Effects of team task structure on team climate for innovation and team outcomes

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Abstract

In this cross-sectional study we analyzed, whether team climate for innovation mediates the relationship between team task structure and innovative behavior, job satisfaction, affective organizational commitment, and work stress. 310 employees in 20 work teams of an automotive company participated in this study. 10 teams had been changed from a restrictive to a more self-regulating team model by providing task variety, autonomy, team-specific goals, and feedback in order to increase team effectiveness. Data support the supposed causal chain, although only with respect to team innovative behavior all required effects were statistically significant. Longitudinal designs and larger samples are needed to prove the assumed causal relationships, but results indicate that implementing self-regulating teams might be an effective strategy for improving innovative behavior and thus team and company effectiveness.

Introduction

The role of team task structure for team effectiveness is still a matter of controversial debate. Particularly in the automobile industry the majority of managers seems to favor the position that restrictive team task structures with low decision latitudes and task demands are more effective than more complex team task structures, which allow more team autonomy and self-regulation. This stand is based on the Toyota production paradigm favoring restrictive types of teams (Womack, Jones & Roos, 1991). On the other hand, socio-technical system theory (Emery & Thorsrud, 1982) and psychological theories of group effectiveness (Hackman, 1987) propose that complex team tasks stimulate task orientation and motivation, learning processes and effective task coordination strategies leading to increased team effectiveness.

Existing research on team effectiveness shows conflicting results leaving room for further debate. For example some studies report that restrictive teams show increasing job satisfaction, satisfaction with employment security and participation in the suggestion program despite having high work load (Adler, 1995; Adler & Cole, 1993). Other studies report that teams having complex and holistic team task structures and autonomy can better cope with high work load, showing less psychological fatigue and higher learning motivation (Mierlo, Rute, Seinen & Kompier, 2001), have a higher innovative capability (Berggren, 1994) and perceive their work as more interesting (Gerst, Hardwig, Kuhlmann & Schumann, 1994; Schumann & Gerst, 1997).

Most studies are output oriented and do not analyze intervening team processes (Antoni, 1997). If team processes, such as social support, communication and cooperation, are addressed at all they are analyzed as predictor and not as mediating variables (Campion, Papper & Medsker, 1996; Cohen, Ledford & Spreitzer, 1996). To open this black box, this study tries to analyze the mediating processes between team task structure and team effectiveness.

Based on socio-technical system (Emery & Thorsrud, 1982) and input-process-output theories of group effectiveness (Hackman, 1987), we assume that complex team tasks lead to increased team effectiveness (hypothesis 1) by stimulating task orientation and motivation, learning processes, and effective task coordination strategies (hypothesis 2), which mediate the effects of team tasks on team effectiveness (hypothesis 3). Complex team task structures are defined as providing task variety, autonomy, team-specific goals, and feedback.

[1] I thank Susanne Theißen for her work in this research project.

The effects of team task structures on team effectiveness encompass both performance criteria, such as team innovations (hypothesis 1a), and quality of work life criteria, such as job satisfaction (hypothesis 1b), organizational commitment (hypothesis 1c), and stress (hypothesis 1d) (Campion, et al., 1996; Cohen et al., 1996). As a first approach to tap the various motivational, learning, and coordinative team processes we refer to the concept of team climate for innovation (West, 1990). This concept integrates motivational, cognitive learning and coordinative team processes in its four factors vision, task orientation, participative safety, and support for innovation.

Motivational processes are primarily addressed by the factor vision, which refers to the clarity, value, sharedness, and attainability of goals. Aspects of task orientation such as self-monitoring and building on each other's ideas refer to learning processes. Information sharing (participative safety) and support for new ideas (support for innovation) refer to team coordinative processes. Studies on team climate for innovation propose that team climate is not only supporting team innovations and performance, but also job-related feelings and affective well-being (Carter & West, 1998; West & Anderson, 1996). For this reason we expect (cf. Figure 1) that team climate mediates the effects of team task structure both on performance-oriented criteria of team effectiveness, such as team innovation (hypothesis 3a), as well as on quality of working life criteria, such as organizational commitment (hypothesis 3b), job satisfaction (hypothesis 3c), and stress (hypothesis 3d).

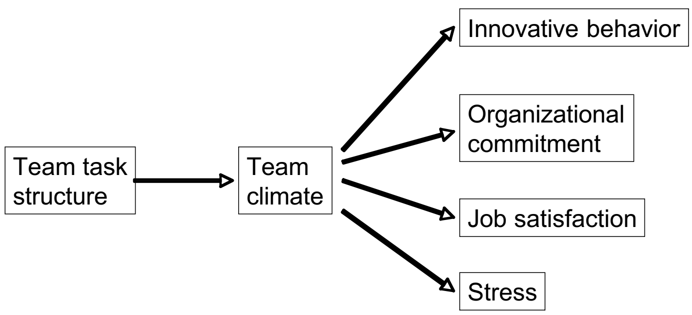

Figure 1. Team effectiveness as a function of team task structure and team climate

To sum up, in this study the following hypotheses will be tested:

- Teams with more complex task structures are more effective than teams with less complex task structures (hypothesis 1), i.e. their team members, are more innovative (hypothesis 1a), are more committed to their organization (hypothesis 1b), are more satisfied with their job (hypothesis 1c), and experience less stress (hypothesis 1d).
- Teams with more complex task structures have a better climate for innovation than teams with less complex task structures (hypothesis 2).
- Team climate for innovation mediates the effects of team task structure on team innovation (hypothesis 3a), organizational commitment (hypothesis 3b), job satisfaction (hypothesis 3c), and stress (hypothesis 3d).

Method

This study was done in a German automobile company, which had introduced teamwork in 1991 mainly focusing on the rotation of production tasks. As team effectiveness did not advance as expected over a 10-year time period, the company tried to increase team effectiveness by changing to a more self-regulated team model in 2001. Starting with 10 teams, team-based goal and feedback systems were implemented to allow a self-regulated staff deployment and performance management. Furthermore, indirect tasks, such as transportation, stock, cleaning, job control, and total productive maintenance, were delegated to these teams, changing them from restricted rotation to self-regulated teams.

This study compared these 10 self-regulated teams having more complex task structures with 10 traditional teams characterized by restrictive task structures. For correlation and regression analysis these two types of team task structures were dummy coded (0 for restrictive and 1 for complex task structure). Because of the small sample size on team level we take effects up to the 10 percent significance level into account. These 20 teams in total represented 487 employees. Team size ranged from 15 to 38 members. In the average a team had 24 members. Team size did not correlate with team task structure or other study variables. 310 team members participated in the survey, reflecting a response rate of 64 percent. Due to company request, the questionnaire had to be restricted to a minimum of questions. Furthermore, demographic questions, e.g. regarding sex and age, had to be omitted to assure confidentiality.

Team climate for innovation was measured using items adapted from the German version (Brodbeck, Anderson & West, 2000) of the Team Climate Inventory (TCI, Anderson & West, 1996). 16 items from the four TCI subscales with the highest factor loadings were selected. All TCI items were rated using 5-point Likert scales.

Vision was measured with five items, e.g., "How clear are you about what your team standards are?" The response scale ranged from *to a little extent* to *to a very great extent*. The scale showed good internal consistency (Cronbach's Alpha = .78).

Task orientation was measured with three items, e.g., "Do you and your team colleagues monitor each other so as to maintain a higher standard of work?" The response scale ranged from *to a little extent* to *to a very great extent*. The scale showed satisfying internal consistency (Cronbach's Alpha = .68).

Participative safety was measured with four items, e.g., "In our shift team we keep in regular contact with each other". The response scale ranged from *strongly disagree* to *strongly agree*. The scale showed good internal consistency (Cronbach's Alpha = .74).

Support for innovation was measured with four items, e.g., "Our shift team provides practical support for new ideas and their application". The response scale ranged from *strongly disagree* to *strongly agree*. The scale showed good internal consistency (Cronbach's Alpha = .78).

As these four subscales showed very high intercorrelations ($.70 < r < .90$) and similar correlations to the other study variables the aggregated 16 items scale was used. The aggregated team climate scale for innovation showed high internal consistency (Cronbach's Alpha = .89) and high inter-rater reliability (average $r_{wg} = .92$).

Affective organizational commitment was measured using the instrument by Allen and Meyer (1990). Four items with the highest factor loadings were selected, e.g., "I am part of the company family". The six-point response scale ranged from *strongly disagree* to *strongly agree*. The scale showed very good internal consistency (Cronbach's Alpha = .94).

General work satisfaction was measured with three items taken from a scale by Klusemann (2003), e.g., "I like to go to work". The 6-point response scale ranged from *strongly disagree* to *strongly agree*. The scale showed satisfying consistency (Cronbach's Alpha = .63).

Perceived stress was measured using the irritability scale by Mohr (1986). Four items were selected, e.g., "I often feel nerved by my work". The 5-point response scale ranged from *strongly disagree* to *strongly agree*. The scale showed good internal consistency (Cronbach's Alpha = .83).

Innovative behavior was measured with three items adapted from Patchen (1965). They asked how often one tries to improve one's work processes, e.g., "How often do you try to improve your work?" The 6-point response scale ranged from *almost never, every few months, one per month, 2-3 per month, one per week* to *almost daily*. The scale showed good internal consistency (Cronbach's Alpha = .78). Scale intercorrelations ranged from very low to medium levels (cf. Table 1).

Table 1: Scale intercorrelations (individual level)

	Team climate	Innovation behavior	Commitment	Irritability
Innovative behavior	.50**			
Organizational commitment	.35**	.31**		
Irritability	.22**	-.17**	-.10	
Job satisfaction	.40**	.29**	.53**	-.45**

** .01; * .05; two-tailed

Results

According to Baron and Kenny (1986; Kenny, Kashy & Bolger, 1998) mediating effects, as expected in hypotheses 3a to 3d, require significant relationships between the independent, mediating, and dependent variables; furthermore, mediators should at least significantly decrease the relationship between the independent and the dependent variable in the case of partial mediation or eliminate it in the case of full mediation; finally, mediators should explain unique variance of the dependent variable. To test for mediation effects, they suggest four steps requiring three regression analyses: first, regressing the dependent on the independent variable; second, regressing the mediator on the independent variable; third, regressing the dependent variable simultaneously on both the independent variable and the mediator, to show that controlling for the independent variable the mediator affects the dependent variable uniquely, and to show, fourth, that the effect of the independent variable on the dependent variable controlling for the mediator is zero (complete mediation) or, at least, decreases significantly (partial mediation).

Relying only on this four-step regression procedure to identify mediation effects implies some disadvantages: For example, one could erroneously conclude that a mediation effect is present, as it is possible that adding a potential mediator turns a significant to a non-significant direct path, although the absolute size of the path coefficient hardly changed; conversely, one could erroneously reject a mediator hypothesis, if the direct path coefficient remains significant, although its absolute size dropped considerably; furthermore, separate significance tests of the indirect paths have a lower power than a joint test (Preacher & Hayes, 2004). For this reason a direct comparison of the direct to the total effect of the independent variable or joint significance tests of the indirect paths, such as modifications of the Sobel test suggested by Baron and Kenny (1986) or nonparametric bootstrapping tests (Preacher & Hayes, 2004), are preferable. Preacher and Hayes (2004) provide a regression analysis tool for these tests, which is used in the following mediating analysis. It provides a more powerful strategy for testing mediation, requiring only that there exists an effect ($c \neq 0$) to be mediated and that the indirect effect is statistically significant in the predicted direction (Kenny et al., 1998; Preacher & Hayes, 2004).

Table 2: Group level intercorrelations of study variables

	Team task structure	Team climate	Innovation behavior	Commitment	Irritability
Team climate	.60**				
Innovative behavior	.44*	.79**			
Organizational commitment	.48*	.52**	.68**		
Irritability	-.27	-.44*	-.56**	-.25	
Job satisfaction	.31°	.48*	.64**	.70**	-.71**

** .01; * .05; ° .1; one-tailed (N=20)

Correlation analysis shows that all analyzed outcomes are significantly related to team climate and all but irritability ($p=.13$ one-tailed) also to team task structure, with medium to high correlation coefficients (cf. Table 2). Team task structure and team climate are also highly correlated ($r_{XM}=.60$; $p<.01$ one-tailed). Mediators, which are highly correlated to the independent variable, reduce the power of the tests of the direct effect and the path from the mediator to the outcome variable, particularly for small samples (Kenny et al., 1998). This can be illustrated by calculating the effective sample size for this study based on formula ($N(1-r_{XM}^2)$) provided by Kenny, Kashy, and Bolger (1998): The already small sample (N=20) is approximately reduced to an effective sample size of 13 cases. Consequently, it can be expected that it will be difficult to find support for mediating effects in this case.

Table 3 shows the direct and indirect effects following the procedure suggested by Baron and Kenny (1986). In the first step, total effects of team task structure were analyzed: In accordance with the hypotheses H1a and H1b, team task structure seems to significantly affect innovative behavior (B=.68; p<.05) and organizational commitment (B=.50; p<.05). Members in self-regulated teams with complex team task structures tried more often to improve their work (M=3.55; SD=.29) than members in restrictive teams (M=3.09; SD=.35) and were also more committed to the organization (M=4.45; SD=.48 vs. M=3.95; SD=.40). The supposed effects (H1c and H1d) regarding job satisfaction (B=.32; p<.1 one-tailed) and irritability (B=-.20; p>.1) are in the expected direction, but less strong and just below or above the significance level. Members in self-regulated teams tended to be more satisfied (M=4.40; SD=.48) than those in restrictive teams (M=4.08; SD=.54) but felt almost as much stress (M=2.40; SD=.28 vs. M=2.60; SD=.46).

Table 3: Direct and indirect effects

	B	s.e.	t	p
$B(Y_1X)$	.68	.33	2.08	.05
$B(Y_2X)$	.50	.22	2.30	.03
$B(Y_3X)$	-.20	.17	-1.18	.25
$B(Y_4X)$	.32	.23	1.39	.18
B(MX)	.45	.14	3.18	.01
$B(Y_1M.X)$	1.67	.38	4.35	.01
$B(Y_2M.X)$	.50	.35	1.44	.17
$B(Y_3M.X)$	-.43	.27	-1.57	.14
$B(Y_4M.X)$	.61	.36	1.70	.11
$B(Y_1X.M)$	-.07	.29	-.25	.81
$B(Y_2X.M)$	.27	.26	1.03	.32
$B(Y_3X.M)$	-.01	.21	-.04	.97
$B(Y_4X.M)$	.04	.27	.15	.88

Y_1 = innovative behavior; Y_2 = organizational commitment; Y_3 = irritability; Y_4 = job satisfaction; X = team task type; M = team climate for innovation; N = 20; B = unstandardized regression coefficients; s.e. = standard error; p = two-tailed significance level.

In the second step, the relation of team task structure and team climate for innovation was analyzed, showing, in accordance with hypothesis H2, that team task structure significantly affects team climate for innovation (B=.45; p<.01). Self-regulated teams with complex team task structures had a more innovative team climate than restrictive teams (M=3.55; SD=.29 vs. M=3.09; SD=.35).

In the third step, the effects of the supposed mediator on the outcomes controlling for team task structure are tested. All supposed effects are supported in the direction expected in hypotheses H3a to H3d (p<.1; one-tailed). The effect of team climate for innovation on innovative behavior is by far the strongest (p<.01). Even irritability seems to be influenced by team climate for innovation (p<.1; one-tailed).

Comparing the absolute size of total and direct effects, the data show that controlling for team climate for innovation reduces the size of regression coefficients of all outcomes close to zero, only organizational commitment shows still a small, but not significant effect (B=.27; p>.1). The direct effect of team task performance on innovative behavior has a negative sign, whereas the indirect and total effects are positive. This indicates that team climate for innovation acts as a suppressor variable. With respect to irritability the data support no significant total effect of team task structure, although an indirect effect is indicated. Regarding the other outcomes, results are in line with the requirements for a mediation effect described by Baron and Kenny (1986) and supposed by hypotheses H3a, H3b, and H3d. This is most clearly the case for innovative behavior (cf. Figure

2), whereas for organizational commitment the effect of team climate is weaker and for job satisfaction both the effects of task structure and team climate are weaker (p<.1 one-tailed).

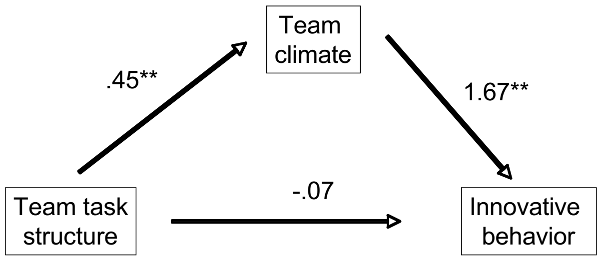

Figure 2: Direct and indirect effects of team task structure on team climate for innovation and innovative behavior
Unstandardized regression coefficients; ** p<.01; two-tailed

The joint significance tests of the indirect effects (cf. Table 4) support the mediation effect of team climate for innovation on innovative behavior. This holds both for the Sobel test and the Bootstrapping results. Regarding the other outcomes, particularly with respect to organizational commitment, the indirect effects are in the expected direction, but as the confidence intervals of the indirect effects for both the Sobel test and the Bootstrapping results include zero, one cannot rule out the possibility that the indirect effect is zero.

Table 4: Indirect effects and significance using normal distribution (Sobel test) and Bootstrap results (number of Bootstrap resamples 1000)

Sobel test	Value	s.e.	LL 95 CI	UL 95 CI	Z	Sig(two)
Innovative behavior	.76	.30	.17	1.35	2.52	.01
Organizational commitment	.23	.18	-.13	.58	1.26	.21
Irritability	-.19	.14	-.47	.09	-1.35	.18
Job satisfaction	.28	.19	-.10	.65	1.45	.15
Bootstrap	**Mean**	**s.e.**	**LL 95 CI**	**UL 95 CI**	**LL 99 CI**	**UL 99 CI**
Innovative behavior	.74	.24	.28	1,21	.15	1,48
Organizational commitment	.23	.17	-.04	.61	-.16	.68
Irritability	-.20	.14	-.49	.04	-.58	.17
Job satisfaction	.26	.17	-.07	.61	-.19	.73

Discussion

Based on psychological theories of group effectiveness (Hackman, 1987), we expected that complex team task structures stimulate motivational, cognitive learning and coordinative team processes, which mediate the effects of team task structures on team outcomes. In line with the hypotheses we found that groups with more complex tasks, i.e., having task variety, autonomy, team-specific goals, and feedback, had higher values on team climate for innovation than groups with more restrictive task structures. They also reported more innovative behavior and affective organizational commitment and tended to be more satisfied. Group differences regarding irritability were in the expected direction, but did not reach statistical significance.

With respect to the observed relationships between team task structure and innovative behavior, the supposed mediating role of team climate for innovation was supported. Team task structure had no direct effect on innovative behavior, if team climate for innovation was statistically controlled for. Regarding affective organizational commitment, job satisfaction and irritability the data indicate the assumed indirect effects of team task structure via team climate for innovation in the expected direction. However, these effects could not be supported at a sufficient statistical significance level. This might be due to the small case numbers on team level and the high correlation of team task structure and team climate for innovation, reducing the effective sample size and test power even further. It might be noted, that only for irritability the criteria for mediation, defined by Baron and Kenney (1986), are not fulfilled, as no significant total effect of team task structure was found. Nevertheless an indirect effect is indicated, which does not require the assumption of a total effect (Preacher & Hayes, 2004).

Taking the small sample size into account, these results support the hypothesis that team processes mediate the relationship between team task structure and team effectiveness. Regarding the innovative behavior of team members, they even show strong support for the mediating role of team climate for innovation. They affirm the assumption that teams with more complex and holistic team task structures, offering task variety, autonomy, team-specific goals, and feedback, are more innovative than teams with more restrictive task structures. As especially in highly standardized production processes innovative processes are of key importance for company productivity in the long term, creating complex and holistic team task structures, which support team innovation processes, can be regarded as an important investment for company success. The finding that teams with holistic team task structures have a more innovative team climate, corresponds with other results that development of innovative team climate can be supported by tasks with high innovation requirements (Curral, Forrester, Dawson & West, 2001).

As team climate for innovation explains more than half of the variance of innovative behavior and, thus, much more than team task structure, it seems worthwhile to analyze further factors, which might support the development of team climate for innovation. It might be promising to analyze the influence of leadership behavior on team climate, as it was shown that work-unit leaders' informing behavior was positively correlated with the strength of innovative climate (Gonzáles-Romá, Peiró & Tordera, 2002). In contrast to other studies (Curral et al., 2001) team size did not correlate with team climate for innovation ($r=-.15$; $p=.54$), whereas Curral et al. (2001) found a medium sized negative relationship ($r=-.33$; $p<.01$). One reason for these diverging findings might be that team sizes in their study were much smaller, ranging from 2 to 18 members, with an average of 5, compared to a range from 15 to 38 members, and an average of 24 members in a team in this study. These results indicate that the negative impact of increasing team size on climate for innovation is strongest for changes from small to large teams (2 to 18 members), whereas further increases in team size (18 to 38) seem to matter less.

This study has some limitations. First, its cross-sectional design precludes any sound causal conclusions among study variables and suggests that the results observed should be interpreted with caution. Longitudinal studies are needed to derive causal relationships. Secondly, data on team climate for innovation and team effectiveness stem from the same source and are based on the same method, hence common source and method variance might have inflated the relationships between those variables. Future studies should, therefore, try to get additionally independent assessments and objective data of innovative behavior. Thirdly, the team climate inventory is a very global and retrospective measure for team processes. For a better understanding of team processes it would be helpful to develop methods, which allow researchers to differentiate the various team processes. Although observational methods are difficult to apply, they might be a feasible alternative to rate innovation processes at least in team meetings.

Despite these limitations, this study could shed some light on the intervening processes between team task structure and team effectiveness, which had been neglected in most studies. The results observed support the assumption that complex and holistic team task structures support team innovation processes, which, in turn, promote team innovation and company effectiveness. Future studies based on larger samples on team level seem promising, which should differentiate team processes more closely and take other variables influencing them into account, such as leadership behavior or reward management system.

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