	University Design Lab	< 1 month	4 (0/4)	9
3	University Design Lab	< 1 month	4 (0/4)	23
4	Consultancy	1.5 year	5 (3/2)	3
5	Consultancy	1.5 year	7 (5/2)	3.5
6	Consultancy	1.5 year	5 (4/1)	3
7	Consultancy	1.5 year	4 (2/2)	4
8	University Student Affairs	12 year	4 (3/1)	28
9	University Human Resources	3 year	5 (2/3)	27
			Total: 42 (21/21)	

### Measures

At T1, each *team member's personal MBTI style* was measured using the MBTI instrument (Hirsh *et al.*, 1992). The instrument consists of 88 forced-choice items. Best-fit types were determined following official MBTI procedures.

We video-taped each team's KE at both T2 and T4 in order to be able to code *members' behaviours per kaizen phase*.

*Perceived KE effectiveness* was assessed immediately after each of the two filmed KEs. Based on the Team Diagnostic Survey (Wageman *et al.*, 2005), a composite measure

that incorporated both technical and social KE outcomes was applied (Farris *et al.*, 2009): 1) productive process, three sub scales with a total of nine items e.g., “Our team often comes up with innovative ways of proceeding with the work that turn out to be just what is needed”; 2) team interpersonal process, two sub scales with seven items in total e.g., “Working together energizes and uplifts the members of our team”; and 3) individual learning and well-being, three sub scales with a total of ten items e.g., “I learn a great deal from my work with this team”. All items were scored on a 5-point Likert scale, ranging from 1 “totally disagree” to 5 “totally agree”. Although the instrument was chosen because of its proven validity, the Cronbach’s alpha analysis of our study was poor so two sub scales and in total 13 items had to be removed. The reliabilities of the remaining sub scales at T2 were between .51 and .76.

The survey at T2 and T4 also measured *team member’s perceived capability in each phase of kaizen*: with a newly-developed questionnaire consisting of 48 items with a 7-point Likert scale ranging from 1 “totally disagree” to 7 “totally agree”; six sub scales consisting of eight items per kaizen phase. The items dealt with the required type of behaviour within each kaizen phase. They were constructed with the help of five lean master black belt consultants each of whom had over ten years of lean experience. After eliminating two items, the six sub scales had acceptable to good Cronbach’s alphas, ranging between 0.65 and 0.82 (T2) and between 0.65 and 0.84 (T4).

At T3, each team participated in a workshop during which the members first discussed the six kaizen phases. Then, they received feedback on their personal styles related to each phase of problem solving (as in Table 2). Moreover, a visualised KE-behavioural team assessment (of T2) was fed back to them. Immediately afterwards, they assessed the workshop quality with seven survey items e.g., “The provided knowledge is interesting”, on a 7-point Likert scale ranging from 1 “totally disagree” to 7 “totally agree”. The mean quality rating was 5.80 (*s.d.* = 0.43; 69% response rate).

#### *Data-analysis*

We calculated the means of each of the KE effectiveness variables and executed one-tailed t-tests to verify the expected improvement between T2 and T4.

The KE videotapes were transcribed and minutely coded in terms of members’ contributions. Each remark from every single participant was categorized into one of the six kaizen phases, based on the code rules created in Table 2. These categorized member contributions were then plotted over time. The resulting team graphs visualised what happened during the subsequent phases of the two KEs (Figure 5).

Finally, we analysed to what extent members rated themselves as more capable at T4 compared to T2 in terms of the kaizen phases that we expected to fit their MBTI functional and lifestyle styles (Table 2). Each participant was thus categorized twice. We then performed a one-tailed t-test, since we expected an improved link, after the workshop, between best-fit MBTI styles and perceived capability in the related kaizen phases.

#### **Results**

Table 4 shows the perceived KE effectiveness per team, both at T2 and T4. Only three teams improved (marginally) significantly on some of the KE effectiveness variables. Surprisingly, in this table one may also notice some drops in perceived KE effectiveness: due perhaps to people’s increased self-awareness of their own and team member’s behavioural shortcomings.

To provide a more detailed example of the video-based analysis, Figures 3 and 4 show the result of the minute coding of team 4’s video-taped KEs at T2 and at T4. Regarding KE process effectiveness it can be seen that after the intervention the team showed a more

Table 4 – Perceived Kaizen Event Effectiveness, Results of the T-tests Comparing T2 vs. T4

Variables	Team 1		Team 2		Team 3		Team 4		Team 5		Team 6		Team 7		Team 8		Team 9	
	T2	T4	T2	T4	T2	T4	T2	T4	T2	T4	T2	T4	T2	T4	T2	T4	T2	T4
<i>Team interpersonal process</i>																		
Quality of team interaction	3.50	<b>4.25</b> <sup>†</sup>	3.75	3.75	4.38	4.25	4.80	4.80	4.07	4.14	4.30	4.20	4.38	4.13	4.13	4.00	4.40	4.20
Satisfaction with team relationships	4.13	<b>4.46</b> *	4.25	4.00	4.38	4.13	4.90	4.50	4.21	4.36	4.20	4.30	4.75	4.63	4.50	4.00	4.50	4.30
<i>Individual learning and wellbeing</i>																		
Satisfaction with growth opportunities	3.75	3.13	3.50	3.50	3.75	4.00	3.90	<b>4.20</b> *	2.86	<b>3.07</b> <sup>†</sup>	4.30	4.40	4.38	4.13	4.25	4.38	4.20	3.90
General satisfaction	4.50	<b>4.88</b> *	4.13	3.88	4.25	4.38	4.80	4.70	4.43	4.29	4.40	4.40	4.63	4.63	4.38	4.50	4.60	4.60
<i>Productive process</i>																		
Effort-related process criteria	4.13	3.88	3.63	3.63	4.25	4.13	4.00	4.10	3.71	3.71	4.60	4.50	4.38	4.38	4.13	4.13	4.30	4.20
Strategy-related process criteria	4.25	3.88	3.13	3.25	3.63	3.50	3.70	<b>4.00</b> <sup>†</sup>	3.79	3.79	4.40	4.20	3.38	3.63	3.75	4.00	4.00	3.70

Note. \* p < .05; † p < .10 (one-tailed).

KE phase

- Problem definition
- Root cause analysis
- Generate ideas
- Plan implementation
- Implement
- Check and sustain

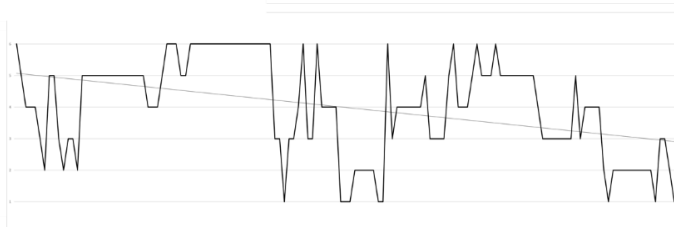


Figure 3 – Example Visualization of KE Members' Behaviour Before Awareness Training (Team 4 at T2)

KE phase

- Problem definition
- Root cause analysis
- Generate ideas
- Plan implementation
- Implement
- Check and sustain

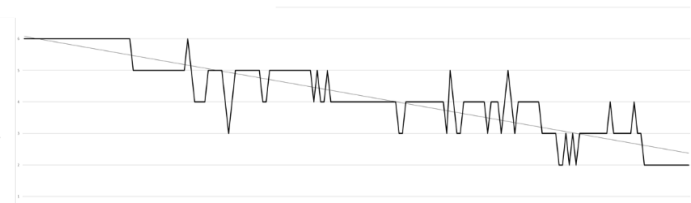


Figure 4 – Example Visualization of KE Members' Behaviour After Awareness Training (Team 4 at T4)

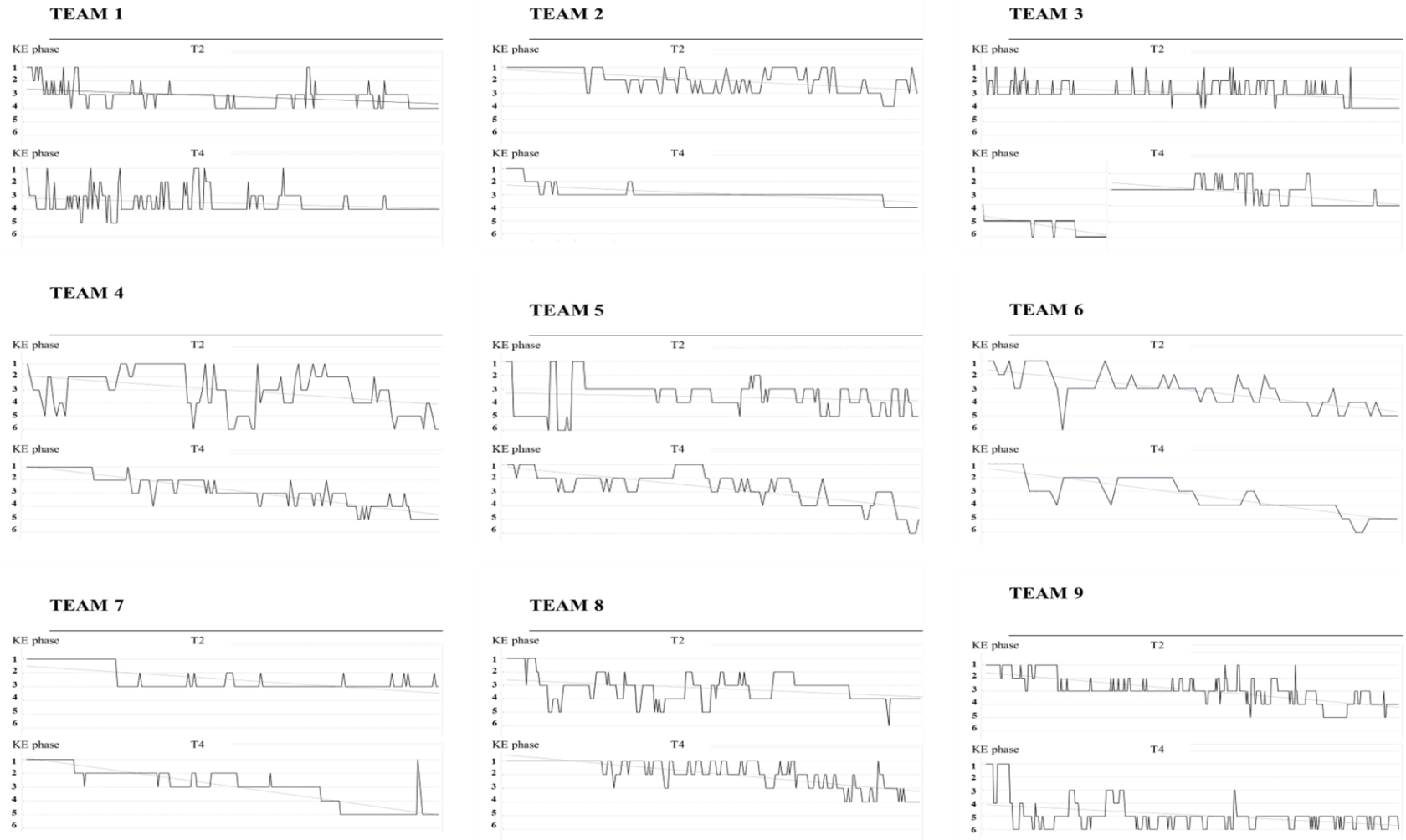


Figure 5 – Comparison of Members Contributions during Minutely Coded KE Events (Upper Graphs: T2; Lower Graphs: T4)

phased approach. Specifically, at T4 (in Figure 4) the team engaged in a root-cause analysis phase after its problem-definition phase. A root cause analysis phase was not clearly visible at all at T2 (Figure 3). Figure 5 shows a visual comparison of the video sessions at T2 and T4 of *all* the studied teams.<sup>1</sup> From this Figure we find that, at T4, teams typically spent more time on defining the problem, and most teams took a more structured or gradual approach: according to the ideal-typical KE phases.

Table 5 reports the results of the changes in the respondents perceived capabilities in their preferred phase (linked to their best-fit MBTI style). Significant changes were found for the functional styles, esp. for the team members who indicated a preference for the ‘Plan implementation’ phase. An even stronger intervention, or more (or less) time between T3 and T4, is likely to lead to more remarkable changes in terms of the exposed preference style (see Table 5). Although not always visible in their perceptions, the people certainly showed an increased individual awareness of personal problem-solving style during the KEs at T4. Various quotes from the participants during and after the workshops at T3 and T4 support this (Table 6).

*Table 5 – Perceived Kaizen Phase Capabilities in Terms of Function and Lifestyle MBTI Styles*

	<i>n</i>	<i>M</i> (T2)	<i>M</i> (T4)	<i>s.d.</i>	<i>t</i>	<i>p</i>
Functional styles linked to kaizen phase	42	5.27	5.40	0.48	-1.85	0.04*
NT – Define the problem	8	5.16	5.42	0.43	-1.75	0.06†
ST – Analyse the current situation	9	4.90	4.82	0.50	0.50	0.32
NF – Plan implementation	13	5.43	5.64	0.43	-1.80	0.05*
SF – Implement the change	12	5.43	5.57	0.55	-0.85	0.21
Lifestyle styles linked to kaizen phase	42	5.07	4.97	0.57	1.16	0.13
P – Generate ideas	25	5.03	4.88	0.65	1.19	0.12
J – Check and sustain	17	5.12	5.10	0.44	0.24	0.41

Note. \*  $p < .05$ ; †  $p < .10$  (one-tailed).

*Table 6 – Illustrative Team Members’ Quotes after the Workshop*

Team 5 at T4	“I am not interested in defining and discussing the problem, because I have already done it in my head.” (remark when he was asked to join the discussion. After a laugh he realised that he had to share his thoughts with his colleagues)
Team 8 after T3	“I used to ask my peers about this because I am not that good at it and always felt some frustration. With this knowledge I will still ask my colleague, but with less frustration.”
Team 5 at T4	“Come on, this is your phase. Help us out.” (with a smile)
Team 6 after T4	“On knowing my preferred phase I now dare to score that I am not good at everything. I dare to emphasize my preferred actions.”

## Discussion

We explore how KE member’s awareness of own and others’ problem-solving styles affect the effectiveness of KEs. We undertook a multi-case analysis of combining behavioural profiling with an innovative micro-behavioural video-method as well as customized feedback and an awareness-rising workshop. After the workshop, whose aim is to raise members’ behavioural styles awareness some teams demonstrate a positive effect in terms of a more phased KE process. In terms of KE outcome effectiveness: both positive and negative changes are found regarding different elements of team effectiveness. Moreover, individuals feel increasingly capable related to their preferred phase of problem solving. The preliminary findings are linked to Buffinton *et al.*’s (2002) suggestion that problem-solving styles and project teams’ interpersonal dynamics are critical factors for effective team functioning. Moreover, Kozlowski (2015) refers to the critical role of team processes in resolving team task demands. Hence, this exploratory



study shows the potential for further investigations of how people's awareness of their own and team members' styles may contribute to KE effectiveness. Possible pathways are expanded below.

The video data could be analysed more extensively. The video analyses of the KEs at T2 and T4 show interesting visual changes in terms of KE process. We may need to come up with a more objective comparison between T2 with T4 across the teams. Coming up with a measurable indicator (i.e., a slope coefficient) that justifies the phased approach should be part of future discussions and research with statisticians and academic peers.

In terms of limitations, all the measurements occurred immediately after the intervention hence, the long-term impact of personal problem-solving style awareness on KE effectiveness has not been taken into account yet. Another point is that we left the source of energy (extraversion/introversion) out of the scope. This should be included in future research. It can be argued that one's source of energy will influence KE process performance in line with a team's action orientation (Farris *et al.*, 2009). Of course, larger-scale studies that include control groups are warranted. They may enable further fine-tuning and validation of the self-developed scale which we used to assess team member's perceived capability in each kaizen phase, plus more robust statistical analyses with more reliable KE outcome measures.

Although this study uniquely focussed on the factor of problem-solving style awareness within teams, no other factors were taken into account, e.g., KE's goal clarity (Farris *et al.*, 2009); The teams were instructed to solve a problem of their own day-to-day work. Each team session had to start with the question: "How do we solve...?" In effect, the videos showed members' mutual collaboration as well as the maturity with which teams were able to perform kaizen. The established fact that not all teams followed a neat KE process, as shown in Figure 5, might be related to the degree of team kaizen experience (Farris *et al.*, 2009). In future behavioural KE research, specifications of the problem-solving phases to be followed by a team might need to be matched to the nature of the status of the particular problem at hand. Explicit articulation of the required phases on each KE agenda might indeed help the members to stick better to what the problem requires rather than to let their behavioural preference determine the KE process.

This study contributes to our understanding of the individual as a component of kaizen and to what extent awareness of team members' diverse problem-solving styles should be present in a team to be successful in kaizen. While most prior kaizen research focused on team *functional* heterogeneity (Farris *et al.*, 2009), perhaps focusing on member's contributions per KE phase would illuminate *problem-solving style* heterogeneity. Although it may not always be possible to compose teams based on members' problem-solving styles in practice, people's awareness of their own and peers' styles is found to contribute to KE effectiveness. The practical relevance of our work is further evidenced by the positive responses of our respondents and their requests for additional tools to make effective use of their behavioural preferences in team settings. Understanding kaizen as a *phased* approach, including its enablers at the individual and team level, provides a new line of research in which many interesting questions can be explored.

## Notes

1. A better readable version of Figure 5 will be provided by the first author upon request.

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