

Team reflexivity in innovative projects

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In this article, we provide a theoretical extension and empirical test of team reflexivity. Building on West's (1996) conceptual discussions of team reflexivity, we argue that in the context of teams with innovative projects (e.g. product development teams), team reflexivity will be positively related to team effectiveness and efficiency. Furthermore, we specify social skills and project management skills as important determinants of team reflexivity. Using data from 575 members, leaders, and team external managers referring to 145 software development teams, we find that team reflexivity is positively related to team effectiveness but not efficiency. Furthermore, both social skills and project management skills are positively related to team reflexivity. Theoretical and practical implications are discussed.

1. INTRODUCTION

The study of teams remains an important component of organizational research to date. Both the conceptual literature (e.g. Johnes and Snelson, 1990; Clark and Fujimoto, 1991; Brown and Eisenhardt, 1995; Nonaka and Takeuchi, 1995) and empirical studies (e.g. Sicotte and Langley, 2000; Hoegl and Gemuenden, 2001; Sethi and Nicholson, 2001) attest to the sustained importance of teams to organizations, particularly those involved in innovative projects. Teams are seen as the vehicle that allows the crucial cross-functional collaboration and sharing of scarce resources to bring projects to successful completion through synergy of the various functions, satisfying increased pressures to bring products to market faster.

Given this importance of teams to organizations, it is not surprising to see that research interest in explaining team performance stays strong (e.g. Sicotte and Langley, 2000; Hoegl and Gemuenden, 2001). Beginning with the conceptual

models and review of such scholarly work by Hackman and Morris (1975) as well as Gladstein (1984) to the more recent fine-grained empirical tests of the relationship between key team characteristics (see, for example the different types of team-integration mechanisms and performance in the study by Sicotte and Langley, 2000), team processes (see the extent of team collaboration and performance in Hoegl and Gemuenden, 2001; Sethi and Nicholson, 2001), and even variables moderating or mediating team-level characteristics and team performance (see Stewart and Barrick, 2000; Hoegl and Parboteeah, 2003), researchers have been strongly interested in explaining what team-level variables are related and influence performance.

As such, the large literature on factors explaining team effects on performance has generated significant understanding. However, an important assumption in most team studies is that teams and team properties are static (for an exception, see Hughes and Chafin, 1996), thus ignoring the possibility that at various stages of their existence,

teams can have different characteristics (West, 1996). However, the reality for most teams involved in innovative projects is that they are facing a constantly changing environment, both internally and externally. This proposition is largely supported by Sicotte and Langley's (2000, p. 2) arguments that teams in innovative projects constantly face uncertainty ('lack of knowledge about future events and consequences of specific actions') and equivocality ('deeper level of ambiguity and confusion regarding what needs to get done'). Similarly, Hughes and Chafin (1996, p. 89) mention that 'competitors come and go, technological change occurs at an ever-increasing rate, customers wants and needs are constantly shifting ...'

The above clearly shows that teams with innovative tasks are facing a dynamic environment. However, in order to cope successfully with such environmental contingencies, it is important for teams to constantly monitor their environment and react appropriately. One key aspect of the ability of teams to monitor and react to their environment is reflexivity (West, 2000). Team reflexivity can be defined as the 'extent to which group members overtly reflect upon the group's objectives, strategies and processes, and adapt them to current or anticipated endogenous or environmental circumstances' (West, 1996, p. 559).

In this paper we investigate the relationship between team reflexivity and performance and examine two types of team member skills (i.e. social skills and project management skills) as antecedents to team reflexivity. Given the above-described state of the literature and noted gaps, our study offers several contributions. First, although West (1996) provided a conceptual introduction to team reflexivity and potential relationships with group effectiveness, empirical evidence remains scarce (Schipper et al., 2003). Hence, this research provides a necessary empirical test of the falsifiability and practical utility (Whetten, 1989) of the initial theoretical propositions of team reflexivity, laying the ground for a better understanding and improvement of the theory. Second, we not only examine how reflexivity is related to effectiveness as proposed by West (1996), but also argue for a relationship of this concept with team efficiency. This approach thus provides for a more complete understanding of aspects of team performance and extends West's (1996) propositions beyond effectiveness. Third, we also extend the concept of team reflexivity by proposing possible antecedents of team reflexivity, namely team members' social skills and project management skills. Such an endeavor

provides important understanding of how organizations can generate reflexivity in their teams. Finally, our study includes teams that are involved in innovative projects. Given that innovative teams face particularly dynamic environments, our study of reflexivity in that context is very fitting and contributes to a deeper understanding of team phenomena in innovative projects.

The detailed discussion of our conceptual arguments begins with a specification of two elements of team performance, namely effectiveness and efficiency, followed by team reflexivity and its proposed relationship with team performance. We also discuss two important antecedents of reflexivity, namely team members' social skills and project management skills, and how they are related to reflexivity. Our hypotheses are then tested using cross-sectional data from 575 members, leaders, and team-external managers of 145 software development teams.

2. Constructs and hypotheses

2.1. Team performance: effectiveness and efficiency

Team performance can be defined as the extent to which a team is able to meet established quality, cost, and time objectives (Schrader and Goepfert, 1996). For the present study, team performance is described by its variables effectiveness and efficiency (Madhavan and Grover, 1998). Effectiveness refers to the degree to which expectations regarding the quality of the outcomes are met, whereas efficiency relates to adherence to schedules and budgets. Therefore, effectiveness reflects a comparison of intended versus actual outputs, whereas efficiency reflects a comparison of intended versus actual inputs.

2.2. Team reflexivity

Team reflexivity is based on the notion that a team's environment is ever changing and that there is a need for constant reflection and contemplation to assess the most current environment in order to apply the best action. Team reflexivity involves actions 'such as questioning, planning, exploratory learning, analysis, diverse explorations ... learning at a meta level, reviewing past events with self-awareness, digestion, and coming to term over time with a new awareness' (West, 1996, p. 560). A reflexive team is said to be more aware of the consequences of its actions and

more proactive, while a non-reflexive team is simply functioning without any self-awareness of their actions. As such, a reflexive team is more likely to be continuously monitoring both its internal and external environments. Such continuous assessment enables team members to develop new meaning regarding their team representations, thereby allowing them to be more able to adapt and be proactive as necessary to these new conditions. Consistent with West's (1996) initial formulation of the team reflexivity concept, we propose that team reflexivity is positively related to team effectiveness. However, we go beyond West (1996) and argue that team reflexivity is also positively related to team efficiency. Below are our detailed arguments for these links.

2.2.1. Team effectiveness

Team reflexivity is positively related to effectiveness because at a fundamental level, the self-reflection and self-awareness inherent in more reflexive teams is likely to help the team find better solutions to problems they are facing. Past research shows that those groups that constantly question their assumptions, find new ways of looking at situations and re-examine meanings inherent in their environment are more likely to be adept at problem solving (Schwenk, 1988; Hirokawa, 1990). Furthermore, given the reality of innovative projects, where the team constantly faces ambiguity and uncertainty (Sicotte and Langley, 2000), it is not always easy to define the problem and prioritize issues. However, self-reflection enables the team to continuously assess the situation to come to an updated and thus accurate understanding of its objectives under dynamic and complex environmental and technical circumstances (e.g. shifting or evolving customer expectations; competitive moves; technological developments). Thus, an ongoingly current definition of what needs to get done is more likely to result in better problem solving as the team is solving the 'right' problems in the right order, and ultimately achieves better team effectiveness (Ancona and Caldwell, 1988).

Teams involved with innovative projects also face high task variety (i.e. a large number of unrelated events associated with a project, Gales et al., 1992) and low task analyzability (i.e. ambiguity surrounding task strategies and work processes, Daft and Lengel, 1986). As such, there is high potential for disruptions as team members face unpredictability. Team reflexivity is very likely to be helpful in dealing with this situation. The constant self-reflection fosters the ongoing collection and sharing of information that is so

critical to project success (Sicotte and Langley, 2000). The mere act of reflexivity is likely to result in better communication and sharing of ideas as team members constantly express their views on problems (Johnson and Johnson, 1987). Such critical gathering and sharing of information both within the team (Hoegl and Gemuenden, 2001; Sethi and Nicholson, 2001) as well as outside the team (Ancona and Caldwell, 1990) is useful in terms of determining the next task, coordinate team-internal and team-external activities, and finding the best way to deal with interruptions. As such, this enhanced communication is likely to result in better team performance as all team members are better informed about problems they are facing and ways to solve them.

Reflexive teams are also likely to make better use of the expertise of team members and thus achieve better project success. Because reflexivity involves each team member to present their accounts of the situation, they are less likely to be judgmental about ideas and more likely to find the best solution to problems (Rogelberg et al., 1992). Moreover, higher levels of reflexivity allow team members to be more aware of their fellow team members' expertise and skills. Such deeper knowledge of team strength and weakness is likely to lead to better project success as expertise is distributed in the most appropriate way. As such, better use of team member knowledge and expertise is likely to result in higher team effectiveness. Given all of the above, we hypothesize:

Hypothesis 1: Team reflexivity is positively related to team effectiveness.

2.2.2. Team efficiency

We propose that team reflexivity is also positively related to efficiency, namely the team's ability to meet its schedule and operate within its budget. As argued earlier, a reflexive team is likely to enable team members to be more aware of the problems and constraints the project is facing (Sicotte and Langley, 2000). As such, it is more likely that team members are informed of where the project stands and where disruptions are occurring. Such knowledge is very valuable as it not only allows the team to be better able to progress through the project, but also to be more cautious about respecting deadlines and cost constraints. Less reflexive teams are, compared with highly reflexive teams, likely to lack focus on the efficiency goal dimensions of budget and schedule. As these efficiency dimensions are of crucial importance to most any organization's innovative projects (i.e. time to

market as a strategic competitive advantage; e.g. Griffin, 1997), Gersick (1988, 1989) has demonstrated that it is the team's awareness of deadlines that affects team members task behaviors. By extension, we expect that highly reflexive teams achieve higher efficiency as they maintain a higher awareness of resource constraints (both time and budget) throughout the project, and such awareness will likely guide their task activities leading to increased adherence to schedule and budget objectives at the project's conclusion.

As discussed with regard to team effectiveness, a reflexive team's ability to identify the 'right' problems is also likely to be related to higher efficiency. Such a team is more likely to make efficient use of time to solve these problems. In contrast, time and resources are more likely to be wasted in a less reflexive team as team members may grapple with solving the wrong (i.e. less relevant and pressing) problems, likely necessitating later changes and re-work. Furthermore, the lack of reflexivity also means that the team takes longer to arrive at the proper identification of problematic issues, thereby also contributing to lower efficiency. Additionally, Moreland and Levine (1992) argue that less reflexive teams are more likely to deny, distort, or hide difficulties and wait to see what happens. In contrast, more reflexive teams are more likely to face problems and thus find solutions in a more efficient manner.

Finally, the teams' deeper knowledge of their own strengths and weaknesses associated with high team reflexivity also enhances the likelihood that a team is more efficient. In such a team, team members perform tasks that are consistent with their own expertise and skills. By contrast, less reflexive teams are more likely to waste time finding the best team member for specific tasks or assign tasks to less appropriate members. More time and resources are likely to be wasted as more effort goes into trial and error. However, for reflexive teams, the appropriate match between knowledge/skills/experiences and task requirements imply that the project is more likely to be completed in a timely and cost-efficient fashion. Given all of the above, we hypothesize:

Hypothesis 2: Team reflexivity is positively related to team efficiency.

2.3. Team member skills as antecedents of team reflexivity

It is the underlying assumption of this study that team reflexivity is influenced by certain skills

brought into the team by its members. For the purpose of this investigation, the term skills, refers to abilities of individual team members. Skills differ from personality characteristics and traits (e.g. agreeableness and conscientiousness), in that skills can be actively learned and improved whereas personality traits remain much more stable over time. In essence, skills are to a far greater extent controllable by team members and management than personality characteristics (Stevens and Campion, 1994, 1999). Without questioning the notion that certain personality characteristics may be important to some team processes (McGrath, 1964; Cannon-Bowers et al., 1995; Kichuk and Wiesner, 1997; Neuman and Wright, 1999) and to team members' capacity to develop certain skills, our focus on team member skills reflects the intention to identify influential antecedents of team reflexivity that are controllable at the team or project level. Team member skills are controllable at the team level by means of team composition (i.e. staffing a team with certain individuals possessing specific skills desired) or professional development activities aimed at improving certain skills before or during projects.

We consider two types of team member skills in our analysis, namely social skills and project management skills. As such, our choice of team member skills variables recognizes innovation teams as socio-technical systems (Cummings, 1978) and addresses both the social interaction as well as the workflow and task sequencing of project teams. In the following, we argue that both sets of skills with their influence on different social- and task-related aspects of the collaborative work process have direct effects on team reflexivity.

2.3.1. Social skills

Social skills refer to a person's abilities to interact with other people (Faix and Laier, 1996). This includes skills for effective communication, i.e. openly approaching others and clearly expressing one's opinions as well as actively and non-evaluatively listening to others (Brodbeck, 1994; Stevens and Campion, 1994, 1999). Social skills also include the ability to understand and respect others' opinions and activities, i.e. to put oneself in other people's positions. In short, social skills enable one to act and interact competently and responsibly in social systems such as teams. Therefore, it is considered to be important that team members possess social skills that enable them to better collaborate on a common task

(Hackman, 1987; Manz and Sims, 1987; Cohen, 1994). Social skills permit team members to openly express their views and to regard others' perspectives at the same time. This creates the basis for effective and efficient exchange of information among all team members and with team-external contacts.

Based on these considerations, the level of social skills present in a team is considered to be positively related to team reflexivity, as this team-level process is highly dependent on team members' interactions within the team and with outside individuals and groups (Tjosvold et al., 2004). Hence, if a team is high on social skills, it is more likely that outside contacts are being made and maintained through which task-related information can be exchanged. Furthermore, such social skills will also foster the sharing and collective interpretation of information within the team. As such, we argue that team members' social skills are a vital determinant for team reflexivity to occur. Socially skilled team members are concerned with the impact of their actions on others and are thus likely to further activities of team reflexivity such as continuously monitoring and rethinking the exchange relationships within the team and with its environment. Moreover, social skills enable team members to act upon such awareness and competently interact with others in the course of reflexive activities such as collecting task performance-related information and initiating discussions and decision processes within the team in order to assess and, if necessary, correct work strategies. Hence, we propose the following:

Hypothesis 3: Social skills are positively related to team reflexivity.

2.3.2. Project management skills

Project management skills refer to team members' abilities to plan and control projects. This includes abilities to structure the team task and to plan the workflow (Gladstein, 1984). To be effective, teams must organize themselves in a way that allows all team members to work simultaneously without gaps and overlaps (Stevens and Campion, 1994). Project management skills are necessary for flexible planning and ongoing controlling of the task process, which is of particular importance in the case of innovative projects, given their high degree of task-related uncertainty and complexity.

We argue that a team's project management skills are positively related to team reflexivity, as a high level of task structuring and coordination

offers the basis for, and likely prompts the awareness of, its current work status relative to given quality, budget, and schedule expectations. As such, teams that have the skills to properly structure and control their task processes will likely demonstrate higher levels of team reflexivity, scanning internal and external environments for feedback based on proper information regarding current task status, routinely re-evaluate chosen task strategies and are prepared to alter them if the situation calls for such action. Therefore, we propose that the level of team members' project management skills directly affects team reflexivity.

Hypothesis 4: Project management skills are positively related to team reflexivity.

3. Methods

3.1. Sample and data collection

A total of 145 software development teams from four German software development laboratories participated in this research. All four laboratories were part of larger organizations, with two of them being independent operations of the same US parent company. The other two laboratories belonged to organizations headquartered in Germany. Each laboratory employed between 100 and 500 software developers.

The laboratories provided lists of projects including names and contact information of team members while the employees of the software laboratories were informed that a study about team management was to be conducted. All team leaders and team-external managers as well as randomly chosen team members were contacted for individual data collection appointments. Respondents' participation in this study was strictly voluntary. All contacted respondents participated in the study. Data were gathered through individual data collection sessions using a fully standardized questionnaire (five-point answer scale). All data collection sessions were conducted on site in dedicated rooms assuring similar conditions for every respondent.

The individual data collection sessions followed a very structured pattern. First, team membership as stated on the list was confirmed with the respondent to ensure that he or she was indeed a member of the team in question and to ascertain that all respondents of one team were referring to the same set of individuals as the team. Then the respondent was instructed to read and complete

the questionnaire on his/her own. This way, possible interviewer effects were minimized, while there was still a researcher present to clarify questions if any occurred. Each data collection session lasted about 45 min.

A total of 575 data collection sessions with members, leaders, and (team-external) managers referring to 145 software development teams were conducted. On average, data from three members of each team were collected. Of the team members and leaders, 22% were female. Our sample contains 26% female respondents. The teams in this sample have an average of 6.3 members (median = 6, standard deviation = 3) and an average age of all team members of 36.6 years (median = 36, standard deviation = 5).

3.2. Multiple informants

In order to ensure content validity and to avoid a possible common source bias, data from different respondents were used to measure the different variables. Team performance was measured using data from (team-external) managers. Team reflexivity was measured using aggregated responses from multiple team members (excluding team leaders). Social skills and project management skills were measured using responses from the team leaders. Prior to the hypotheses testing analyses, we calculated interrater agreement for social skills and project management skills based on both team leader and team member data available. Using the multiple item estimator for within-group interrater agreement (IRR) as proposed by James et al. (1984), we found generally strong agreement between the raters (team leader and team members) across all teams (social skills: IRR = 0.90; project management skills: IRR = 0.79). This offers support for using the team leaders as reliable key informants for these variables. All further analyses are conducted on the team leader responses for social skills and project management

skills, thus using different sources for the team member skills variables (team leader ratings), team reflexivity (team member ratings), and team performance (manager ratings).

3.3. Measures

All constructs considered in this investigation refer to the team as the unit of analysis. Accordingly, all measures were specified at the team level. The questionnaire was administered in German language. The German language measurement scales were specifically generated for the present study based on descriptions and measures of related constructs in the literature (Stevens and Campion, 1994; Boesch, 1996; Faix and Laier, 1996; West, 1996). In developing these scales, we followed Churchill's (1979) and Bagozzi's (1994) suggestions for developing measures. All items for our measures were generated based on a thorough literature review. A pretest was conducted including 23 members of product development teams at a machine tool manufacturing company. Following this pretest the wording of some items were refined for later use in the present study (Table 1).

The measurement scales for effectiveness and efficiency were based partly on the scales used by Lechler (1997) in a large-scale study of project management in Germany. Effectiveness, i.e. the technical quality of the software solution, including the satisfaction with the software solution from different perspectives (customer, team), was measured using 10 items. Another five items were used for measuring the teams' adherence to schedule and budget (i.e. efficiency). Representative items from these two scales, which are documented in full by Hoegl and Gemuenden (2001), are as follows: *effectiveness*: The customer was satisfied with the quality of the project result. The product required little rework. The product proved to be stable in operation. 10 items, Cronbach's $\alpha = 0.87$; *efficiency*: The project was within

Table 1. Number of items, means, standard deviations (SDs), reliabilities, and correlations.

	Informant	Indicators	Mean	SD	α	1	2	3	4	5	6
1. Social skills	Team leader	6	3.76	.55	.87						
2. Project management skills	Team leader	2	4.00	.66	.84	.37					
3. Team reflexivity	Team members	5	3.60	.41	.77	.41	.31				
4. Effectiveness	Manager	10	4.11	.55	.87	.06	.13	.20			
5. Efficiency	Manager	5	3.93	.78	.85	.07	.15	.09	.61		
6. Team size	Team leader	—	6.34	2.88	—	-.22	-.05	-.18	.06	-.10	
7. Project type (new versus upgrade)	Team leader	—	—	—	—	.01	.06	.19	.02	-.07	-.05

N = 145.

schedule. The project was within budget. Five items, Cronbach's $\alpha = 0.85$.

Building on the extensive descriptions by West (1996), the scale for team reflexivity includes five items (Cronbach's $\alpha = .77$) referring to the collection of information on the progress of the project, observation of the project context for important changes, as well as the team's readiness to react to substantial changes. Before aggregating multiple team members' evaluations of team reflexivity, interrater agreement (James, 1982; James et al., 1984; Campion et al., 1993) was assessed using the multiple item estimator for within-group interrater agreement as proposed by James et al. (1984). This test yielded results indicating generally very strong agreement of ratings referring to the same team. The average score of this test across all teams is .87, with all teams exceeding .70. Given this homogeneity of within-team ratings, data were aggregated by calculating the arithmetic mean.

The scales for assessing social skills as well as project management skills of team members were constructed based on the discussions of these concepts by Stevens and Campion (1994), Faix and Laier (1996), as well as Boesch (1996). The social skills scale (six items; Cronbach's $\alpha = 0.87$) addresses team member extroversion, verbal skills, comprehension, sensitivity, and adaptability, while the scale for project management skills (two items; Cronbach's $\alpha = 0.84$) refers to abilities for planning and controlling of the project. The measurement scales for social skills, project management skills, and team reflexivity are documented in the Appendix of this article.

3.4. Control variables

We included team size as a control variable in our analysis. Team size was reported to us by the laboratories and confirmed by the team leaders. The size of a project team is an important structural variable with potential influences on the team's collaborative task process and project success (Gladstein, 1984; Hackman, 1987; Campion et al., 1993). Large team sizes make it more difficult for team members to interact with all other team members given the dramatic increase of (possible) individual links between team members as team size grows (Steiner, 1966). Therefore, we are controlling for the possible influence of team size in our hypotheses-testing analyses.

In addition, we included a dummy variable to differentiate between new software projects and upgrade projects. This categorization was based on the team leaders' assessments of whether their

projects involved primarily the design and development of new software solutions (more innovative), or primarily the upgrade or customization of existing software solutions (less innovative). We suspected that project type might matter because the more innovative new software projects might have been staffed with individuals particularly strong in social as well as project management skills. Furthermore, it seems plausible to assume that the increased complexity and uncertainty of the more innovative new software projects may prompt teams to be particularly reflexive in their task approaches. By including project type in our analysis, we are controlling for any effects that differences of project type might have on the relationships that we are testing.

Given that this study includes data from four different software development laboratories, we are controlling for possible organizational effects (i.e. dependencies between observations from one laboratory) in our analysis. Specifically, prior to the hypotheses testing analyses, we have regressed the independent variables and the dependent variables on laboratory and saved the standardized residuals. We have used the standardized residuals from this procedure as the basis for all hypotheses-testing analysis. This procedure effectively controls for all constant and unmeasured differences across the laboratories that may explain differences in the variables and relationships investigated.

4. Results

We have conducted multiple-regression analysis in order to test our hypotheses. The results are documented in Table 2. One set of regression-analyses tests for the proposed positive influence of team reflexivity on effectiveness and efficiency. As the results indicate, this test provides support for hypothesis (1) showing a positive effect of team reflexivity on team effectiveness (standard coefficient = .19; $P < .05$) after controlling for team size and project type as well as laboratory (the latter controlled for before the regression analyses by means of the above described procedure). Hypothesis (2), positing a positive influence of team reflexivity on team efficiency, however, is not supported by these analyses. Furthermore, none of the two control variables included in the regression analyses showed any significant influences. (Table 2).

We have conducted another regression analysis testing for the proposed positive influences of

Table 2. Multiple regression analyses.

Independent variables	Effectiveness	Efficiency	Team reflexivity	
	Standard coefficient		Standard coefficient	
Control variables				
Team size	.12	-.03	Team size	-.12
Project type	-.01	-.05	Project type	.22**
Main effects				
Team reflexivity	.19*	.11	Social skills	.32**
			Project management skills	.18*
R ²	.04	.02	R ²	.27
F	1.98	.83	F	12.98

N = 145. **Significant at the 0.01 level. *Significant at the 0.05 level.

team members' social as well as project management skills on team reflexivity. The results support both hypotheses (3 and 4) showing significant positive effects for both social skills (standard coefficient = .32; $P < .01$) and project management skills (standard coefficient = .18; $P < .05$) on team reflexivity. Of the two control variables included in the regression equation, project type showed a significant positive influence on team reflexivity (standard coefficient = .22; $P < .01$), affirming our initial assumption that new software projects may prompt teams to be particularly reflexive given the more complex and uncertain nature of those projects compared with the relatively less innovative software upgrade and customization projects.

In a third set of regression analyses we have tested possible direct effects of both social skills as well as project management skills on team effectiveness and efficiency. In doing so, we conducted hierarchical-regression analyses using team effectiveness and team efficiency as dependent variables, team size and project type as control variables, as well as team reflexivity, social skills, and project management skills as main effects. The results showed no significant direct effects on team effectiveness or team efficiency by either social or project management skills.

5. Discussion

In this paper, we contribute to the literature on teams by focusing on a relatively ignored but important aspect of the team process, namely team reflexivity (Carter and West, 1998). Specifically, we argue that team reflexivity is positively related to team effectiveness and team efficiency. Additionally, we also propose that social skills and project management skills are two important antecedents of team reflexivity. Results provide

support for three of our four hypotheses, thereby largely endorsing our main theoretical argumentation for an extended team reflexivity framework.

5.1. Theoretical implications

Results largely support the hypothesized positive relationship between team reflexivity and effectiveness. Consistent with West's (1996) theoretical arguments, a reflexive team is more likely to be questioning and tackling challenges produced by the continuously changing environment of innovative projects. Such proactive effort likely contributes to a better understanding of the ambiguity and confusion (Sicotte and Langley, 2000) surrounding innovative projects. Furthermore, more reflexive teams are also more likely to make effective use of team members' expertise and skills as the constant reflection makes team members aware of the various strengths of team members. Additionally, the mere act of 'reflecting' on the project is also likely to induce better communication among team members, thus contributing to higher effectiveness through better information sharing (Hoegl and Gemuenden, 2001; Sethi and Nicholson, 2001).

Our results for efficiency were, however, surprising, as team reflexivity was not related to efficiency. We initially argued that at a basic level, reflexive teams, through their inherently goal-oriented 'high awareness' approach, are more likely focused on team budget and cost and thus are more likely to be efficient. We further proposed that more reflexive teams are more likely to be aware of their team members' strengths and weaknesses and thus be in a better position to judiciously distribute tasks.

However, there seem to be some feasible explanation for our counterintuitive results for the relationship between team reflexivity and efficiency. Reflexivity necessarily involves dedication

both in terms of resources and time. The reflexive actions of questioning, planning, and the sustained continuous monitoring (West, 1996) are likely to require significant time commitment from team members, thus contributing to additional time and resource use. Furthermore, the notion of reflexivity implies self-reflection and exploratory learning, both requiring significant dedication from team members. Additionally, relative to a less reflexive team, the ability of team members to be reflexive also involves training and dealing with trial and error. In sum, relative to a non-reflexive team, the ability of a team to be reflexive likely involves additional cost and time. As such, any additional efficiency benefits gained from more reflexive teams may be offset by the additional cost and time use in more reflexive teams.

Furthermore, team reflexivity may have two other efficiency-inhibiting results in innovative projects. First, highly reflexive teams may not focus enough on their own team's project work by monitoring the project environment through all team phases. While such outward orientation may be beneficial in the early stages of the innovation project where the product concept is being crafted, the later design and development phase may require the teams to be more inwardly oriented and focus on their own development work rather than spend time and effort reflecting (and questioning) its work strategies all through this implementation phase (Ancona and Caldwell, 1990; Gupta and Wilemon, 1990; Clark and Fujimoto, 1991; Souder and Moenaert, 1992). Second, team reflexivity, particularly in later stages of the innovation project, may result in new qualitative demands on the product to be developed, requiring perhaps re-work and additional work for the team to incorporate, for instance, functionality not previously planned (Eisenhardt and Tabrizi, 1995). While such additional demands (even if they might appear relatively minor to management) may improve the quality of the final product (i.e. effectiveness), they certainly have implications on resource consumption, both time and cost, thus relating directly to team efficiency. This, of course, assumes that schedule and budget objectives are not, or not sufficiently, adjusted at the same time; apparently a quite common reality in the projects we studied. These possible explanations raise interesting new questions with regard to the sequencing of team reflexivity over the life of the project, with the early planning and concept phases perhaps calling for more team reflexivity, while later

design and development phases may require the team to be more focused on the efficient implementation of previously planned strategies (Gupta and Wilemon, 1990; Clark and Fujimoto, 1991; Souder and Moenaert, 1992). It is worth noting, however, that our data do not show a negative relationship between team reflexivity and team efficiency, implying that the positive reflexivity-effectiveness relationship is not 'offset' by a negative reflexivity-efficiency relationship.

With regards to our investigation of possible antecedents of team reflexivity, both social skills and project management skills were positively related to team reflexivity. Teams with higher levels of social skills are likely to have team members who are more 'connected' with each other. As West (1996) argues, team reflexivity involves such components as better interaction, better communication, better feedback, and better inter-group relations. As social skills reflect the ability of team members to interact and communicate, they are likely to enhance the above aspects of team reflexivity. The easier the access to other team members, the ability to empathize and the generally easy flow of communication, all key effects of social skills, are likely to contribute to the higher team reflexivity. As reflexivity is achieved through intensive self-exploration and reflection that necessarily involves all team members, better social skills are also likely to facilitate the actions leading to better reflexivity. Finally, the ability of a team to deal constructively with criticisms and sustained questioning (i.e. reflexivity) will likely be enhanced by higher social skills as team members are more in tune with each others' needs and thus know how to adapt to personal styles positively.

Our results also show that project management skills are related to team reflexivity. Key components of team reflexivity include the ability to define clear objectives and the ability to devise strategies and plans to achieve such objectives (West, 1996). As such, high degrees of project management skills are likely related to high reflexivity, as teams are more likely to have the skills to devise objectives and the strategies to achieve such objectives. Teams with higher levels of project management skills are necessarily more skilled at planning and gauging progress of the project, thus enhancing reflexivity. Frese and Zapf (1994) also argue that the extent of reflexivity of a team is dependent on the team's ability to detail their plans, include potential problems and devise both long-term and short-term plans to complete the project successfully. It is feasible

to argue that teams with higher project management skills are likely to be in a better position to be reflexive as such skills are likely to enhance the teams' ability to complete the various reflexive activities suggested by Frese and Zapf (1994).

Our analyses also demonstrate that team members' social skills and project management skills are only indirectly related to team effectiveness, i.e. through team reflexivity. Hence, these results support the input-process-output structure suggested in many comprehensive models of team effectiveness (Gladstein, 1984; Hackman, 1987) and inherent in our hypotheses.

5.2. *Practical implications*

This research holds important practical implications, especially in light of the effects of team members' social and project management skills on team reflexivity. It should be noted that social and project management skills explain 27% of the variance in team reflexivity, underscoring the importance of these variables. Hence, it is essential that managers emphasize social and project management skills along with team members' domain-relevant skills (e.g. programming skills, hardware expertise, skills regarding the application field of the software), when (1) selecting applicants to join a team-based innovative organization, when (2) assigning individuals to work in teams, and when (3) crafting training and development schemes. Throughout the interviews for this study, we could hardly sense that managers were considering social skills at all when carrying out these three activities. Team leaders are mostly appointed on the basis of their technical and project experience, while the other team members are included for their specific domain-relevant expertise. Social skills, as a prominent ingredient for generating team reflexivity as a performance-relevant quality of the team task process, were almost entirely disregarded. This research, of course, is not to indicate that technical skills can be disregarded in light of the impact that social and project management skills exert. However, it is important for managers to understand and accept the critical role that teamwork skills (Stevens and Campion, 1994, 1999) play in a team-based innovative organization.

5.3. *Limitations and future research*

On a methodological note, our research draws on data from 575 members, leaders, and managers of

145 software development teams with responses from different informants used to measure the different constructs. Using this elaborate research methodology, any inflation of results because of common source bias was avoided while the most credible respondents were surveyed to provide information on the variables of interest.

A few limitations of this study along with questions for future research should be noted. First, the data for this research are cross-sectional rather than longitudinal. As this study demonstrates associations between variables, it cannot fully establish causality. A longitudinal research design using multiple informants would further our knowledge toward both causality of relationships as well as the development of team reflexivity perceptions over time. The latter aspect is particularly notable in regard to the above-discussed possible project phase-specific effects of team reflexivity on team efficiency (i.e. is team reflexivity beneficial in the early phases and/or detrimental in the later phases of innovative projects?). A longitudinal research design with several measurements of team reflexivity would be necessary in order to test such phase-specific effects. Second, the scope of the empirical data gathered for this research allows generalization of the results obtained chiefly to the domain of teams with innovative tasks such as R&D teams, new venture teams, etc. As such, it is necessary to replicate our study in more routine projects. Specifically, given our results for efficiency, it would be interesting to determine how beneficial team reflexivity is for more routine projects. Third, the present study was conducted in software development laboratories in Germany, raising the question of transferability of results to other cultures such as those of North America or Asia. While this study is not internationally comparative in nature and therefore cannot offer any answers to this question, the theoretical considerations presented in this article as well as the industry for this study (software) are not country-specific, but rather our arguments are based on international scholarly work and empirical findings. Further research in other countries is encouraged in order to increase our understanding of the possible influences of country contexts on the relationships investigated here. Lastly, while team members' social and project management skills have shown to have a sizable influence on team reflexivity, other individual, team, and organizational characteristics should be explored as determinants of team reflexivity, thus further enabling organizations to ensure team reflexivity.

6. Conclusion

Taken together, the discussions outlined earlier suggest some notable contributions. First, we provide for an empirical verification of West's (1996) conceptual propositions. Given the inherent nature of more innovative projects reflecting ambiguity, complexity, uncertainty, and high task variety (Sicotte and Langley, 2000), we argue that team reflexivity, the ability of a team to continuously monitor its environment and be proactive is crucial to project success. As such, our study furthers much needed understanding of the reflexivity concept. Second, we go beyond West's (1996) conceptualizations and make a considerable contribution to this theory by examining the relationship of team reflexivity with team efficiency and by investigating two important antecedents to team reflexivity. As such, we contribute to a better theoretical understanding of team reflexivity. Finally, our focus on innovative projects as opposed to more routine projects also contributes to substantial understanding of team reflexivity in such projects.

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Appendix 1: Measurement scales

Variables	Items
Team reflexivity	My team investigated and observed the context and the progress of our project (e.g. task performance strategies, goals, project requirements, the organizational context, etc.). My team adjusted its task performance strategies in response to changes in the context and progress of the project. My team spent an adequate amount of time considering the likely consequences of its task activities (e.g. considerations regarding usability of the product, compatibility with other products, cost, etc.). Strategies and work approaches chosen were later checked for their appropriateness. My team learned from its experiences.
Social skills	The team members were competent at approaching each other. The team members were competent at expressing their needs and requirements. The team members were competent at comprehending other peoples' needs and requirements. The team members were competent at projecting themselves into others' situations. The team members were competent in making sense of others' situations and actions. The team members were capable of adjusting to others' personal styles.
Project management skills	The team had the necessary skills for planning the project (e.g. setting sub-goals, structuring the work, etc.). The team had the necessary skills to control the progress of the project.

Note: These are translations from the original German language items used in the study.