The relationships between team learning activities and team performance

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Abstract

Purpose – The purpose of this paper is to investigate how different team learning activities relate to different types of team performance as rated by team members and managers.

Design/methodology/approach – The 624 respondents, working in 88 teams in seven different organizations indicate their perceptions of team learning and their performance ratings of the team. Moreover, managers in the organization are asked to evaluate the team performance.

Findings – Team member ratings of effectiveness are positively related to the boundedness and stability of the team and information processing and negatively related to information acquisition. Manager ratings of effectiveness are positively related to boundedness and stability, information processing and information storage and retrieval. Team member ratings of efficiency are positively related to boundedness and stability and information storage and retrieval. Team member ratings of innovativeness are positively related to information processing, while no predictors are found for manager ratings of innovativeness.

Research limitations/implications – Since the data are cross-sectional, the authors cannot draw conclusion about the causality between the variables. Longitudinal designs that study the sequence of team learning and team performance are called for. Furthermore, future studies might include more objective performance measures.

Practical implications – As team learning proved to have predictive value for diverse team performance indicators, rated by team members and managers, team should carefully organise their learning process in order to enhance their performance.

Originality/value – Although some studies have proven the significance of team learning for team performance, none have investigated which team learning activities are related to which types of performance ratings.

Keywords Team working, Team performance, Team learning

The implementation of team-based work is widely believed to be a performance enhancing human resource management (HRM) practice (Delaney and Huselid, 1996) and teams have become important building blocks of organizational effectiveness over the past 20 years (Wilson et al., 2007). Also, since the synergistic value from teams is almost impossible for competitors to imitate, sustainable competitive advantage comes from teams more than from individuals (Barney and Wright, 1998). One of the expected yields of a team-based organization is the stimulation of collective learning as teams are
supposed to be good agents of learning (van Offenbeek, 2001). Since team members can interact with one another, knowledge and skill gathered by one team member can be transferred to the other team members, which can affect the efficiency and effectiveness of the team’s collective learning process (Ellis et al., 2003). This way, the output of a team is thought to be greater than the sum of the individual outputs of its members. But although it has been recognized that organizations can only learn if teams in the organization learn through the sharing of knowledge and experience among individuals (Chan et al., 2003a), our understanding of team learning remains limited (Bunderson and Sutcliffe; 2003; Edmondson, 1999) and only few studies have attempted to examine the process of team learning (van Offenbeek, 2001). Where some authors (Edmondson, 1999; Edmondson et al., 2001a, b; van der Vegt and Bunderson, 2005; Zellmer-Bruhn and Gibson, 2006) have shown that learning behaviour in teams is positively related to team performance, none of them have investigated how different team learning activities relate to different types of performance, as rated by different actors in the organization. Nevertheless, both team learning and team performance can be seen as multi-faceted concepts (Ancona and Caldwell, 1992b; Dunphy and Bryant, 1996; Paauwe, 2009). Also, it is important to take into account the performance ratings of both team members and managers since these actors have different interests and different knowledge (Gerhart et al., 2000) and because a balanced approach of HRM should pay attention to both a managerial and an employee perspective (Paauwe, 2009). Therefore, the objective of this study was to explore how different team learning activities relate to different aspects of performance, as rated by team members and managers.

Since the chances for a good team performance are higher when the people responsible for the work are a real team rather than a team in name only (Wageman et al., 2005) we also investigated the impact of the extent to which teams are “real teams” (Hackman, 2002; Kozlowski and Bell, 2003; West et al., 1998) in terms of having clear boundaries to distinguish members from non-members, and having at least moderate stability of team membership.

What is team learning?

Despite the growing body of theory and empirical research on team learning, definitions of this construct have varied considerably across studies (Wilson et al., 2007). Team learning is often measured as an outcome (Levitt and March, 1988; Zellmer-Bruhn and Gibson, 2006) and confused with performance, assuming that no change in performance means that learning did not take place (Cook and Yanow, 1993; Wilson et al., 2007). Ellis et al. (2003), for instance, define team learning as a relatively permanent change in the team’s collective level of knowledge and skill produced by the shared experience of the team members. However, as learning does not always lead to a change in a team’s overall performance, and improved performance is not always a result of learning (Wilson et al., 2007), it is important to distinguish between team learning processes and their outcomes in terms of team performance. Therefore, following Argyris and Schöon (1996) and Edmondson (1999), we focus on the learning activities carried out by team members through which a team obtains and processes data that allow it to adapt and improve and through which outcomes such as a better team performance can be achieved. Huber (1991) and van Offenbeek (2001) distinguish between four different team learning activities, namely information acquisition, information distribution, information interpretation and information storage and
retrieval. However, as the processes of information distribution and information interpretation are strongly intertwined (van Woerkom and van Engen, 2009), we have chosen to combine these activities in the activity of information processing:

- **Information acquisition.** It is the process by which information is obtained by passive scanning of the internal and external environment in order to identify problems and opportunities or by actively initiating inquiries into the environment when more information is needed.

- **Information processing.** It refers to the processes by which team members distribute information to the other members of their team and give shared interpretations to this information. Team members may have developed different mental schemas on the basis of their information acquisition activities. To come to a common understanding of this information, members transfer and combine insights through a process of dialogue and reflective communication which enables them to arrive at potential solutions (Gibson and Vermeulen, 2003).

- **Information storage and retrieval.** It refers to the storage of shared information and locating and using this information in the future. The newly developed knowledge needs to be translated into concrete, generalized concepts, decisions, or actions, so that a workable outcome can be developed. Codification of the newly developed knowledge by putting it on paper, entering it into meeting minutes or adding it to a database decreases ambiguity and enables a team to put knowledge and ideas into practice (Gibson and Vermeulen, 2003).

Insights from team information processing and collective cognition literatures suggest that the processes of information acquisition, information processing and information storage may be iterative rather than sequential but that they each are necessary for team learning to occur (Gibson, 2001; Gibson and Vermeulen, 2003). However, it is likely that teams will differ in their preference for each of these three activities, depending on the context and the desired outcome of the team.

**Team performance**

While team performance is often treated as a unitary construct (Dunphy and Bryant, 1996; Wageman et al., 2005), diverse output indicators can be used for measuring team performance. In this paper, we distinguish between effectiveness, efficiency, and innovation as different indicators of team performance. Although effectiveness and efficiency are often confused, or used as synonyms, both concepts have a different meaning. Effectiveness refers to an absolute level of attainment of goals and expectations (Hoegl and Gemuenden, 2001) and depends on the degree that work products or processes are free from errors or defects (Janz, 1999) and on the satisfaction of internal or external customers with the value of the products or services that are provided by the team (Spencer, 1994). The efficiency of a team refers to an input-output ratio or comparison (Ostroff and Schmitt, 1993) and relates to, for example, the team’s adherence to schedules and budgets (Hoegl and Gemuenden, 2001). Innovation is increasingly the performance factor which provides key competitive advantage in high value-added industries and the service sector (Dunphy and Bryant, 1996). In the context of teams, innovation refers to the intentional introduction and application of ideas, processes, products or procedures that are new to the team, and designed to improve the team performance (Anderson and West, 1996).
The relationship between team learning and team performance

Group researchers have long been interested in finding the process variables that affect team performance (Ancona and Caldwell, 1992b). As today many teams are confronted with change or uncertainty, teams must engage in learning activities to understand their environment and their customers and for effective self-management and team process improvement (Edmondson, 1999). Learning may help a team to adapt to changing circumstances, continually refine processes and practices, and discover new and better ways of achieving team objectives, which will finally result in a better team performance (Bunderson and Sutcliffe, 2003; Edmondson, 1999). However, research has only begun to examine the empirical relationship between team learning and team performance (Druskat and Kayes, 2000). Whereas several authors (Chan et al., 2003b; Edmondson, 1999; Edmondson et al., 2001b; van der Vegt and Bunderson, 2005; van Offenbeek, 2001; Zellmer-Bruhn and Gibson, 2006) show that team learning behaviour is positively related to team performance, what has not yet been studied is how different types of team learning relate to different types of performance, as rated by different raters. Team learning and team performance are often measured as single concepts, by single (mostly team member or team leader) ratings leaving space for bias caused by social desirability and percept-percept bias. The study of van Offenbeek (2001) is the only one we could find that focussed on the relationships between different team learning activities and team performance. However, since her study was conducted in the context of short-term student teams, and her performance measure consisted of the mark of the teacher on the report that this student team produced it may be difficult to compare the results of this study to the situation of long-term work teams.

The relationship between team learning and different performance indicators

We expect a positive relationship between team learning activities in general and team effectiveness. As team members learn from each other, they may acquire a broader understanding and appreciation of how the full range of skills needed for the task can be combined in an optimal way to produce the product or service (Dunphy and Bryant, 1996). Edmondson (1999) who demonstrated a positive relationship between team learning behaviour and team performance used a performance scale that focused especially on team effectiveness, with items referring to meeting customer expectations, the frequency of quality errors, and the level of accomplishments. Also the study from de Dreu (2007) can be seen as evidence for the relationship between team learning and effectiveness, since the performance scale that he used covered effectiveness in terms of task completion, and effectively dealing with unexpected events. Given these results, we expect that team learning activities will be positively related to team effectiveness.

We also expect a positive relationship between team learning and innovation. Team learning is likely to lead to a greater awareness of the whole team task, enabling team members to take part in problem solving and innovation (Dunphy and Bryant, 1996). Teams that underemphasize learning may engage in too little experimentation and persevere with inferior alternatives that become inadequate for the current situation (Bunderson and Sutcliffe, 2003). The link between team learning and innovativeness has also been shown by a study of Edmondson et al. (2001a), demonstrating that learning teams were better in implementing an innovative technology for cardiac surgery. Also Bunderson and Sutcliffe (2002) found that survey measures of team learning orientation were associated with observed process and product innovations. Therefore, we expect a
positive relationship between team learning and team innovation. Furthermore, it is likely that especially activities at the boundaries of the team that involve outside sources generate new insights that will lead to innovation of products or processes. Several studies (Burgleman, 1983; Ebadi and Dilts, 1986; Katz, 1982) suggest that high levels of external communication, and obtaining information from other parts of the organization are positively related to team innovation. Also, Ancona and Caldwell (1992a) show that successful development teams are deeply engaged in communications with outsiders and in acquiring information from its environment. Therefore, we expect that of all three team learning activities, information acquisition will have the strongest relationship with innovation.

As for the relationship between team learning and team efficiency, this relationship is expected to be more ambiguous. On the one hand, learning activities can be expected to improve efficiency as the possibility of transferring the knowledge and skills of one team member to the other is likely to result in less time being wasted on lengthy individual learning processes (Hinsz et al., 1997). On the other hand, learning costs time, effort and energy (de Dreu, 2006) and timeliness is an important element of efficiency. Bunderson and Sutcliffe (2003) who used efficiency-based measures of team performance showed that even though a team learning orientation can lead to improved performance, it may also compromise performance in the near term by overemphasizing learning. The more time it takes for learning activities to pay-off in terms of improved task performance, and the less certain it is that this will ever happen, the more learning activities will harm efficiency in the short-term. As acquiring information by exploring the external environment and by experimenting in the internal environment consumes time without assurance of results (Bunderson and Sutcliffe, 2003; March, 1991), we expect that information acquisition will compromise efficiency in the near term. As the benefits of information processing and information storage and retrieval (less ambiguity and more easy access to relevant information) are more likely to counterbalance the costs in terms of time, we expect that these learning activities will not be related to efficiency in our cross-sectional study.

Based on the previous argumentation about the relationships between team learning activities and different performance indicators, we propose that:

**H1.** Information acquisition is positively related to team: (a) effectiveness; (b) innovation; and (c) is negatively related to efficiency.

**H2.** Information processing is positively related to team: (a) effectiveness and (b) innovation.

**H3.** Information storage and retrieval is positively related to team: (a) effectiveness and (b) innovation.

**H4.** Information acquisition is more strongly related to innovation than information processing or information storage and retrieval.

**Boundedness and stability**

The chances for a good team performance in terms of effectiveness and efficiency are higher when the people responsible for the work are a real team rather than a team in name only (Wageman et al., 2005). Two important characteristics of real teams are boundedness and stability of membership (Wageman et al., 2005). Real teams have
clear boundaries that distinguish team members from nonmembers and have at least moderate stability of membership, giving members time and opportunity to learn how to work together well. We expect however no relationship between team boundedness and stability and innovativeness. While on the one hand, keeping the same team together facilitates coordination of interdependent work, on the other hand, over time, stable teams may also become slaves to routine and fail to respond to changing conditions (Edmondson et al., 2001a). Therefore, we propose that:

*H5.* The boundedness and stability of a team is positively related to: (a) effectiveness and (b) efficiency.

**Methods**

*Participants and design*

We employed a cross-sectional design in which we sampled teams from seven different organizations in both the public and the private sector. Our sample consists of a diversity of teams, however all respondents were participants in ongoing teams with a long task duration (Bradley et al., 2003) where team members are interdependent for some common purpose, work together regularly for an extended period of time and also expect to work together in the future. Information about these team characteristics was provided to us by our contact person in the organization (usually a manager or a HR manager).

Questionnaires were distributed to a total of 1,107 respondents. The overall response rate was 61.5 per cent. Furthermore, questionnaires concerning the team performance were distributed to managers in the organization. Three teams and one respondent were eliminated from further analyses because of missing values on the manager ratings. One respondent has been deleted because of too much missing values. The final sample consisted of 624 respondents, working in 88 teams in seven different organizations. Health care teams were over represented with 43 teams (nine hospital units and 34 teams from nursing institutions). Apart from the health care teams there were teacher teams (eight teams), production teams in the food industry (15 teams) retail teams (ten teams) and 12 teams in an engineering and construction company. There were 41.6 per cent men and 58.4 per cent women in our sample; the mean age was 39.4 years old (SD = 11.48). Of our respondents, 36.5 per cent held a bachelor degree or higher, 56.6 per cent held a vocational education degree and 6.8 per cent had low-educational levels. Team size varied from four to 35 members with an average of 12.21 members in a team. A total of 47 teams (53.4 per cent) consisted of four to ten team members, 24 teams (27.2 per cent) consisted of 11-15 team members and 17 teams (19.1 per cent) consisted of 16-35 team members. Although there is no consensus in the literature about a maximum team size, we chose for a cut-off point of 35 team members since large teams tend to segment into subgroups (Kratzer et al., 2004).

*Instruments*

Team members were asked to indicate their perception of team learning processes and how well their team performed. Unless otherwise stated, we assessed all variables by questionnaire items with a response scale ranging from 1, “strongly disagree” to 7, “strongly agree”. Random missing data on items of each scale were replaced by imputation of regression estimates with added error components, controlled for team, organization, gender, age and educational level (Little and Rubin, 1990). Means and standard deviations are presented in Table I.
### Table I.
Descriptive statistics and between teams correlation matrix.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Boundedness/stability</td>
<td>6</td>
<td>5.19</td>
<td>1.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Information processing</td>
<td>12</td>
<td>5.13</td>
<td>0.85</td>
<td>0.54***</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. Information storage</td>
<td>5</td>
<td>5.04</td>
<td>1.06</td>
<td>0.22</td>
<td>0.21</td>
<td></td>
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<tr>
<td>4. Information acquisition</td>
<td>5</td>
<td>4.59</td>
<td>1.05</td>
<td>0.21</td>
<td></td>
<td>0.54***</td>
<td>0.07</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Effectiveness (team member rating)</td>
<td>7</td>
<td>5.20</td>
<td>0.94</td>
<td>0.63***</td>
<td>0.84***</td>
<td>0.21</td>
<td>0.24</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6. Efficiency (team member rating)</td>
<td>3</td>
<td>5.03</td>
<td>1.00</td>
<td>0.52***</td>
<td>0.83***</td>
<td>0.36*</td>
<td>0.13</td>
<td></td>
<td>0.93***</td>
<td></td>
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<td></td>
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<tr>
<td>7. Innovativeness (team member rating)</td>
<td>4</td>
<td>4.86</td>
<td>1.07</td>
<td>0.53***</td>
<td>0.69***</td>
<td>0.26</td>
<td></td>
<td>0.52*</td>
<td>0.66***</td>
<td>0.52***</td>
<td></td>
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<tr>
<td>8. Effectiveness (manager rating)</td>
<td>6</td>
<td>5.04</td>
<td>0.74</td>
<td>0.48***</td>
<td>0.60***</td>
<td>0.46***</td>
<td>0.18</td>
<td></td>
<td>0.60***</td>
<td>0.56***</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>9. Efficiency (manager rating)</td>
<td>3</td>
<td>4.43</td>
<td>0.97</td>
<td>0.48***</td>
<td>0.41***</td>
<td>0.40***</td>
<td>0.10</td>
<td>−0.16</td>
<td>−0.18</td>
<td>0.35</td>
<td>0.76***</td>
<td></td>
</tr>
<tr>
<td>10. Innovativeness (manager rating)</td>
<td>4</td>
<td>4.21</td>
<td>1.44</td>
<td>0.24*</td>
<td>0.18</td>
<td>0.19</td>
<td>0.20</td>
<td>−0.07</td>
<td>−0.11</td>
<td>0.42***</td>
<td>0.51***</td>
<td>0.54***</td>
</tr>
</tbody>
</table>

**Note:** Correlation is significant at: *0.05, **0.01 and ***0.1 per cent levels (two-tailed), respectively.
Team learning. We measured team learning using the team learning scale developed by van Offenbeek (2001). Since a previous validation of van Offenbeek’s instrument for team learning activities resulted in a three factor solution that was clearly interpretable (van Woerkom and van Engen, 2009) we conducted a principal component analysis (PCA) (oblimin rotation) on all team learning items with three components to be extracted. Again, this resulted in three clearly interpretable components, explaining 54.39 per cent of the variance (eigenvalues first component, 9.99; second component, 2.25; third component, 1.90; fourth component, 1.27 and fifth component 1.09). The first factor consisted of 12 items referring to information distribution and information interpretation ($\alpha = 0.89$), the second factor consisted of five items referring to information storage and retrieval ($\alpha = 0.82$) and the third factor consisted of five items referring to information acquisition ($\alpha = 0.83$):

- **Information acquisition.** It measures the extent to which team members bring in information that is collected outside the team (e.g. “in my team we retrieve information from outside the team by collaborating with others outside the team”, “in my team we search for professional information and knowledge outside the organization”).

- **Team information processing.** It assesses the way the team deals with the distribution of information amongst all team members and the process of collective interpretation and sense making (e.g. “in my team we listen to each others ideas”, “in my team we challenge each other to take new perspectives concerning our work”).

- **Information storage and retrieval.** It measures whether information is systematically stored, retrieved and utilized (e.g. “in my team reports are made of team meetings”, “my team refers to documents made previously”).

For information acquisition, the intraclass correlation (ICC1), the proportion of the total amount of variance in the data that is between the teams is 0.15, which implies that 15 per cent of the total variance in employee ratings of their team’s performance is variance that is between the teams. For information processing and information storage and retrieval, the ICC1’s were, respectively, 0.10 and 0.18.

Team performance. To measure team performance, we developed four scales that were intended to measure effectiveness, efficiency, quality and innovativeness. Effectiveness was measured with a scale adapted from Zellmer-Bruhn and Gibson (2006) and consisted of five items. Efficiency was measured with a self-developed four-item scale. Quality was measured with a scale adapted from Lai et al. (2004) and consisted of four items. Innovativeness was measured with a self-developed scale and consisted of four items. We conducted a PCA with varimax rotation on all items of the four scales with four components to be extracted. The four component solution explained 69.44 per cent of the variance (eigenvalues first component, 7.77; second component, 1.91; third component, 1.18 and fourth component, 0.94) with the first component consisting of eight items referring to effectiveness and quality, the second component consisting of four items referring to innovativeness and the third factor consisting of three items referring to efficiency. The fourth component consisted of two reversed items (our team gets complaints about the quality of her services and products and our team makes unnecessary costs). We decided not to include this fourth component in our further analyses. Since items from the effectiveness and quality scale loaded on the same component, we decided to merge these items in one
new scale, labelled effectiveness. The PCA on the four performance scales rated by the manager resulted in a similar solution. Hence, we constructed similar scales for the manager ratings.

Example items of effectiveness are “Our team achieves its goals” and “The clients (internal or external) of this team are satisfied.” The effectiveness scale as rated by the team members had an ICC1 of 0.23 ($\alpha = 0.91$ for the team member ratings and 0.88 for the manager ratings). Examples of items of the efficiency scales are “Our team works efficiently” and “Our team spends the available time well.” The efficiency scale as rated by the team members had an ICC1 of 0.17. ($\alpha = 0.81$ for the team member ratings and 0.84 for the manager ratings). Example items of the innovativeness scale are “Our team develops new and improved ways of working” and “Our team develops new products or services.” The innovativeness scale as rated by the team members had an ICC1 of 0.08 ($\alpha = 0.86$ for the team member ratings and 0.92 for the manager ratings).

**Boundedness/stability of the team.** To measure to what extent the teams in our sample were bounded and stable we used a six item scale from Wageman *et al.* (2005). Example items of this scale are “Team membership is quite clear – everybody knows exactly who is and who is not on this team” and “This team is quite stable, with few changes in membership.” For boundedness/stability the ICC1 is 0.22 ($\alpha = 0.69$).

**Two-level regression analyses**

The hypotheses formulated above pertain to relationships among variables at the team level. The variables which are based on the questionnaire administered to the team managers can be considered as variables directly defined at the team level. Other variables, however, were collected from the team members themselves, and are hence measured at the individual level. In a traditional approach, the latter kind of variables would be aggregated to the team level and become part of an analysis at the aggregated higher level. Aggregating variables in this way, however, has several drawbacks. First, by aggregating individual variables to the team level one reduces the effective sample size for the ensuing analyses, thereby reducing their statistical power. Second, it is well known that relationships among variables at the higher level need not exist at the lower level, and vice versa. A third much less well-known disadvantage of aggregating data is that the (co)variances of aggregated variables are not only a function of the between-group differences, but also partly reflect within-groups differences (Muthén and Muthén, 2007).

The appropriate way to deal with this problem is to carry out a two-level analysis based on unbiased estimates of the within- and between-groups covariance matrices. Recent advances in statistical methodology have lead to procedures that yield the maximum-likelihood estimates of the parameters of the separate models for the within- and between-group differences (Kaplan, 2009). These procedures have been incorporated in the Mplus® software program (Muthén and Muthén, 2007) which was used in the present paper, for carrying out two-level regression analyses. In all two-level regression analyses reported below, the independent or explanatory variables were measured at the individual level. For the dependent variables, however, two different cases have to be distinguished depending on whether the dependent variable was measured at the individual level or at the team level.

For dependent variables measured at the individual level two-level regression analyses were carried out based on a model, of which the basic principles will be
explained for the case where a dependent variable $Y$ is regressed on a single explanatory variable $X$. Its generalization to the case of several explanatory variables is immediate. Since both variables are measured at the individual level, individual scores on them are represented by $y_{ig}$ and $x_{ig}$, with $i$ denoting an arbitrary individual within team $g$. The unobserved mean for group $g$ on $Y$ will be denoted by $\eta_g$, and the same group’s mean on $X$ by $\xi_g$. The regression model for the within-teams scores can now be written as:

$$y_{ig} - \eta_g = \alpha_0 + \alpha_1(x_{ig} - \xi_g) + \epsilon_{ig},$$

with constant variance $\sigma^2_{\epsilon_g}$ for the error terms $\epsilon_{ig}$. This regression equation describes the relationship between $X$ and $Y$ within the teams. The regression model for the between-teams relationship between the same variables is:

$$\eta_g = \beta_0 + \beta_1 \xi_g + \nu_g,$$

with constant variance $\sigma^2_{\nu_g}$ for the error terms $\nu_g$. The model parameters consist of the two sets of regression coefficients at the two levels, and the two error variances. In the present paper the focus is on the parameters estimates of the between-team regression model.

The model sketched above is no longer appropriate when the dependent variable is measured at the team level. In this case only, a single team score $y_g$ is available for the dependent variable $Y$ which does not have within-team variation. The explanatory variable $X$, on the other hand, remains measured at the individual level so that individual scores $x_{ig}$ are available. Croon and van Veldhoven (2007) described an alternative multilevel model for this type of data in which only a between-team regression is retained:

$$y_g = \beta_0 + \beta_1 \xi_g + \nu_g,$$

with constant variance $\sigma^2_{\nu_g}$ for the error terms $\nu_g$. In this model, the group mean $\xi_g$ is treated as an unobserved latent variable for which the individual scores $x_{ig}$ are treated as indicator variables via the following definition:

$$x_{ig} = \xi_g + \epsilon_{ig},$$

with constant variance $\sigma^2_{\epsilon_g}$ for the error terms $\epsilon_{ig}$. For data of this kind, no within-groups regression model can be formulated since the dependent variable has no within-group variation. Croon and van Veldhoven (2007) showed that regression analyses on the aggregated data do not yield consistent estimates of the regression parameters. In the present paper, the parameters of the Croon-van Veldhoven model were also estimated by means of the Mplus package.

Results

Correlation analysis
Table I reports the descriptive statistics and the between teams correlations between our scales. As can be seen, boundedness and stability, was positively related to all performance ratings. Information processing was significantly related to all performance ratings except for the manager rating of performance. Information acquisition was only positively related to the team member rating of innovativeness while information storage and retrieval was positively related to both team member and manager ratings of efficiency and manager ratings of effectiveness.
Two-level regression analyses for dependent variables measured at the individual level

The between-team results of the three two-level regression analyses for effectiveness, efficiency and innovation as rated by the team members are summarized in Table II. Each panel contains the unstandardized coefficient $B$, the standardized regression coefficient $\beta$, the standard error (SE) of $B$, and the ensuing $z$-value ($z = B/SE$). At the bottom of each panel the corresponding square multiple correlation coefficients $R^2$ are reported.

Analyses for dependent variables measured at the team levels

The results for the adjusted regression analyses on the aggregated means as proposed by Croon and van Veldhoven (2007) are given in Table III. This table contains the unstandardized regression coefficient $B$, the standardized regression coefficient $\beta$, the SE of $B$, and the ensuing $t$-statistic. At the bottom of each panel $R^2$ is reported.

Since information acquisition is negatively related to team member ratings of team effectiveness and not related to manager ratings of team effectiveness (respectively $\beta = -0.27$, $p < 0.05$ and $\beta = 0.01$, ns), $H1a$ cannot be confirmed. Since information acquisition is not related to team member or manager ratings of innovativeness (respectively $\beta = 0.26$, ns and $\beta = 0.19$, ns), $H1b$ and $H1d$ can also not be confirmed. Since information acquisition is negatively related to team members rating of efficiency ($\beta = -0.44$, $p < 0.01$) but not to manager ratings of efficiency ($\beta = -0.02$, ns), $H1c$ is partly corroborated.

<table>
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<tr>
<th></th>
<th>$B$</th>
<th>$\beta$</th>
<th>SE ($B$)</th>
<th>$z$</th>
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<td><strong>Effectiveness-quality</strong></td>
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<td>-0.18</td>
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<td>$R^2 = 0.79$</td>
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<tr>
<td>($p = 0.000$)</td>
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<tr>
<td><strong>Efficiency</strong></td>
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<tr>
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<td>-0.44</td>
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<td>($p &lt; 0.001$)</td>
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<td><strong>Innovativeness</strong></td>
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<td>($p = 0.009$)</td>
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</table>

Notes: Significant at: *5, **1 and ***0.1 per cent levels (two-sided), respectively; $^a$ regression analysis with innovativeness as dependent variable and information processing as the only explanatory variable; $N = 624$ individuals, 88 teams

Table II.
Between-team results of the two-level regression analyses for team effectiveness-quality, efficiency and innovativeness as rated by team members.
$H_2a$ is corroborated since information processing is positively related to both team member and manager ratings of effectiveness (respectively $\beta = 0.85$, $p < 0.001$ and $\beta = 0.56$, $p < 0.01$).

There is no relationship between information processing and the team manager rating of innovation ($\beta = 0.08$, ns). In the regression analysis for innovativeness as rated by the team members, none of the predictors have significant regression coefficients, but all of them together explain a significant proportion of the dependent variable ($R^2 = 0.58$, $p = 0.002$). Therefore, a forward selection procedure was performed for the between-team model. This showed that using information processing as the only explanatory variable in the between-team model yielded a $R^2$ value of 0.57 (see Innovativeness$^a$ model in Table II) which was almost as high as the $R^2$ value of 0.58 in the model with all explanatory variables. Next, each of the other three independent variables was added to the model that already included information processing. In none of the three analyses did the added explanatory variable have a significant regression coefficient, showing that none of them improved the predictory power of information processing alone. Therefore, we may conclude that information processing is the crucial explanatory variable for predicting innovativeness at the team level ($\beta = 0.76$, $p < 0.001$) and that $H_2b$ can be partially corroborated.

Information storage and retrieval is positively related to manager ratings of effectiveness ($\beta = 0.37$, $p < 0.001$) but not to team member ratings of effectiveness ($\beta = -0.02$, ns), $H_3a$ partly corroborated. Since information storage and retrieval is not related to team members and manager ratings of innovativeness (respectively $\beta = 0.09$, ns and $\beta = 0.16$, ns), $H_3b$ cannot be confirmed.

As expected, $H_5a$, the boundedness and stability of a team is positively related to both team member ratings ($\beta = 0.25$, $p < 0.05$) and manager ratings ($\beta = 0.33$, $p < 0.01$)
of effectiveness. Boundedness and stability is not related to team member ratings of efficiency ($\beta = 0.05$, ns) but is positively related to manager ratings of efficiency ($\beta = 0.39, p < 0.01$), $H5b$ partly corroborated.

**Discussion and conclusion**
Organizational learning is widely recognized as a viable survival strategy for modern organizations (Chan *et al.*, 2003a) and teams are thought to be the fundamental learning blocks in organizations (Chan *et al.*, 2003a; Senge, 1990). Therefore, managers and teams seeking particular kinds of performance improvement need to know which team learning activities lead to what type of team outcomes (Dunphy and Bryant, 1996; Edmondson, 1999). This study refines the insight that team learning affects team performance by showing that different team learning activities influence particular aspects of team performance.

While information processing turns out to be the most important predictor for team member ratings of effectiveness, efficiency and innovativeness, information storage and retrieval is the most important predictor for manager ratings of effectiveness and efficiency. None of the learning activities could predict manager ratings of team innovativeness. A remarkable result of this study is thus that predictors of team member ratings of team performance are not the same as the predictors of manager ratings of team performance. This result is in line with several studies of group performance that have shown differences between team-member performance ratings and managerial performance ratings (Ancona, 1990; Ancona and Caldwell, 1992b; Gladstein, 1984). An explanation for this is that each constituent group has different interests and different data. Where team members are interested in creating a productive and pleasant atmosphere, managers are interested in the realized output. Team members have specific information about team interaction and tend to have schema that link internal processes to performance (Ancona, 1990; Gladstein, 1984). Managers are more distant from the team processes and will base their performance evaluations more on concrete visible output of the team. Information storage will often result in concrete documents, such as minutes of meetings, reports, etc. that are visible to the manager outside the team. Teams that document their learning processes and resulting decisions in formal writing may, therefore, come across as more professional in the perception of managers.

Information processing is clearly an internal process, and is likely to be strongly related to the quality of team interaction and the satisfaction with team relationships (Wageman *et al.*, 2005). As expected, team member’s perceptions of team performance are strongly related to social processes in the team. Team members may label their team high performing if it exhibits the processes thought to be linked to performance (Gladstein, 1984). Conversely, team members who view their team as effective may attribute effective processes to it. Since managers are not informed well enough about these social processes, they will base their evaluations on indicators that are more visible to them. For team members information processing is likely to result in a pleasant and constructive atmosphere that will contribute to their performance rating. The physical storage of information in minutes, documents and archives may be of less importance in the perception of team members since teams that process information effectively, may store information in their collective mind.

When controlling for the other learning activities, information acquisition was negatively related to team member ratings of efficiency and effectiveness, while it was
not related to team member ratings of innovativeness or to any of the manager ratings of performance. Possibly, information acquisition by exploring the external environment is an unsure investment of time that might harm team performance or simply does not pay-off in the short-term. Information acquisition may also result in an information overload and team members may have difficulty in integrating diverse information concerning a task. Future studies, using a longitudinal design should investigate the possible benefits of information acquisition in the long run. While we didn’t expect any of the learning activities to be positively related to efficiency because of our cross-sectional design (learning activities cost time and will therefore only contribute to efficiency in the long-term), it was striking to see that information storage and retrieval was positively related to manager ratings of efficiency. Apparently, the time that teams spend on this activity is a sure investment when it comes to influencing the perception of the manager. A well-organised process of information storage and retrieval may also make it easier for teams to exploit the knowledge that they have developed, although team members may not be aware of this. Information processing was positively related to the team member ratings of efficiency. Probably, the transferral of information from one team member to the other and the subsequent process of developing shared interpretations saves time being spend on lengthy individual learning process.

Stable teams in which team members know exactly who is and who is not on the team outperform other teams in terms of effectiveness and efficiency. Apparently, team members need time to develop productive relationships, resulting in more effectiveness and efficiency.

Limitations
Since our data are cross-sectional in nature we cannot draw conclusion about the causality between our variables. Longitudinal designs that study the sequence of team learning activities and team performance are called for. Also, even though on an individual level we had data from 624 individuals, they represent only 88 teams, thus limiting the complexity of the models that can be tested. A next restraint of our study relates to our subjective performance measures. It was striking to see that performance ratings of team members are related to other learning activities than performance ratings of managers. The question which ratings are more important, those of team members or those of managers, is hard to answer. On the one hand, team members can be expected to have a clearer picture of what is going on in the team, and therefore can give a better evaluation of its performance than managers who operate on some distance of the team. On the other hand, managers can be expected to have a more business wise evaluation of team performance and are less likely to confuse affective outcomes of teamwork with task related outcomes. Even if subjective ratings of performance are related to final performance evaluations and more “objective” indicators are often also a product of “subjective” ratings (Ancona and Caldwell, 1992b) future research should try to include more objective performance measures and compare these to manager and team member perceptions.

Practical implications
Teams that want to enhance their own team member’s satisfaction with the team performance, should especially invest in information processing and make time for sharing and interpreting information in team meetings. To enhance manager’s satisfaction with team performance, team members should invest in information storage
and retrieval. In the perception of team members, storing information by writing it down in reports, meeting minutes or adding it to a database may not contribute to effectiveness or quality. They may prefer to store information implicitly in their collective mind, and may find these activities bureaucratic or time consuming. However, team members should realize that carefully documented knowledge makes their team processes more visible to managers outside the team and affects manager evaluations of the team’s effectiveness and efficiency.

Also ensuring that teams in the organization are “real teams” (Wageman et al., 2005) with stable membership, and with team members who know each other well pays off in terms of performance. Team boundedness and stability positively affects the team member’s ratings of effectiveness and the manager ratings of the team effectiveness and efficiency.

This study has shown that it is worthwhile for teams to pay attention to their learning activities. Depending on the type of performance that is particularly relevant for a specific team, and the importance of favourable management evaluations, teams need to invest in specific team learning activities.

References


Further reading


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