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How Team Efficacy Beliefs Impact Project Performance: An Empirical Investigation of Team Potency in Capital Projects in the Process Industries

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***Abstract*—**Team efficacy beliefs show promise in enhancing team performance. Using a model-based quantitative research design, we investigated the antecedents and performance consequences of generalized team efficacy (potency) in a sample of 56 capital projects executed by 15 Fortune 500 companies in the process industries. Empirical analysis of our field survey identified that generalized team efficacy beliefs were positively associated with an objective measure of project cost performance. Regression analysis revealed that team competence, empowering leadership, and performance feedback all predicted generalized team efficacy beliefs. Tests of mediation revealed that generalized team efficacy fully mediated between these three inputs and project cost performance.

***Keywords*—**Team efficacy, Potency, Leadership, Feedback, Project cost.

I. Introduction

SOCIAL-COGNITIVE theory has identified the construct of efficacy, or perceived competence, as an important belief that optimizes performance [1]. There is a well-established link between a team's positive frame of mind and achieving sporting success [2]. Increasingly, researchers are recognizing that a positive "can do" attitude is equally important for productive workplace performance. Perceived efficacy is defined as the "belief in one's capabilities to organize and execute the courses of actions required to produce given attainments" [3]. Perceived efficacy acts as a cognitive mediator between employees' abilities and their task performance. While a large body of research in different domains shows that the concept of efficacy is robust at the individual level [2], research is still in its infancy at the higher collective or team level [4] and more particularly for workplace teams [5].

The initial indications of the importance of team perceived efficacy for successful team performance has prompted calls for further collective efficacy research [1], [6] in actual work teams, and in different workplace settings [7]. Studies are only just beginning to confirm Bandura's theory concerning a strong relationship between team performance and collective efficacy [8], [9], [10]. To our knowledge, our recent study [11] is the only one to include team efficacy as a predictor of project performance in manufacturing sector projects.

Given that effective team management creates organizational competitive advantage [12], we believe it is timely to investigate the applicability of the concept of efficacy to project teams in industry. Specifically, how does the construct of generalized team efficacy add to our understanding of managing teams in the capital project management context? Our research aims to use the existing theoretical and empirical efficacy literature to develop and test a conceptual model of the antecedents and performance consequences of generalized team efficacy in manufacturing sector projects.

II. Literature Review and Hypotheses

A. Proposed Model

Researchers have often omitted studying team processes as mediating variables, tending to focus instead on the direct effects of inputs on outputs. One of the most common conceptual frameworks of team performance is the Input-Process-Output (I – P – O) model adopted by Guzzo [13]. Inputs (such as team composition or work design) influence team processes (such as cohesion or efficacy), which in turn influence task outcomes (such as task performance and stakeholder satisfaction). Since team efficacy is classified as a process in Guzzo's model, we have adapted their Input-Process-Output structure in developing our proposed model of the antecedents and outcomes of team efficacy (see Fig. 1).

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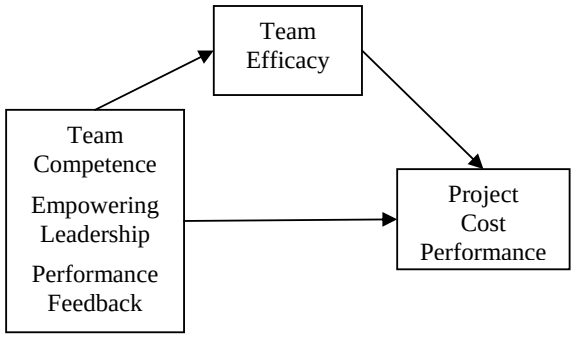

Fig. 1 Proposed model of antecedents and outcomes of team efficacy

B. Performance Effects of Team Efficacy

Although research into the possible team level effects of efficacy is relatively new, early results with student groups are promising for a variety of performance outcomes [8]. In a study of insurance teams, Campion [9] identified generalized team efficacy (potency) as a key factor that predicted most of team performance outcomes. A meta-analysis of a variety of teams confirmed that team efficacy exhibits a strong relationship with team performance, which strengthens as goal, task and outcome interdependence increase [14]. A team's generalized efficacy beliefs are also related to stakeholder satisfaction. More potent teams are associated with higher levels of internal and external customer satisfaction [15], and teams with high levels of perceived team efficacy experience greater job satisfaction [16], [17]. On the basis of the mounting empirical evidence of positive performance effects, we predict that:

Hypothesis 1. Team efficacy will be positively related to project cost performance.

C. Antecedents of Team Efficacy

There is little available research about the determinants of team efficacy [6]. Studies of individual self-efficacy show that efficacy is a socially constructed cognition. According to Bandura [3], people acquire their efficacy beliefs in three ways: from personal experience (learning through action), through watching the experiences of others (learning through modeling) or socially, through encouragement or criticism from others (learning through persuasion). Building on the efficacy and management literatures, we propose there are three organizational factors that may facilitate generalized team efficacy: empowering leadership and performance feedback.

i. Empowering leadership style

Despite its acknowledged importance to team performance, leadership as a predictor of either team effectiveness, or collective efficacy, is rarely studied [18]. Some authors have theorized about the positive relationship between leadership and collective efficacy [19], and between leadership and potency or generalized efficacy [15], but few have empirically tested this relationship. Kirkman and Rosen [20] developed an allied construct, team empowerment, which includes potency as one of its dimensions. They found that empowering leadership was positively correlated with potency. Kumpfer [21] also found that empowering leadership increased efficacy in health care teams. More specifically, leaders who communicate their belief in the teams' capacity to perform their designated tasks, enhance their teams' efficacy beliefs [13]. In their study, the more the leaders believed in their teams, the more the teams believed in themselves. Based on these initial findings we propose that:

Hypothesis 2a. Empowering leadership will be positively associated with project cost performance.

Hypothesis 2b. Empowering leadership will be positively associated with team efficacy.

ii. Performance feedback

Team members scan their environment and process diverse sources of information and feedback concerning their team's capability to perform. Such feedback can come from the team's own observations and assessment of how well they actually enact a task [22]. Successful completion of previous projects, or smaller sub-tasks in the current project, is likely to enhance the team's belief in their competence [22]. A strong belief in their team's ability can also be learned vicariously [3] from hearing valued others (such as other team members, managers and colleagues) express that belief, or from observing competent team mates successfully performing tasks. Also important to the formation of efficacy beliefs is task feedback [1] received from other team members, project managers, senior management, clients or company colleagues. Parker, Wall and Corderey [23] maintain that feedback has been relatively ignored at the team level, and deserves greater study. However, team research is beginning to empirically investigate theoretical contentions about the impact of performance feedback. Appropriate task-related feedback about what went wrong, and what went right, has been found to be associated with both collective efficacy [22], [24] and potency [25]. In view of these findings, we hypothesize that:

Hypothesis 3a. The practice of performance feedback will be positively associated with project cost performance.

Hypothesis 3b. The practice of performance feedback will be positively associated with generalized team efficacy.

D. Team Efficacy as Mediator

Collective efficacy is conceptualized as providing the link between team ability and team performance [3], by serving as a regulator of team behavior [24]. Guzzo [15] and Campion [9] classify generalized collective efficacy as a team *process* that mediates between team inputs and outputs in their linear Input-Process-Output (I-P-O) models of team effectiveness.

Bandura [25] concurs that efficacy is a *mediating* variable that explains the mechanism underlying the relationship between inputs and task performance outcomes.

Several empirical studies have verified the contention that team efficacy mediates between team performance and inputs such as team ability [11], collective team leadership [18], and task feedback [24], [25]. Hecht and colleagues [6] were the first to investigate the combined effects of ability and efficacy on group performance, finding that generalized team efficacy contributed to student group performance over and above student ability. In the light of these results, we propose that:

Hypothesis 4. Generalized team efficacy will mediate the relationship between the organizational inputs of team member competence, empowering leadership and performance feedback, and the outcome of project cost performance.

III. Methodology

A. Sample

The field survey was conducted with 252 team members from 56 completed capital projects ranging from small (US$270,000) to very large (US$203.25 million), with a median cost of US$8.73 million. Projects were executed by 15 large Fortune 500 processing companies representing a variety of sectors. The chemical processing sector formed 52% of the sample, oil refineries represented another large portion (29%), while 9% were projects from the steel sector. Other sectors represented were pharmaceutical products, consumer goods and forest products.

B. Procedure

The research method was cross-sectional and retrospective in design, with teams surveyed at project completion. A standard procedure was followed at data collection. Individual team members anonymously and confidentially completed the written surveys at their scheduled project close-out meeting. To avoid common method bias, an objective measure of project cost performance was obtained from external project auditors after project completion.

C. Control Variable

Studies of generalized team efficacy have largely ignored team ability or competence [24], even though Bandura [25] has theorized that ability affects both efficacy and performance. In addition, the team literature has established that team competence and ability is associated with group performance [26]. Therefore we have included team competence as a control variable.

D. Measures

Since our study was interested in group level constructs, the level of analysis was the project team at the project level. Team inputs were assessed using the triangulation of multiple sources from each team, as recommended by Kirkman and colleagues [27]. To operationalize the selected constructs we used valid, reliable scales drawn from the team and project literature. All measures used a 1-7 Likert-type response scale, where 1 = very strongly agree and 7 = very strongly disagree. Since our level of analysis was the team, where necessary, we reworded scale items to refer to team-level of behavior ("we") as recommended by Chan [28].

Generalized team efficacy was measured using five items adapted from Guzzo's Potency Scale [15]. The Cronbach's alpha for the Potency Scale was .84. Team competence was measured using three items from Pinto and Slevin's [29] Technical Tasks Scale (Cronbach's alpha = .82). For empowering leadership, we used a modified version of Kirkman and Rosen's [20] External Leader Behavior Scale, with a reported reliability α of .91. For this study the coefficient alpha was .89. We used Pinto and Slevin's [29] five-item Monitoring and Feedback Scale to measure performance feedback *(*Cronbach's alpha = .94).

Project cost performance was measured objectively using a proven benchmarking metric developed initially by the RAND Corporation [30] and further refined by Merrow and colleagues [31], [32]. Industry average was operationalized as 1.0 (one hundred percent). Better cost efficiency was indicated by scores less than 1.0. For example, a score of 0.8, indicated that a particular project performed at eighty percent of the Industry Average, that is, it cost twenty percent less than the average project cost. A score of 1.2 indicated that a particular project cost twenty percent more than the Industry Average. This normalized index enabled the direct comparison of project cost performance for projects of different types, scopes, and sizes, executed in different process industry sectors.

IV. Results

Factor analysis confirmed the structure and validity of the perceptual scales, showing item loadings greater than .50 for each factor. The measures exhibited high reliability, with Cronbach's alpha scores ranging from .82 to .94. Statistical checks using ANOVA and the multiple-item estimator for with-in group inter-rater reliability justified the aggregation of individual responses to form a team-level score [33].

A. Project Cost Performance and Team Efficacy

Generalized team potency was strongly associated with project cost (β=.45, p<.01) in the regression analysis explaining nineteen percent of variance in project cost performance (*Adjusted* R^2 =.19). Therefore Hypothesis 1 received support.

B. Antecedents of Team Efficacy

To test for the hypothesized relationships between team efficacy and the three independent variables (team member competence, empowering leadership and performance

feedback), we entered these variables into a regression equation. Together, team member competence (β=.32, p<.01), empowering leadership (β=.24, p<.01) and performance feedback (β = .26, p<.05) explained forty percent of variance in team potency (F=13.39, p<.001). The regression results lend support to Hypothesis 2b and 3b that empowering leadership and performance feedback are both positively associated with generalized team efficacy.

C. Team Efficacy as Mediator

A variable may be considered to be a mediator to the extent to which it carries the influence of an independent variable (IV) to a given dependent variable (DV) [34]. This relationship is illustrated in Fig. 2 below.

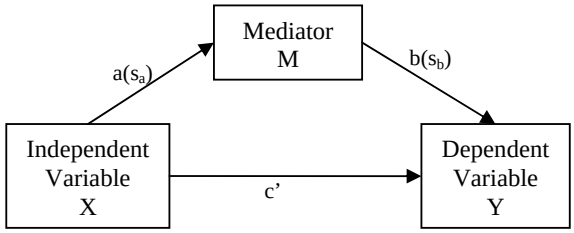

Fig. 2 Statistical mediation model

To test for generalized team efficacy as a mediator of the relationship between the team inputs and project cost performance (Hypothesis 4), we adopted Baron and Kenny's [35] widely used approach. In Step 1 of the hierarchical regression analysis, project cost performance was predicted by generalized team efficacy, satisfying the first requirement of Baron and Kenny's procedure. We then entered team competence in Step 2. This variable accounted for fifteen percent of the variance in project cost performance. Team competence and generalized team efficacy were then entered simultaneously in the third step. The R^2 change of .07 was significant, indicating that generalized team efficacy was a more powerful predictor of project cost performance than team member competence alone. Team competence was no longer significant, indicating that generalized team efficacy fully mediated between team competence and project cost performance. In the fourth step, along with team competence and generalized team efficacy, we entered empowering leadership and performance feedback to determine residual variance. Generalized team efficacy remained significant, but none of the other input variables was significant. Therefore generalized team efficacy fully mediated the relationship between empowering leadership and project cost performance, and between performance feedback and project cost performance. All four steps were satisfied, indicating that full mediation occurred [34].

As recommended by MacKinnon and Dwyer [36], the mediation was then formally tested using Sobel's [37] formula to confirm whether team potency significantly carries the influence of each of the independent variables to the dependent variable (cost performance). This test confirmed that team potency is a mediator between the control variable (team competence) and project cost performance (z = 1.89, p<.05). Generalized team efficacy is also a strong mediator between both empowering leadership (z = 2.52, p<.001) and performance feedback (z = 2.33, p<.01) and project cost performance. The results of the Sobel test lend further support to Hypothesis 4, which proposed that generalized team efficacy will mediate the relationship between team inputs and project cost performance.

V. Discussion

Our findings confirm that the cognitive-behavioral concept of team efficacy is indeed a robust team-level construct, which readily generalizes to a project management context in the manufacturing industries. We found that team members' cognitive evaluation of their teams' capacity to successfully implement their work tasks clearly has performance implications. Project teams that share stronger collective beliefs in their capability to successfully execute projects are able to produce more successful results than those teams with lower generalized efficacy beliefs. This finding is consistent with research conducted with other team types in other domains [5], [8], but it is the first time that the performance-enhancing effects of this motivational state have been demonstrated in the context of capital project management.

Similar to Barrick [26], we found that team competence is an important predictor of overall task performance. Our results also confirm that team efficacy beliefs contribute to team performance over and above the team's actual capability. While team capability explained a significant proportion of the variance in project performance, team efficacy explained an even greater proportion. Given team efficacy's strong predictive power and its relevance to project outcomes, it is likely that an increased understanding of this cognitive motivational state will make an impact on operational performance.

Our findings also expand the limited literature on the antecedents of team efficacy. Our results extend Hecht's [6] findings for generalized team efficacy/potency with adhoc student teams, by demonstrating that team competence is a strong predictor of workplace team efficacy as well. Competent teams with strong expertise are more likely to hold strong, positive beliefs about their collective capabilities to successfully execute tasks. Prussia and Kinicke [24] note that most collective efficacy studies tend to ignore ability/capability. The strong relationship found between team competence and generalized team efficacy signals that future efficacy research needs to take team competence into account, either as a substantive variable, or at least as a control.

With regard to project managers, our findings add empirical weight to the theoretical contention that empowering team leadership engenders strong generalized team efficacy beliefs. This result supports and extends Kirkman and Rosen's [20] findings for the relationship between empowering external leadership and generalized team efficacy/potency in self-managing work teams, and Kumpfer et al.'s [21] results for

community health teams. Empowering leaders use encouraging behaviors that build competence and confidence in their followers [15], which results in positive team efficacy. By consulting with team members, delegating responsibility, soliciting input, using their ideas, and trusting their actions, project managers can foster strong generalized team efficacy beliefs that in turn improve project outcomes. We also found that the relationship between empowering leadership and project performance is mediated by generalized team efficacy.

Our study also confirmed Bandura's [3] contention that performance feedback is a very important mechanism for building and maintaining team efficacy beliefs in the workplace. According to Bandura, timely, accurate and appropriate task feedback increases a team's outcome expectancy for future performance, and enhances their confidence, motivation and subsequent efficacy beliefs. Specific and detailed feedback about task enactment assists to identify specific causes of performance and may increase the team's propensity to self-correct and improve their subsequent task performance [2]. It appears from our study that planned efforts to monitor task performance, and an emphasis on maintaining continuous feedback to the team are effective methods for building up the team's efficacy beliefs. We found that not only does performance feedback predict generalized team efficacy, which is then associated with better project cost performance, but also that generalized team efficacy fully mediates the relationship between performance feedback and project cost performance. This result is consistent with social-cognitive theory [8], and suggests the need for more detailed research into the type, content and timing of performance feedback that is capable of engendering greater team efficacy beliefs.

A. Limitations

A limitation of our research is our cross-sectional design that prevents us from making any conclusions about causation in our model. Given the exploratory nature of our study, our findings should be interpreted with caution. However, as generalized team efficacy/potency appears to be a promising new area for enhancing performance in project management, we recommend that future researchers adopt a longitudinal design to capture the dynamic nature of the generalized team efficacy construct.

VI. Conclusion and Contributions

Research in psychology and general management has demonstrated that the social-cognitive construct of self-efficacy is an enduring theoretical principle underpinned by rigorous research. However research into efficacy as a team-level construct is still in its infancy, and, to our knowledge, team efficacy has not been studied before in industrial project management research. Our study demonstrated the generalizability of team efficacy theory to the setting of capital project execution in the manufacturing sector. This research provides new theoretical insights for advancing our understanding of project performance from a social-cognitive perspective. We have demonstrated that cognitive-behavior theory is able to shed light into the "black box" of people management in project management research. Team efficacy is a relatively new construct that appears to have important performance implications for improving operational outcomes in capital projects executed in the process industries, and possibly for other types of teams in operations management.

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