Empowered Learning as a Control System*

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Abstract

Empowered learning is a management control system that consists of setting learning objectives and delegating autonomy to employees, allowing them to take control of their own active learning to achieve those learning objectives. This study explores the impact of adopting an empowered learning system on employee performance and the conditions enhancing its effectiveness. We exploit proprietary data from a service-providing organization that implemented an empowered learning system which empowers employees to actively reflect upon and learn from their prior performance. Our identification strategy relies on the staggered feature of the adoption of the system. We find that, on average, the system significantly boosts employee performance, with a 64.5% standard deviation increase in quarterly performance ratings among treated employees. The performance benefits unfold progressively, underscoring the system's long-term effect. We also find that the impact of empowered learning is amplified with audience effect but reduced with self-serving attributions. These findings offer key insights for researchers and guidance for practitioners on implementing empowered learning as a control system and investing in employee learning and development.

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1. INTRODUCTION

In an ever-changing business landscape, continuous learning and adaptation among employees have become critical to organizational growth and effectiveness (Arrow 1962; Cyert and March 1963; Garratt 1987; Senge 1990). Empowered learning as a management control that consists of (1) setting learning objectives and (2) delegating autonomy to employees so that employees can take control of their own active learning to achieve those learning objectives, has increasingly gained attention (Larman 2004; Garvin 1993; Garvin, Edmondson and Gino 2008). Despite the importance of learning mechanisms, the impact of empowered learning systems on employee performance remains understudied, presenting a significant gap in the literature. Furthermore, under what conditions does the empowered learning system work better or worse? This paper seeks to address the gap and explore these research questions.

Ex ante, the effect of empowered learning systems on employee performance is unclear. On one hand, learning process theory suggests that empowered learners need to go through a self-explanation process—an active process of gathering, analyzing, and integrating information on their individual past performance. Self-explanation process has been found to be effective in improving subsequent performance in a variety of contexts (Chi, De Leeuw, Chiu and LaVancher 1994; Ellis and Davidi 2005; Ellis, Carette, Anseel and Lievens 2014; Kale and Singh 2007). On the other hand, prior studies suggest that empowered learning may not necessarily improve learner effectiveness due to employee cognitive constraints (Levitt and March 1988). Behavior economic theories suggest that people do not always possess perfect knowledge about their own abilities and preferences and that such imperfect self-knowledge can lead to biased inferences and uninformed decisions (Benabou and Tirole 2000, 2003). In particular, unlike conventional instructor-led learning programs where organizations have control over what employees learn, when employees

take charge of their own learning, they may learn things that serve their personal interests (e.g., avoid responsibility and minimizing efforts) without enriching their own or their organization's knowledge base.

To address our research questions, we conduct an empirical study using proprietary data from a service-providing organization (SITE) that adopted an empowered learning system in 2020. Unlike conventional learning and development systems with designated instructors, coaches or/and platforms, the empowered learning system is designed to empower employees to take control of their own learning and self-development through actively reflecting upon and learning from their past performance. As part of the empowered learning process, SITE requires employees to deliver a presentation regarding their self-reflections and learning on a quarterly basis.

The research setting at SITE provides an ideal context to investigate our research questions for several reasons. First, as one of the top digitalization solution providers in China, SITE operates in a high-velocity business environment, which necessitates continuous learning and adaptation among its employees. The organization's adoption of an empowered learning system is thus reflective of its commitment to fostering continuous learning and improvement. The system's design, which includes performance self-reflections and presentations, further underscores its commitment to a proactive and reflective learning process. Second, the staggered rollout of the empowered learning system across different business divisions allows us to leverage a quasi-experimental research design. This design isolates the impact of the empowered learning system on employee performance by comparing the performance of employees exposed to the system (treated) with those not exposed (control) at the same point in time. Third, prior work exploring the relationship between various management control practices and employee learning mainly focuses on performance improvement as an outcome of learning (e.g., Campbell, Epstein and

Martinez-Jerez 2011; Casas-Arce, Lourenco and Martinez-Jerez 2017; Buell, Cai and Sandino 2022) while presents limited evidence on how employee learn and what they have learnt. This is because learning as an internal activity is difficult to be directly observed. We obtain hundreds of employee presentation decks from SITE, which provide us a unique opportunity to directly probe employees' internal learning processes. Furthermore, employees are given the entire discretion to decide the actual structure and content of their presentations. The variation in how employees recollect their performance and organize their learning allows us to examine under what conditions do employees learn more effectively.

Our empirical investigation yields several key findings. First, we find a positive and significant impact of adopting an empowered learning system on employee performance, with employees exposed to the system achieving, on average, a 64.5% standard deviation increase in their individual quarterly performance ratings. This finding underscores the effectiveness of empowered learning in enhancing employee performance.

Second, we find that the performance differentials between treated and control employees increase over time. Specifically, starting from the second quarter after the adoption of the empowered learning system, treated employees who conduct empowered learning begin to significantly outperform control employees who do not. The improvement rate accelerates from the sixth quarter after the system's adoption, yielding approximately a one standard deviation increase in employee quarterly performance. This finding suggests that empowered learning has positive long-term implications for employee performance, and the learning process unfolds progressively over time.

Third, our investigation of the moderating conditions reveals two important insights. We find that consistent with social facilitation theory, the positive impact of empowered learning on

employee performance is more pronounced in the presence of a larger audience (Markus 1978; Schmitt, Gilovich, Goore and Joseph 1986; Rajecki, Ickes, Corcoran and Lenerz 2010). Furthermore, we find that when there is a larger audience, employees are more likely to integrate knowledge and internalize their generated knowledge, which reflects the self-explanation process. However, when employees exhibit a higher degree of self-serving attributions, the beneficial effect of empowered learning on performance is diminished, highlighting the potential detrimental impact of cognitive biases on employee self-directed learning process (Benabou and Tirole 2003).

In addition to our primary analyses, we conduct several supplementary tests to explore potential alternative explanations for the observed improvements in employee performance. First, we examine objective performance ratings, utilizing detailed performance data encompassing specific performance targets and scores for each dimension. Our analysis consistently supports our main findings, indicating that enhanced performance is unlikely attributable to presentation skills. Second, we investigate feedback from supervisors, employing various measures of feedback characteristics. Our results indicate no significant differences in feedback characteristics between treated and control groups following the implementation of the empowered learning system, thus mitigating concerns regarding the influence of supervisor feedback. Additionally, we explore the possibility of knowledge spillover effect. Our findings suggest that the variation in knowledge shared by peers during presentations does not fully account for the observed improvements in performance. These supplementary analyses collectively support the robustness of our primary findings regarding the effectiveness of the empowered learning system.

We conduct a battery of robustness tests to corroborate our findings that adopting an empowered learning system has a positive effect on employee individual performance. First, we adopt the method proposed by Sun and Abraham (2021) to address potential bias associated with

standard difference-in-difference TWFE estimation when the treatment is introduced in a staggered fashion (Goodman-Bacon 2021; Baker, Larcker and Wang 2022). Our inferences remain robust with the Sun and Abraham's adjustment. Second, we employ coarsened exact matching to address potential concerns that employees who do and do not undertake empowered learning are inherently different by controlling for observable employee characteristics. Our results continue to indicate that adopting an empowered learning system has a positive impact on employee performance and the performance benefits unfold progressively, underscoring the system's long-term effect.

Our study contributes to the extant literature in two important ways. First, by examining the impact of an empowered learning system on employee performance, we contribute to the literature on management control systems in learning. Prior literature predominantly studies management control systems such as training platforms, coaching programs, and performance feedback systems that stress control by discouraging deviations from the desired behaviors and practices and allow little flexibility (Otley 1980; Simons 1995; Merchant and Van der Stede 2017). Our findings suggest that providing employees with flexibility in learning has positive performance implications. Moreover, such performance benefits unfold progressively, which highlights self-directed learning as a learning mechanism that can have a long-term impact on employee continuous learning and development.

Second, by investigating the conditions under which the impact of an empowered learning system on performance is moderated, we contribute to the literature on learning and performance. Specifically, our study underscores the importance of audience effect and the role of self-serving attributions in the learning process. This advances our understanding of the interplay between individual cognitive processes, social dynamics, and control systems in influencing organizational outcomes (Argote 2013; Levitt and March 1988; Nonaka 1994).

Our findings have several important implications. For researchers, they enrich our understanding of performance implications of adopting an empowered learning system and the moderating roles of audience presence and cognitive biases. For practitioners, they underscore the potential benefits of adopting an empowered learning system to enhance employee performance and highlight the need to foster a social environment and mitigate the potential biases in the learning process. The long-term performance benefits of the empowered learning system further underscore the value of investing in continuous learning and development. Collectively, these findings advance our understanding of empowered learning's role in management accounting and control and offer actionable insights for the design and implementation of effective learning systems.

The remainder of this paper proceeds as follows. Section 2 reviews prior literature and develops hypotheses. Section 3 describes our research setting and provides descriptive statistics of our sample and data. Section 4 tests our hypotheses and discusses the empirical results. Section 5 presents results from supplementary analyses. Section 6 concludes.

2. THEORY AND HYPOTHESIS DEVELOPMENT

2.1. Employee Learning

Employee continuous learning and development is considered one of the key factors to organizational growth and effectiveness (Arrow 1962; Cyert and March 1963; Garratt 1987; Senge 1990; Dodgson 1993). Management control systems play an instrumental role in facilitating employee learning (Kelly and Nuttall 2024). Existing studies have addressed a variety of management control systems in learning, including training and development programs (Merchant and Van der Stede 2017; Buell, Cai and Sandino 2022; Cardinaels, Choi and Ruan 2023) and

performance feedback systems (Casas-Arce, Lourenco and Martinez-Jerez 2017; Choi, Hecht, Tafkov and Towry 2020; Anderson and Kimball 2019).

While these control mechanisms are effective in managing employee learning, they vary in terms of levels of control and flexibility. For instance, training and development programs stress control and allow for limited flexibility as employees all learn the same program content and are discouraged to deviate from the principles, guidelines, and information provided by the designated instructors, coaches and platforms. Similarly, performance feedback systems also emphasize more on control and offer limited flexibility. By providing feedback to employees, employees receive guidance and information regarding what actions or results are desired and how the assigned tasks can be best performed. While high level of control reduces deviations from the desired behaviors and practices, it also deters exploration and leaves employees with fewer opportunities to learn. For example, Campbell et al. (2011) document that excessive monitoring imposes implicit incentives on employees to experiment less by deviating less often from explicit decision guidelines. Casas-Arce et al. (2017) examine the performance consequences of feedback frequency and detail and find that frequent feedback may introduce salience effect and hamper employee ability to learn. Cardinaels et al. (2023) demonstrate that in a lab experiment setting, allowing participants to choose three out of five learning modules to complete learning programs increases perceptions of autonomy and sparks curiosity, thereby reducing the propensity to use ineffective learning strategies.

2.2. Empowered Learning and Its Impact on Employee Performance

Organizations are increasingly adopting empowerment and encouraging employees to act proactively and self-sufficiently (Lawler, Mohrman and Benson 2001; Lee, Willis and Tian 2018).[1]

[1] Lawler, Mohrman and Benson (2001) provides evidence that more than 70% of organizations they surveyed have implemented some form of empowerment for at least some part of their workforce.

Empowerment provides employees with flexibility by granting them the authority, resources, and support to make decisions and act autonomously within their roles. In this paper, we focus on empowered learning as a control system, examine its impact on individual employees, and investigate the conditions under which it works better or worse.

The impact of adopting an empowered learning system on individual employee performance is unclear *ex ante*. On the one hand, empowered learners need to go through a self-explanation process—an active process of gathering, analyzing, and integrating information on their individual past performance. Learning process theories suggest that self-explanation promotes learning via comprehension (Chi 2000; Rittle-Johnson and Loehr 2017). Self-explanations are *generated by the learner*, rather than by an instructor. Thus, it aids comprehension by promoting knowledge integration and internalization. For instance, prior research has shown that systematic reflection where learners comprehensively analyze their behavior and evaluate the contribution of its components to performance outcomes is an effective tool for learning from both failed and successful experiences (Ellis and Davidi 2005; Ellis et al. 2014). Kale and Singh (2007) document that in the acquisition and alliance setting, alliance managers can improve future alliance success if their learning processes involve articulating and internalizing know-how from prior alliances. Ron, Lipshitz and Popper (2006) find that learners' interpretations of what went good and bad during the flights in their postflight reviews yield specific lessons for navigating future flights and they argue that learning through critical self-examination of one's own experience is the key to improvement.

On the other hand, behavioral economic theories suggest that unlike homo economicus, people may face uncertainties regarding their own abilities and preferences and the imperfect self-knowledge can lead to biased inferences and uninformed decisions (Benabou and Tirole 2003).

For instance, Benabou and Tirole (2000) demonstrate analytically that when an agent must decide whether to engage in a project of which the long-term payoff depends on the agent's unknown ability, the agent will forgo the project if he has insufficient confidence in his talent even if his actual ability reaches the required level. Farh and Dobbins (1989) document that employee self-appraisals are more biased when the ambiguity in performance dimensions is high. We argue that such imperfect self-knowledge is particularly relevant in self-directed learning process to the extent employees form misspecified belief and act upon it. This notion resonates with the extensive economic literature on misspecified learning emphasizing that when an agent has a misspecified mental model, his beliefs and the optimal actions may not necessarily converge and would act in a more biased manner than a sophisticated agent with correctly specified views (Nyarko 1991; Esponda and Pouzo 2016; Fudenberg, Romanyuk and Strack 2017; Heidhues, Koszegi and Strack 2023). Collectively, the fundamental insight from these studies is that empowered learning might bring unintended negative consequences, depending on whether employees can form correct inferences from their experiences.

Given the conflicting arguments described above, we postulate that the impact of an empowered learning system on employee performance may be either positive or negative. We therefore state our hypothesis in null form as follows:

H1: The empowered learning system has no effect on employee individual performance.

2.3. Conditions Moderating the Impact of Empowered Leaning on Employee Performance

Motivated by the theoretical tension built in the hypothesis development, we propose two potential moderators for the performance consequences of an empowered learning system: (1) audience effect, and (2) employee self-serving attributions.

2.3.1. Audience Effect

Social facilitation theory suggests that people increase their level of efforts or improve performance in the presence of others. For example, Triplett (1898) finds that cyclists' performance was improved when training as a group. Travis (1925) documents superior performance for subjects in a social situation with the presence of audience. Zajonc (1965) argues that the presence of others increases a person's generalized drive and thus influences his or her behavior through facilitating the tendency to emit dominant response for the task. While some theorists argue that the increased level of efforts or performance stems from a cognitive anticipation of being evaluated (Cottrell 1968, 1972; Geen 1981; Geen and Gange 1977), ample evidence has shown that the mere presence of audience, as opposed to the presence of a potentially evaluative audience, is a sufficient condition for the social facilitation of performance (e.g., Markus 1978; Schmitt, Gilovich, Goore and Joseph 1986).

Drawing on social facilitation theory, we conjecture that employees are prompted to articulate their thoughts more clearly and comprehensively when the audience effect is stronger. This process of explaining concepts to others not only reinforces their own understanding but also encourages them to explore different perspectives and find more effective ways to communicate information. As a result, the self-explanation process is heightened, leading to enhanced learning outcomes and a more robust knowledge base within the organization. Prior research has shown that employees with high learning goal orientation may perceive sharing their learning with others as a learning opportunity because it is unlikely for them to explain the knowledge in a clear and intelligible way unless they fully understand and internalize it themselves (Wang and Noe 2010; Zhu, Chiu and Infante Holguin-Veras 2018). To the extent that employees who share their knowledge with others feel uncertain about whether they are capable to communicate the knowledge in a way in which it will be well understood, they are more likely to deepen their own

understanding and find a better way to organize and explain the knowledge in the presence of a larger audience.

Taken together, we posit that an empowered learning system is more likely to have a positive impact on employee individual performance when audience effect is stronger. We state our hypothesis as follows:

H2a: The empowered learning system is more effective on employee individual performance when audience effect is stronger.

2.3.2. Employee Self-serving Behavior

Behavioral economic theories point out that in reality, agents possess limited attention, imperfect memory, and selective awareness (Benabou and Tirole 2002, 2003). Due to the imperfections in information processing, people's recollections of their past actions, behaviors and performance may be self-serving. The self-serving attribution effect refers to the tendency for individuals to attribute their favorable performances to dispositional factors (e.g., individuals are more likely to attribute their success to things like ability and effort) and their unfavorable performances to situational factors (e.g., individuals are more likely to attribute their failure to things like bad luck, task difficulty, demanding clients) (Heider 1958; Nisbett and Ross 1980; Mullen and Riordan 1988). A large number of studies have confirmed that people tend to attribute success to themselves and denying their responsibility for failure (e.g., Crary 1966; Miller and Ross 1975), recalling their successes more than their failures (e.g., Korner 1950; Mischel, Ebbesen, and Zeiss 1976), and considering themselves as instrumental for only good rather than bad outcomes (Bradley 1978; Zuckerman 1979). We argue that self-serving attributions may hamper employee learning to the extent that employees make inaccurate inferences and form incorrect beliefs from their biased recollections. For example, Ellis, Mendel and Nir (2006) find that the more learners attribute prior performance to external factors, the less they experience improvement

in their subsequent performance. Gervais and Odean (2001) demonstrate analytically that traders who experience self-serving attribution bias by taking too much credit for successes make overconfident trading decisions and incur losses in the long run.

In light of the arguments above, we posit that an empowered learning system is more likely to have a positive impact on employee individual performance when employees are less subject to self-serving bias. Our hypothesis is stated formally as follows:

H2b: The empowered learning system is less effective on employee individual performance when employees make more self-serving attributions.

3. RESEARCH SETTING, DATA AND MEASURES

We conduct our analyses using data from a service-providing organization in China that offers digitalization solutions (hereafter, SITE). As one of the top digitalization solution providers in China, SITE's business covers hundreds of major cities nationwide. Due to the nature of its services, SITE thrives on its continuously improving research and development capabilities and espouses organizational learning and iterative optimization as its core management philosophies. Figure 1 illustrates SITE's organizational structure. At the top, there are business divisions and within each business division, employees are segmented into different teams and oversaw by their supervisors.

[Insert Figure 1 Here]

3.1. Empowered Learning System

SITE considers employee-oriented value to be one of the foundations for its organizational long-term success. The top management perceives employees' active learning and internalization of work knowledge and experience to be pivotal for employee individual development and strives

to facilitate employees to realize greater self-advancement. In 2020, SITE implemented a major initiative by adopting an empowered learning system into its organizational learning process.

3.1.1. Learning Objective and Guiding Framework

SITE adopted the empowered learning system with the aim of facilitating continuous performance improvement for employees. Prior to its adoption, employees relied on feedback from supervisors to learn from past performance. With the introduction of the empowered learning system, employees are now empowered with autonomy to actively reflect on and learn from their previous performance. To this end, SITE developed a general framework for employee reflection and learning, consisting of four key sections: (1) briefing performance for the past quarter, (2) identifying successes and failures, (3) reflecting on identified successes and failures, and (4) discussing plans for improvement in the upcoming quarter. It is important to note that this framework serves only as a guide and that employees have complete discretion to structure and conduct their own learning. The final deliverable of employee empowered learning is a quarterly presentation to supervisors.

The guiding framework is formulated as follows. In the first section, employees are advised to give a brief rundown on their work in the quarter just ended and review the degree of target completion as compared to the pre-determined performance targets. For example, employees can provide a quantitative review (i.e., completion rate in percentages) or/and a qualitative description of their work done. In the second section, employees are suggested to discuss what are their successes and failures in the past quarter. For examples, employees can showcase their successes in connecting with new clients, improving skills or attaining personal developments. They can also discuss their failures, such as failing to cooperate effectively, make a thorough decision, or keep up with task schedules. In the third section, employees are advised to reflect on the identified

successes and failures. For example, employees can discuss their understandings of the root causes of those successes and failures or share their work knowledge acquired through specific events or projects. In the last section, employees are suggested to discuss plans for future improvements. For instance, they can put forward a trackable work plan for the upcoming quarter (e.g., concrete timeline for project milestones or key project deliverables) and provide suggestions for their own, for business units, or/and for the organization.

3.1.2. Autonomy and Employee Presentations

In addition to clarity in learning objectives, another crucial feature of empowered learning is high employee autonomy. Specifically, although there is a guiding framework for employee reflection and learning, employees have complete discretion over what they learn and how they learn. The variation in how employees structure and conduct learning is reflected in the variation in their quarterly presentations to supervisors.

The presentation decks are valuable in two folds. First, they allow us to directly probe employees' internal learning processes. Because learning as an internal activity is difficult to be directly observed, prior studies on employee learning have primarily focused on performance improvement as an outcome of learning while have presented limited evidence on employees' actual learning behaviors. Second, as employees possess high autonomy in deciding their own learning, they exhibit significant variation in their learning and presentation decks. The variation in those employee presentation decks allows us to examine the moderating role of various learning behaviors. As revealed by the presentation decks, some employees learn in a perfunctory manner without putting in genuine effort. For instance, here is the entire reflection and learning from one employee: "With the help of colleagues, I have gained an understanding of the company's business scope and a rough idea of the content of the materials within my scope of work. I am gradually

becoming familiar with the tasks at hand." The reflection is fairly straightforward and descriptive without delving deeper into the underlying complexities or engaging in critical analysis. In contrast, some employees conduct more insightful reflection and learning by providing specific examples of challenges faced, lessons learned, or personal growth experienced during the past quarter. For example, one employee wrote, "Event: [Project Name]. Failed to obtain project information after surveying archives. Reflection: 1. Lack of long-term investment in the industry: we only made initial visits without establishing long-term communication and interaction. This led to a lack of multi-perspective and timely information channels. 2. Insufficient communication skills: we did not adequately prepare information regarding customer, industry, and competitors and failed to create a dialogue environment where customers are willing to communicate." In addition to the variation in width and depth of employee reflection and learning, we also observe variation in use of visual representations such as figures, graphs and charts and a variety of linguistic features. Figure 2 provides examples of employee presentation decks and showcases the variation in employee presentation decks with respect to a variety of characteristics such as length, depth, and visual representations.

[Insert Figure 2 Here]

3.1.3. Adoption Timeline

The SITE adopted the empowered learning system in staggered stages. Given that the empowered learning system is an unconventional management control system, SITE made a strategic choice by limiting its adoption to headquarter employees in order to facilitate better monitoring of its implementation. The adoption occurred in different batches based on the business divisions they belong to. Interviews with SITE's top management team suggest that the timing to adopt the empowered learning system was primarily decided based on work capability of each

division. In the first quarter of 2020, tech division was the first business division that adopted the empowered learning system. Following tech division, in the second quarter of 2020, sales division and finance division adopted the empowered learning system. Finally, SITE rolled out the empowered learning system to strategy division and operating division in the first quarter of 2021. Figure 3 depicts the timeline of the adoption of the empowered learning system.

[Insert Figure 3 Here]

3.1.4. Presentation Audience

Employee presentations are delivered in two formats: one-to-one presentations and one-to-many presentations. In one-to-one presentations, employees deliver presentations exclusively to their supervisors, while in one-to-many presentations, the audience includes both supervisors and colleagues within the same team. Presentation format varies at the team level and is determined by one of SITE's senior executives. Interviews with SITE's top management team suggest that senior executives are not directly involved with day-to-day work with or supervision of employees. Therefore, the decision of whether a team conducts one-to-one presentations or one-to-many presentations is unlikely to be made based on employee performance or abilities. The variation in audience size enables us to examine the moderating role of audience effect in the relationship between empowered learning and employee performance.

3.2. Performance Evaluation Process

At SITE, each employee receives an individual performance rating on a quarterly basis. At the beginning of each fiscal year, human resource managers set annual performance targets and evaluation metrics for each performance dimension for employees. It is important to note that within each year, the performance targets and evaluation metrics remain constant. In addition, throughout the three-year sample period, we observe minimal variation in employee performance

metrics and targets. The thresholds for performance ratings primarily comprise of objective targets and at the end of each quarter, employees are assigned a performance rating based on their target achievement rate.[2] For most employees, their presentations do not affect their individual performance ratings. One exception is that for employees in planning and support team, one of their performance metrics involves subjectivity and takes employee self-reflection and learning during presentations into consideration. Fortunately, performance data we obtain is sufficiently granular for us to separate overall performance ratings into objective and subjective components.

The performance evaluation process unfolds in the following manner: At the end of each quarter, individual employee performance ratings are determined and supervisors communicate these ratings with the employees. With the introduction of the empowered learning system, performance ratings are first determined based on pre-established performance metrics without disclosing to employees. Employees perform self-reflection and learning and deliver presentations. Subsequent to the presentation, supervisors communicate performance ratings with employees. Figure 4 provides a visual representation of the timeline for the performance evaluation process, contrasting the pre- and post-implementation periods.

[Insert Figure 4]

3.3. Data and Descriptive Statistics

We obtained data on all employees with quarterly performance data from 2019-2021. The data includes employee's gender, education, tenure, position (i.e., what business unit they are in), and individual quarterly performance evaluation ratings. We also obtained employee presentation decks for employees who are required to conduct self-reflections. The final sample includes 144

[2] Employees who meet targets for every performance dimension earn 100 points.

unique employees across 48 unique teams and 964 observations at employee-quarter level in our sample period.

Table 1 presents the summary statistics. In our sample, approximately 25 percent of employees were exposed to the empowered learning system. The average employee receives a quarterly performance rating of 91.67. The average employee presentation deck contains 8.3 slides, 1505.4 words and 1.3 figures.

[Insert Table 1 here]

Table 2 reports the correlation matrix. We notice that employee individual quarterly performance is positively correlated with their tenure and being female. Individual performance is not significantly correlated with conducting one-to-many presentations, which corroborates the institutional feature that the decision of whether a team conducts one-to-one presentations or one-to-many presentations is unlikely to be made based on employee performance or abilities.

[Insert Table 2 here]

4. EMPIRICAL TESTS AND RESULTS

4.1. Empirical Methodology

Our identification strategy relies on the staggered adoption of the empowered learning system at the research site. The quasi-randomized feature allows us to compare employees who were exposed to the empowered learning system (i.e., Treated) with employees who were not exposed to the empowered learning system (i.e., Control) at the same point in time. Specifically, we estimate the following two-way fixed effects regression model to test for H1:

$$Performance_{it} = \beta_0 + \beta_1 Treated_{it} + \gamma_i + \lambda_t + \epsilon_{it} \quad (1)$$

The unit of analysis is at individual-quarter level for all employees in our final sample from 2019-2021. The dependent variable *Performance* is individual performance rating that each employee receives at the end of each quarter. Our main variable of interest is *Treated*, which is an indicator variable equal to 1 if an employee *I* was exposed to the empowered learning system to conduct self-reflections at time *t* and 0 for employees who are not exposed to the empowered learning system at time *t*. In addition, we include employee fixed effects to account for time-invariant individual employee heterogeneity, as well as quarter fixed effects to control for idiosyncratic events common to all employees at the same time. Our choice of fixed effect is fairly restrictive. These fixed effects allow us to 1) isolate the impact of any individual-specific attributes that could confound the results, such as innate abilities, work ethic, and baseline skill levels; 2) control for any time-varying factors that affect all employees similarly within the same time period. Such factors could include seasonal variations in business activity, changes in company policy, or external economic conditions. Standard errors are clustered at the employee level. If treated employees who are exposed to the empowered learning system, on average, perform significantly better than those are not exposed to the empowered learning system, as predicted in H1, we expect to observe a significantly positive coefficient on *Treated*.

To examine how the treatment effect evolves over time, we perform an event-study different-in-difference analysis and estimate the following regression model:

$$Performance_{it} = \beta_0 + \sum_{\tau=-K}^{-1} \beta_\tau DD_{it}^{\tau} + \sum_{\tau=1}^{L} \beta_\tau DD_{it}^{\tau} + \gamma_i + \lambda_t + \epsilon_{it} \quad (2)$$

The specification utilizes a set of relative-time indicators where the first summation captures the time periods leading up the treatment and the second summation captures the time periods following treatment. The relative-time indicator for the quarter prior to treatment (i.e., τ = 0) is excluded to avoid multicollinearity. The main variable of interest β_τ captures the difference

between the performance differentials between the treated and control observations τ quarters from treatment relative to the performance differentials between treated and untreated observations in the excluded quarter (i.e., the quarter before treatment). In particular, coefficients on the relative-time indicator for the periods following treatment allow us to examine the variation in employee learning rates.

To examine the cross-sectional differences in employee performance as hypothesized in H2a, we conduct subsample tests in which we estimate Equation (1) separately on subsamples based on whether employees deliver one-to-one presentations individually to their supervisors or one-to-many presentations where the audience consists of their supervisors as well as their colleagues in the same team. Specifically, one subsample consists of control employees and treated employees who deliver one-to-one presentations, while the other consists of control employees and treated employees who deliver one-to-many presentations. If consistent with H2a, we expect the coefficient on *Treated* for the subsample of employees who deliver one-to-many presentations to be significantly higher than that for the subsample of employees who deliver one-to-one presentations.

To examine the cross-sectional differences in employee performance as hypothesized in H2b, we measure the extent to which employees exhibit self-serving behavior while conducting self-reflections using variable *Self-serving*. We adopt the classification as in Mullen and Riordan (1988) and perform content analysis on the following dimensions of attribution: ability, effort, task difficulty, resources, and clients. We identify an employee to be self-serving if he or she attributes good performance to ability or/and efforts and attributes failures to task difficulty, lack of resources, and/or clients. We then conduct subsample tests where we estimate Equation (1) separately on each of the subsamples based on the partitioning variables *Self-serving*. For the subsample test, one

subsample consists of control employees and treated employees who are identified to be self-serving, while the other consists of control employees and treated employees who are identified to be not self-serving. If employee self-serving behavior constitutes a significant moderating condition, we expect the coefficient on *Treated* to be significantly different from each other in each subsample. In particular, we expect the coefficient on *Treated* for the not self-serving subsample to be significantly higher than the self-serving subsample.

4.2. Performance Consequences of Adopting an Empowered Learning System

Table 3 reports estimation results from Equation (1). In Column 1, we find a positive and significant coefficient on our main variable of interest *Treated* (coefficient = 2.967; $p < 0.01$). This suggests that on average, the adoption of empowered learning system has a positive impact on employee individual performance. In terms of economic magnitude, employees are exposed to the empowered learning system obtain, on average, 64.5 percent standard-deviation increase in individual quarterly performance rating. The results are qualitatively robust when controlling for employee past performance.[3] In columns 3 and 4, we include division fixed effect to control for time-invariant division-specific characteristics and we find consistent results.

[Insert Table 3 Here]

Table 4 reports the estimation results from Equation (2). Figure 5 illustrates the dynamic treatment effect of adopting the empowered learning system on employee performance and corroborates the empirical results in Table 4. The results suggest that the performance differentials between treated and control employees increase over time. Specifically, at the initial quarter of the adoption of the empowered learning system, performance does not exhibit significant differences between employees who are exposed to the empowered learning system and employees who are

[3] The TWFE controls for seasonality by having time fixed effect at the quarterly level.

not exposed to empowered learning. Starting from the second quarter after the adoption of the empowered learning system, their performance diverges so that treated employees who undertake empowered learning start to outperform significantly better than control employees who do not conduct empowered learning. The improvement rate accelerates starting from the sixth quarter after the adoption of the empowered learning system and yields on average, approximately one standard-deviation increase in employee quarterly performance. Collectively, our findings suggest that adopting an empowered learning system has a positive effect on employee performance and employees learn progressively over time.

[Insert Table 4 and Figure 5 Here]

4.3. Moderators of the Performance Consequences of Adopting an Empowered Learning System

We then test for the second set of hypotheses by exploring two conditions under which the empowered learning system is more effective on employee performance: (1) the audience effect is stronger (as stated in H2a), (2) employees make less self-serving attributions (as stated in H2b).

4.3.1. Audience Effect

Table 5 reports results of subsample test on audience effect. Columns 1 and 3 use the subsample of control employees and treated employees who deliver one-to-many presentations and Columns 2 and 4 use the subsample of control employees and treated employees who deliver one-to-one presentations. Consistent with H2a, we observe a significant and positive coefficient on *Treated* for the subsample where employees deliver one-to-many presentations (coefficient = 3.636; $p < 0.01$) and an insignificant coefficient on *Treated* for the subsample where employees

deliver one-to-one presentations. The coefficients on *Treated* for two subsamples are statistically different from each other at 0.1 significance level. [4]

[Insert Table 5 Here]

We further explore whether audience effect strengthens self-explanation by examining whether employees exhibit different learning patterns in one-to-many presentations compared to those deliver one-to-one presentations. Learning process theory suggests that self-explanation promotes learning by aiding knowledge integration and internalization. [5] Drawing on learning process theory, we perform content analysis on employee presentations and estimate the following logit regression model among treated employees.

$$f(Knowledge\ Integration) = \beta_0 + \beta_1 One\ to\ Many_{it} + Perf_{it} + Past\ Perf_{it} + \lambda_t + \epsilon_{it} \quad (3)$$

$$f(Internalization) = \beta_0 + \beta_1 One\ to\ Many_{it} + Perf_{it} + Past\ Perf_{it} + \lambda_t + \epsilon_{it} \quad (4)$$

We follow Chi (2000) and identify an employee as integrating knowledge if (1) he or she links performance in the current quarter with prior performance or experiences, or/and (2) if new information conflicts with prior knowledge, he or she can notice the conflict and attempt to resolve it. We identify an employee as internalizing knowledge if he or she improves accordingly based on his or her learning from prior quarter. [6] We find that employees in one-to-many presentation group are more likely to generate knowledge by integrating their performance in the current quarter with past experiences compared to those employees in the one-to-one presentation group

[4] One may argue that the more pronounced effect in a one-to-many setting could be driven by employees' inclination to present a more favorable image of themselves. This is unlikely to be a major concern because performance ratings are primarily objective. On top of that, employees are more likely to depict a better self in a one-to-one setting because the audience cost in a one-to-many setting is higher. Moreover, if the result is driven by the more favorable self-image, then we should not observe a more pronounced effect when employees exhibit less self-serving attributions.

[5] When individuals engage in self-explanation process, they integrate pieces of new information together or integrate new information with prior knowledge (Chi 2000; Lombrozo 2006). Internalization refers to the process in which individuals transform their declarative knowledge into actionable procedural knowledge (Wipawayangkool and Teng 2016).

[6] Knowledge integration and internalization were coded independently and cross-validated by one research assistant and one of the authors.

(coefficient = 11.445; $p < 0.01$). Furthermore, they are more likely to internalize the generated knowledge into their performance in the upcoming quarter relative to employees in the one-to-one presentation group (coefficient = 21.027; $p < 0.01$).[7] Taken together, our findings suggest that empowered learning system facilitates employee learning by fostering a self-explanation process and the audience effect strengthen such self-explanation process.

[Insert Table 6 Here]

4.3.2. Employee Self-serving Attributions

Table 7 reports results of subsample test on employee self-serving attributions. Columns 1 and 3 use the subsample of control employees and treated employees who do not exhibit self-serving attributions and Columns 2 and 4 use the subsample of control employees and treated employees who exhibit self-serving attributions. The coefficient on Treated is significantly positive for both the not self-serving subsample (coefficient = 3.641; $p < 0.01$) and the self-serving subsample (coefficient = 1.916; $p < 0.05$). The coefficients on Treated for two subsamples are statistically different from each other. Our findings are consistent with the notion that self-serving bias in information processing may hinder employee learning as employees are not able to make correct inferences and unbiased decisions based on a misspecified mental model (Benabou and Tirole 2003).

[Insert Table 7 Here]

5. ADDITIONAL TESTS AND ROBUSTNESS TESTS

In this section, we conduct a battery of tests to strengthen our findings regarding the effect of adopting the empowered learning system on employee performance.

[7] Chen et al. (2024) find that failure disclosure boosts employee exploration performance. In untabulated test, we find that employees in the presence of a larger audience are more likely to discuss their failures.

5.1. Additional Tests

5.1.1. Objective Performance Ratings

One possible alternative explanation is that the improvement in employee performance ratings is not a result of employee learning but rather a reflection of employee bettered presentation skills. This is unlikely to be a major concern in our tests because at SITE, employee performance evaluation primarily comprises of objective performance targets and the ratings are given based on the target completion rates. One exception is that for employees in planning and support team, their performance metrics involve subjectivity and takes employee presentations into consideration.

We obtain performance dimensional level data, which includes description of performance targets for each performance dimension, proportional score designated to each dimension, and the actual score obtained by employees for each performance dimension. The granularity of the performance data allows us to categorize performance ratings into objective performance ratings and subjective performance ratings based on descriptions of each performance dimension. We then estimation Equation (1) using objective performance ratings as dependent variable. Table 8 reports the results. We find that the results with objective performance ratings as dependent variable is consistent with our main findings (coefficient = 2.873; $p < 0.01$), suggesting that employee improved performance is unlikely to be driven by bettered presentation skills.

[Insert Table 8 Here]

5.1.2. Feedback from Supervisors

Alternatively, one may argue that employee presentations reduce information asymmetry between employees and supervisors so that supervisors can provide more informed feedback to employees, which explains the improvement in employee performance. To explore this alternative explanation, we examine whether feedback from supervisors systematically changes after the

introduction of the empowered learning system. We estimate the following regression model to test this alternative explanation:

$$Feedback\ Characteristics_{it} = \beta_0 + \beta_1 Treated_{it} + \gamma_i + \lambda_t + \epsilon_{it} \quad (5)$$

We look at several feedback characteristics and measure the dependent variable *Feedback Characteristic* using either one of the four measures: *Feedback Length*, *Positive Feedback*, *Negative Feedback*, and *Evaluative Feedback*. Specifically, *Feedback Length* measures the number of words in feedback from supervisors. *Positive Feedback* and *Negative Feedback* are indicator variables equal to 1 if feedback from supervisors expresses a positive or negative judgement, respectively. *Evaluative Feedback* is an indicator variable equal to 1 if feedback from supervisors focuses on assessing employee performance against pre-determined performance standards and targets and equal to 0 if feedback from supervisors focuses on supporting the growth and developmental of employees' skills, abilities or performance.

Table 9 reports the results. We find that there is no systematic difference in feedback from supervisors with respect to a variety of feedback characteristics between treated and control groups subsequent to the introduction of the empowered learning system. We believe that these results alleviate the concern that the positive effect of the empowered learning system is driven by the more informed feedback given by supervisors.

[Insert Table 9 Here]

5.1.3. Spillover Effect

The more pronounced effect for one-to-many presentations could be explained by spillover effect in the sense that employees may learn from peers' presentations. If the spillover effect is the driving force behind the result, we expect to observe a stronger impact on employees who are exposed to greater knowledge sharing within the group of employees delivering one-to-many

presentations. We explore this alternative explanation by exploring the variation in peers' presentation decks. Specifically, we use the length of peers' presentation decks to proxy for the knowledge shared by peers during one-to-many presentations. Table 10 reports the results. Columns 1 and 3 use the subsample of control employees and treated employees who deliver one-to-many presentations and the total length of peers' presentations is below median. Columns 2 and 4 use the subsample comprising control employees and treated employees who deliver one-to-many presentations and the total length of peers' presentations is above median. We compare the coefficients on *Treated* for two subsamples to examine the spillover effect. The coefficients on *Treated* for two subsamples are not statistically different from each other, which suggest that the variation in total knowledge shared by peers during one-to-many presentations does not explain the observed more pronounced result on one-to-many presentations.

[Insert Table 10 Here]

5.2. Robustness Tests

5.2.1. Addressing Potential Biases in Staggered Difference-in-Differences Estimator

Recent development in econometric theory suggests that standard difference-in-difference TWFE estimation may introduce potential bias which arises from using earlier treated employees as controls for later treated employees, especially when the impact of adopting the empowered learning system on employee individual performance evolves over time (Goodman-Bacon 2021; Baker, Larcker and Wang 2022). To address this concern, we adopt the method proposed by Sun and Abraham (2021) and present the results generated by the adjusted estimator that are robust to treatment effect heterogeneity in Table 11. Overall, we find the effect of adopting an empowered learning system on employee performance estimated by Sun and Abraham's estimator to be fairly consistent with our earlier estimation in terms of both pattern and economic magnitude.

[Insert Table 11 Here]

5.2.2. Coarsened Exact Matching Analysis

We conduct additional robustness tests to address potential concerns that employees who do and do not undertake empowered learning are inherently different by controlling for observable employee characteristics. Specifically, we employ coarsened exact matching between the treated and control employees based on their gender, education, and tenure and re-estimate Equation (1) and Equation (2) with balanced sample. Table 12 reports the corresponding results. Note that the balanced sample has a smaller sample size than unbalanced sample because CEM automatically restricts the matched sample by requiring common empirical support (Blackwell, Iacus, King and Porro 2010). Panel A presents the regression results of Equation (1). We observe a significant coefficient on *Treated* with the balanced sample (coefficient = 2.612; $p < 0.05$), which is comparable to that of main test in terms of economic magnitude. Panel B presents the event-study estimation results with balanced sample. We observe that starting from the fourth quarter after the adoption of the empowered learning system, treated employees who undertake empowered learning start to outperform significantly better than control employees who are not exposed to the empowered learning system. Furthermore, the divergence in performance between treated and control employees enlarge over time, which is also consistent with our main findings. Overall, these results add further credence to our findings that adopting an empowered learning system has a positive impact on employee performance and the performance benefits unfold progressively, underscoring the system's long-term effect.

[Insert Table 12 Here]

6. CONCLUSION

Given nowadays ever-changing business landscape, continuous learning and adaptation among employee have become increasingly important to organizational growth and effectiveness. This study contributes by examining the impact of adopting an empowered learning system on employee individual performance. Using proprietary data from a service-providing organization, we document the employee-level performance consequences of adopting an empowered learning system and under what conditions the empowered learning system is more effective.

Our study generates several important insights. First, we find that adopting an empowered learning system has a positive impact on employee performance. Second, we document that the performance benefits of undertaking empowered learning unfold progressively, underscoring the system's long-term effect. In addition, our findings suggest that the performance implications are amplified with audience effect but reduced with self-serving attributions. Moreover, we find that when there is a larger audience, employees are more likely to engage in knowledge integration and internalize their generated knowledge. These results provide important managerial implications on the design of empowered learning system such as creating social environment among employees and exerting proper control to minimize employee cognitive constraints.

Whereas we believe that our findings are generalizable to a broad class of organizations that operate in a high-velocity business environment, which necessitates employee continuous learning and development, we also acknowledge that our study is subject to the usual caveats for studies that rely on archival field data from a single organization. While this is an inherent limitation of this study, the methodology is the best suited to directly examine employee internal learning process, a topic that is of interest to academics and practitioners alike.

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APPENDIX A: Variable Definitions

Variable	Definition
Employee Performance	Employee's quarterly performance rating
Treat	An indicator variable equal to 1 if an employee was selected into the employee empowered learning system to conduct self-reflection and 0 otherwise
Tenure	Employee's tenure
Female	An indicator variable equal to 1 if an employee is female and 0 otherwise
Education	A categorical variable capturing an employee's education level (=1 if high-school degree; = 2 if college degree; = 3 if bachelor's degree; = 4 if master's degree or higher)
Past Performance	Employee's last quarter's quarterly performance rating in last quarter
One-to-Many Presentation	Indicator variable equal to 1 if an employee delivers one-to-many presentation where the audience consists of supervisors and colleagues in the same team, and 0 if an employee delivers one-to-one presentation only supervisors.
Self-serving	Indicator variable equal to 1 if an employee attributes good performance to ability and efforts and attributes failures to task difficulty, lack of resources, and clients.
Knowledge Integration	Indicator variable equal to 1 if an employee integrates his or her performance in the current quarter with past experiences.
Internalization	Indicator variable equal to 1 if an employee incorporates the previously generated knowledge into current performance
Feedback Length	The total number of words in feedback from supervisors.
Positive Feedback	An indicator variable equal to 1 if feedback from supervisors expresses a positive judgement.
Negative Feedback	An indicator variable equal to 1 if feedback from supervisors expresses a negative judgement.
Evaluative Feedback	An indicator variable equal to 1 if feedback from supervisors focuses on assessing employee performance against pre-determined performance standards and targets and equal to 0 if feedback from supervisors focuses on supporting the growth and developmental of employees' skills, abilities or performance.
Knowledge from Peers	The total number of words in peers' presentation decks.

APPENDIX B: Example Employee Presentations (Excerpts) on Self-serving Attributions

Self-Serving Example 1
Event: Handling invoices and deposits Reflection: 1. From sales [team's] point of view, they think this task belongs to commerce [team]. [They think] maintaining customer relationships is a very difficult task – the commerce [team] has not only failed to back them up, but also increased their workload. My team [serves as] the commerce interface for sales [team], which leads [the sales team] to misinterpret the nature of my tea''s work and create unnecessary conflicts; 2. From my personal point of view, [this task] is not my job responsibility. However, they expect me to connect sales [team] and finance [team]. For the conflicts in communication [process], I feel helpless.

Self-Serving Example 2
Event: Bid opening for the procurement project {} Reflection: First, for [this] cooperative project, {} should be responsible for controlling the timeline for each stage of the project. Second, {} should have informed [me] in advance for any special requirements. Lastly, I must inform {} that I only have the obligation to assist and do not have the responsibility for execution.

Not Self-Serving Example 1
Event: Project {} Reflection: Due to my overconfidence when preparing bidding document for project {}, I made mistakes that were empiricist in nature, which ultimately resulted in losing the bid.

Not Self-Serving Example 2
Event: Project {} Reflection: 1. [I] failed to realize the unchangeable nature of business terms and failed to emphasize it with outsourcing contractors in the early stage; 2. Due to various reasons, I executed [the project] with negative mindsets; 3. I did not conduct sufficient research on outsourcing contractors because I was eager to facilitate [the agreement on] outsourcing and was overdependent on market recommendations.

FIGURE 1: SITE's Organizational Structure

Figure 1 illustrates SITE's organizational structure. At the top, there are business divisions that are oversaw by senior partners. Within each business division, employees are segmented into different teams and oversaw by their supervisors.

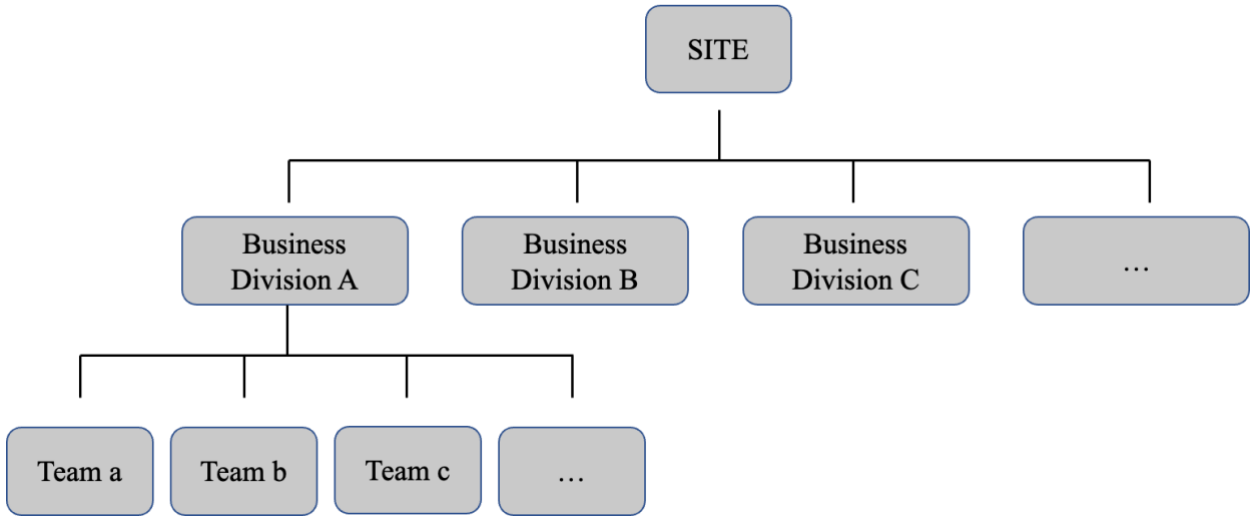
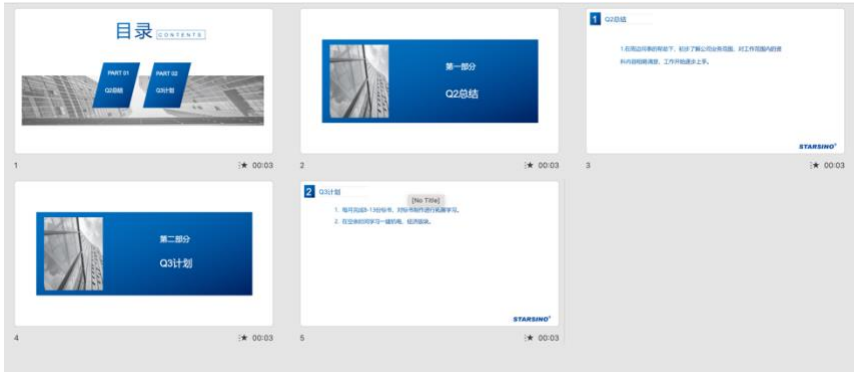
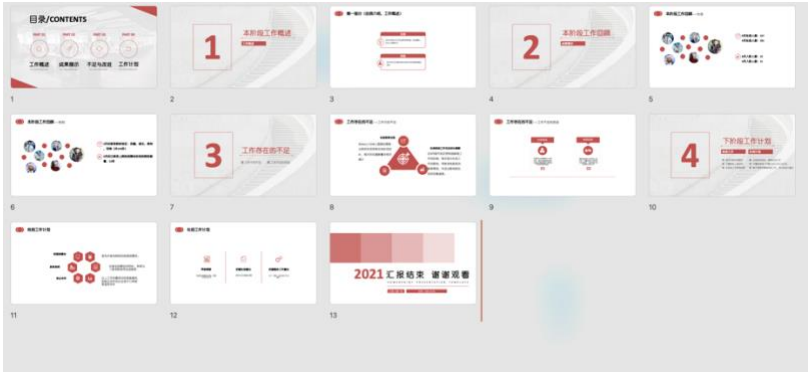


FIGURE 2: Examples of Employee Presentation Decks

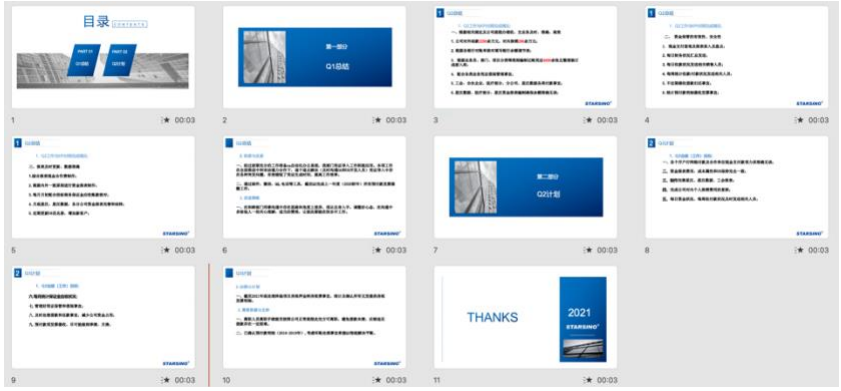
Figure 2 provides examples of employee presentation decks and showcases the variation with respect to a variety of characteristics such as length, depth, and visual representations. The four presentations are all from the same quarter. Presentation (a) is an example of perfunctory presentations. It is short in terms of length and the analysis lacks substance. Presentation (b) serves as an example of presentations with great emphasis on visual representations. Presentation (c) is an example of presentations conveyed through words. Presentation (d) serves as an example of presentations using both words and visual representations.



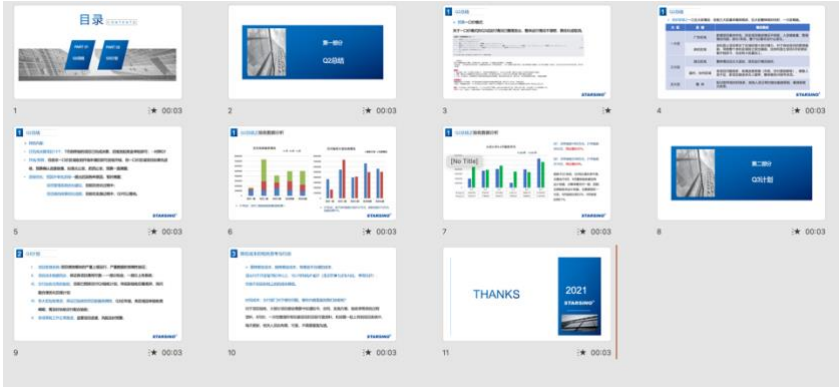
(a)



(b)



(c)



(d)

FIGURE 3: Timeline of Implementation of Empowered Learning System

Figure 3 illustrates the timeline of the empowered learning system implementation and business division(s) that started to adopt the system in each quarter. In the first quarter of 2020, tech division was the first division that adopted the empowered learning system. Following that, in the second quarter of 2020, sales division and finance division adopted the empowered learning system. Finally, SITE rolled out the empowered learning system to strategy division and operating division in the first quarter of 2021.

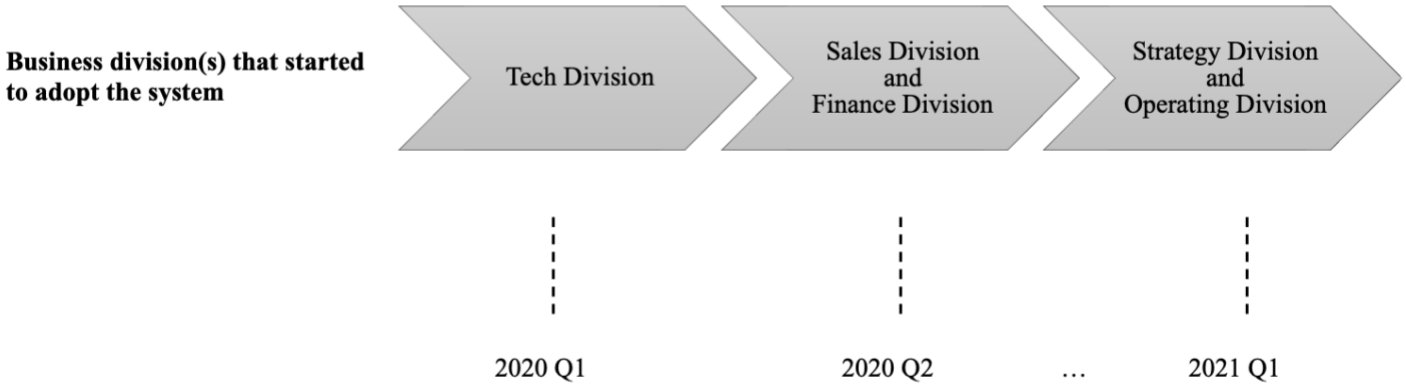


FIGURE 4: Timeline of Performance Evaluation Process in the Pre- and Post-Implementation Periods

Figure 4 depicts the timeline for the performance evaluation process, contrasting the pre- and post-implementation periods.

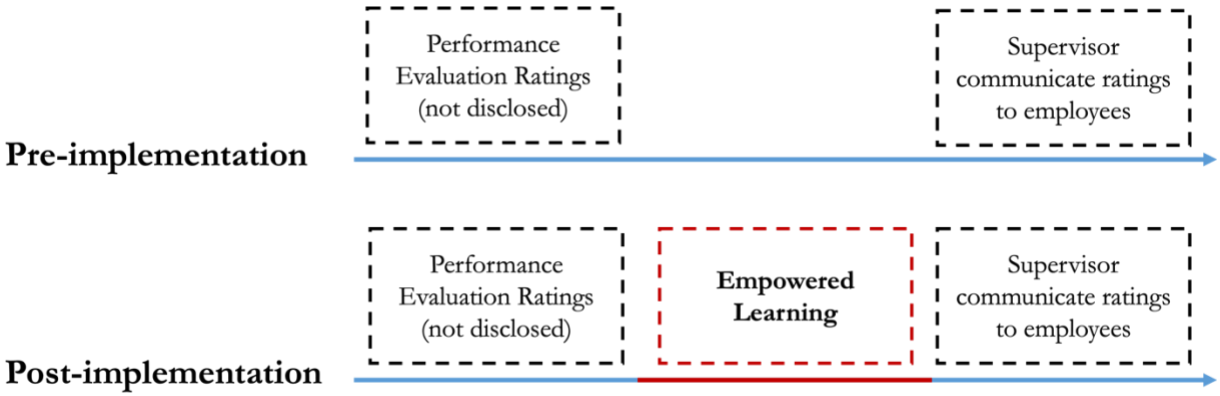


FIGURE 5: Event-Study Estimates of Adopting Empowered Learning System on Employee Performance

Figure 5 plots event-study estimates from Equation (2). The quarter prior to adoption of the empowered learning system serves as the baseline group and is omitted to avoid multicollinearity. Shaded areas represents conference intervals at different significance levels.

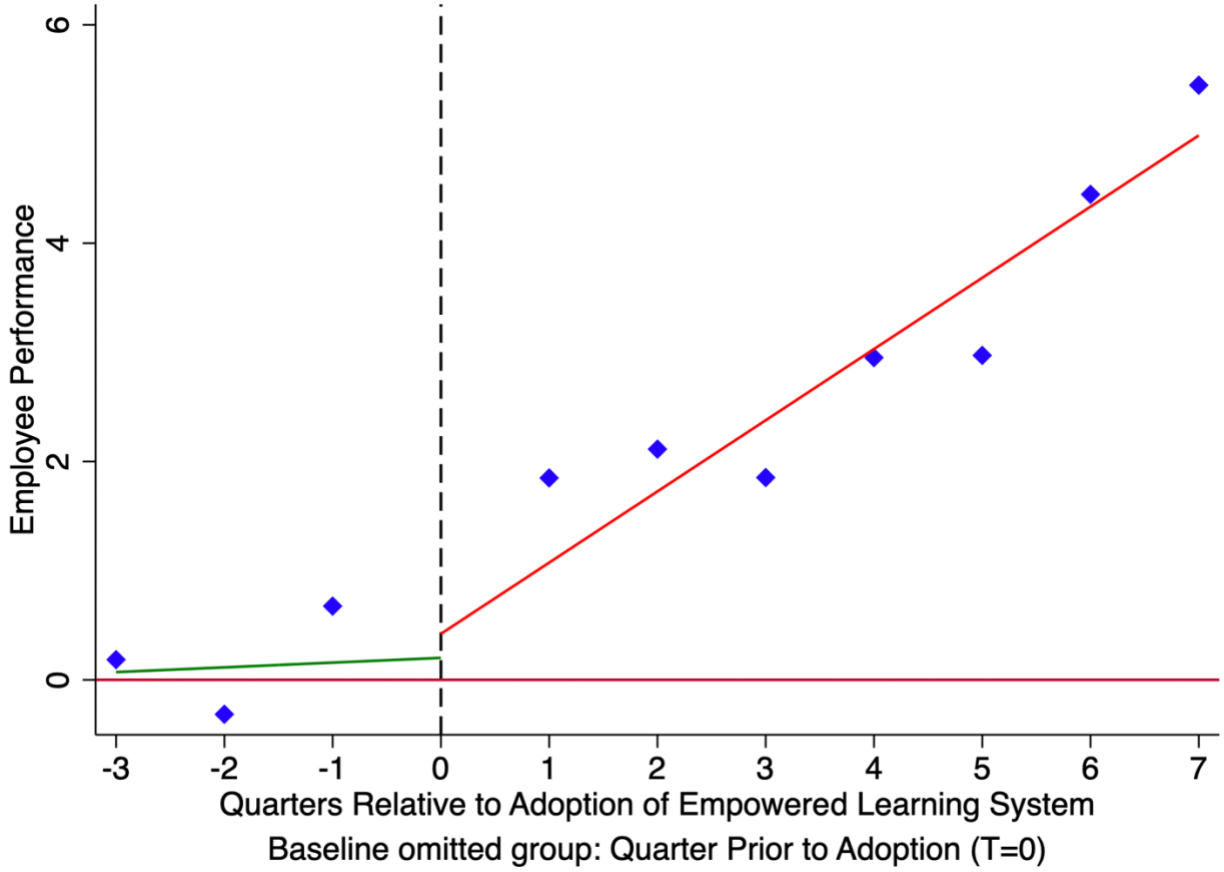


TABLE 1: Summary Statistics

Table 1 presents sample descriptive statistics. All variables are defined in Appendix A

	N	Mean	Sd	P25	P50	P75
Performance	964	91.67	4.6	80	89	91
Treat	964	0.33	0.47	0	0	0
Female	964	0.38	0.49	0	0	0
Education	964	2.51	0.62	1	2	3
Tenure	964	3.46	3.23	0.19	1.21	2.37
One-to-Many Presentation	962	0.57	0.5	0	0	1
Knowledge Integration	168	0.62	0.49	0	0	1
Internalization	141	0.72	0.45	0	0	1
Self-serving	172	0.34	0.48	0	0	0

TABLE 2: Correlation

Table 2 reports the correlation matrix for the variables defined in Appendix A. *, **, and *** denote significance at the 0.10, 0.05, and 0.01 level, respectively.

	(1)	(2)	(3)	(4)	(5)
Performance (1)	1.00				
Treat (2)	0.05	1.00			
Female (3)	0.08*	0.32***	1.00		
Education (4)	-0.01	0.16***	0.13***	1.00	
Tenure (5)	0.14***	0.15***	0.09**	0.04	1.00

TABLE 3: The Effect of Adopting Empowered Learning System on Employee Performance

Table 3 reports regression results of estimating Equation (1). The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
Treated	2.967***	2.140***	2.796***	2.003***
	(3.34)	(2.98)	(3.40)	(3.01)
Past Performance		0.241***		0.233***
		(4.86)		(4.76)
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Division Fixed Effect	No	No	Yes	Yes
Adjusted R-squared	0.347	0.416	0.352	0.419
Observations	964	779	962	779

TABLE 4: Event-Study Estimates of Adopting Empowered Learning System on Employee Performance

Table 4 reports regression results of estimating Equation (2). The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
Quarter 3 Pre-Adoption	-2.756**	-1.114	-2.642**	-1.072
	(-2.08)	(-1.06)	(-1.98)	(-1.03)
Quarter 2 Pre-Adoption	-0.704	-0.443	-0.408	-0.487
	(-0.75)	(-0.44)	(-0.44)	(-0.48)
Quarter 1 Pre-Adoption	-0.747	0.158	-0.806	0.135
	(-0.93)	(0.16)	(-0.98)	(0.14)
Quarter 1 Post-Adoption	1.807*	1.466	1.757*	1.495
	(1.82)	(1.30)	(1.77)	(1.32)
Quarter 2 Post-Adoption	2.631**	2.312*	2.581**	2.390*
	(2.06)	(1.84)	(2.02)	(1.89)
Quarter 3 Post-Adoption	1.746	1.502	1.726	1.594
	(1.55)	(1.42)	(1.51)	(1.48)
Quarter 4 Post-Adoption	2.340*	2.238**	2.318*	2.228**
	(1.94)	(1.99)	(1.94)	(1.99)
Quarter 5 Post-Adoption	2.256	2.652*	2.238	2.622*
	(1.60)	(1.94)	(1.59)	(1.92)
Quarter 6 Post-Adoption	3.908**	4.462***	3.873**	4.401***
	(2.60)	(3.31)	(2.56)	(3.23)
Quarter 7 Post-Adoption	4.705***	4.547***	4.657***	4.492***
	(3.23)	(3.03)	(3.18)	(2.99)
Past Performance		0.202***		0.193***
		(4.47)		(4.09)
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Division Fixed Effect	No	No	Yes	Yes
Adjusted R-squared	0.380	0.454	0.385	0.456
Observations	933	764	929	763

TABLE 5: Subsample Test on Audience Effect

Table 5 reports regression results of subsample tests on audience effect. The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. We also test the difference in the coefficients on *Treated* between subsamples and report the p-values. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
	One-to-Many Presentation	*One-to-One Presentation*	*One-to-Many Presentation*	*One-to-One Presentation*
Treated	3.630***	0.680	2.561***	0.690
	(3.60)	(0.46)	(3.16)	(0.45)
Past Performance			0.267***	0.193***
			(5.61)	(3.60)
p-value for difference in *Treated*	0.070*		0.241	
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Adjusted R-squared	0.353	0.327	0.428	0.353
Observations	900	713	721	567

TABLE 6: Audience Effect on Employee Self-Explanation Learning Process

Table 6 reports regression results of Equations (3) and (4). The dependent variables are *Knowledge Integration* and *Internalization*. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Knowledge Integration**		**Internalization**	
	(1)	(2)	(3)	(4)
One-to-Many Presentation	11.445***	11.472***	21.027***	21.389***
	(7.49)	(7.71)	(9.81)	(9.05)
Performance	-0.270	-0.269	0.021	-0.020
	(-2.51)	(-2.43)	(0.15)	(-0.14)
Past Performance	0.065	0.068	-0.121	-0.180
	(0.71)	(0.75)	(-0.88)	(-1.02)
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Division Fixed Effect	No	Yes	No	Yes
Pseudo R^2	0.302	0.305	0.413	0.433
Observations	117	117	82	82

TABLE 7: Subsample Test on Self-Serving Attributions

Table 7 reports regression results of subsample tests on employee self-serving attributions. The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. We also test the difference in the coefficients on *Treated* between subsamples and report the p-values. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
	Not Self-Serving	*Self-Serving*	*Not Self-Serving*	*Self-Serving*
Treated	3.641***	1.916**	2.771***	1.161*
	(3.41)	(2.37)	(3.25)	(1.75)
Past Performance			0.255***	0.215***
			(5.15)	(4.79)
p-value for difference in *Treated*	0.086*		0.038**	
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Adjusted R-squared	0.353	0.298	0.425	0.339
Observations	904	849	720	673

TABLE 8: Additional Test - Objective Evaluation Ratings

Table 8 reports results of estimating Equation (1). The dependent variable is *Individual Objective Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Objective Performance**			
	(1)	(2)	(3)	(4)
Treated	2.873***	2.165***	2.696***	2.021***
	(3.20)	(2.98)	(3.25)	(3.00)
Past Performance		0.239***		0.231***
		(4.78)		(4.70)
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Division Fixed Effect	No	No	Yes	Yes
Adjusted R-squared	0.360	0.422	0.364	0.424
Observations	962	778	960	778

TABLE 9: Additional Test - Feedback from Supervisors

Table 9 reports results of estimating Equation (5). All regressions include employee individual fixed effects and year fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Feedback Length**		**Positive Feedback**		**Negative Feedback**		**Evaluative Feedback**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	19.882	23.129	0.000	0.009	0.176	0.182	0.000	0.002
	(1.05)	(0.87)	(0.00)	(0.24)	(0.57)	(0.57)	(0.00)	(0.01)
Past Performance		9.199		0.024		0.016		0.005
		(1.47)		(0.78)		(1.08)		(0.32)
Employee Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-squared	0.149	0.255	0.251	0.247	0.478	0.326	0.283	0.343
Observations	58	48	58	48	58	48	58	48

TABLE 10: Additional Test – Knowledge Spillover

Table 10 reports regression results of subsample tests on knowledge shared by peers. The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
	Below Median	*Above Median*	*Below Median*	*Above Median*
Treated	4.093***	3.197***	3.470***	2.331***
	(2.68)	(3.86)	(2.76)	(2.83)
Past Performance			0.269***	0.244***
			(5.85)	(5.01)
p-value for difference in *Treated*	0.400		0.253	
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Adjusted R-squared	0.339	0.318	0.415	0.370
Observations	833	824	656	649

TABLE 11: Robustness Test - Event-Study Estimates with SA Estimator

Table 11 reports the results of tests estimating the effect of adopting the empowered learning system on employee performance using the modified difference-in-differences estimator proposed by Sun and Abraham (2021). The coefficients on past performance are not explicitly reported because the *eventstudyinteract* package written by Sun and Abraham (2021) does not automatically report the coefficients on control variables. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
Quarter 3 Pre-Adoption	-2.412**	-1.172	-2.428**	-1.150
	(-2.25)	(-1.04)	(-2.28)	(-1.03)
Quarter 2 Pre-Adoption	-0.455	-1.033	-0.346	-1.101
	(-0.44)	(-0.77)	(-0.33)	(-0.82)
Quarter 1 Pre-Adoption	0.085	0.327	-0.009	0.224
	(0.10)	(0.31)	(-0.01)	(0.20)
Quarter 1 Post-Adoption	2.391**	1.355	2.206**	1.283
	(2.07)	(0.99)	(1.98)	(0.96)
Quarter 2 Post-Adoption	3.213**	2.246*	3.051**	2.249*
	(2.45)	(1.74)	(2.39)	(1.77)
Quarter 3 Post-Adoption	2.185*	1.313	2.023*	1.331
	(1.83)	(1.14)	(1.74)	(1.18)
Quarter 4 Post-Adoption	2.932**	2.442*	2.628*	2.221*
	(2.07)	(1.80)	(1.90)	(1.67)
Quarter 5 Post-Adoption	1.981	1.585	1.728	1.368
	(1.50)	(1.11)	(1.30)	(0.95)
Quarter 6 Post-Adoption	3.181**	3.030*	2.911*	2.804*
	(2.13)	(1.87)	(1.90)	(1.70)
Quarter 7 Post-Adoption	4.212***	3.369*	3.925**	3.152*
	(2.71)	(1.78)	(2.49)	(1.66)
Control Past Performance	No	Yes	No	Yes
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Division Fixed Effect	No	No	Yes	Yes
Adjusted R-squared	0.355	0.414	0.357	0.414
Observations	964	779	960	778

TABLE 12: Robustness Test - Coarsened Exact Matching Analysis

Panel A: TWFE Estimation

Table 12 Panel A reports the results of estimating Equation (1) with balanced sample after coarsened exact matching. The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
Treated	2.612**	2.067**	2.497**	2.090**
	(2.13)	(2.13)	(2.08)	(2.25)
Past Performance		0.223***		0.226***
		(3.47)		(3.45)
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Team Fixed Effect	No	No	Yes	Yes
Adjusted R-squared	0.346	0.432	0.346	0.430
Observations	785	624	781	623

Panel B: Event-Study Estimation

Table 12 Panel B reports the results of estimating Equation (2) with balanced sample after coarsened exact matching. The dependent variable is *Individual Performance*. All regressions include employee individual fixed effects and quarter fixed effects. Corresponding t-stats are reported in parentheses. *, **, *** corresponds to two tailed p-values < 0.10, 0.05, and 0.01, respectively. All variables are defined in Appendix A.

Dependent Variable:	**Individual Performance**			
	(1)	(2)	(3)	(4)
Quarter 3 Pre-Adoption	-2.373	0.185	-2.413	-0.011
	(-1.22)	(0.12)	(-1.27)	(-0.01)
Quarter 2 Pre-Adoption	-0.492	-0.316	-0.449	-0.445
	(-0.41)	(-0.25)	(-0.38)	(-0.36)
Quarter 1 Pre-Adoption	-0.886	0.676	-0.945	0.777
	(-0.85)	(0.52)	(-0.93)	(0.61)
Quarter 1 Post-Adoption	1.541	1.849	1.600	1.946
	(1.28)	(1.42)	(1.33)	(1.50)
Quarter 2 Post-Adoption	1.820	2.113	1.892	2.238
	(1.20)	(1.46)	(1.24)	(1.54)
Quarter 3 Post-Adoption	1.291	1.853	1.381	2.008
	(0.98)	(1.46)	(1.05)	(1.58)
Quarter 4 Post-Adoption	2.238	2.951**	2.515	3.311**
	(1.46)	(2.12)	(1.62)	(2.36)
Quarter 5 Post-Adoption	1.579	2.972*	1.898	3.383**
	(0.96)	(1.84)	(1.13)	(2.08)
Quarter 6 Post-Adoption	2.901*	4.447***	3.306*	4.944***
	(1.74)	(2.87)	(1.94)	(3.15)
Quarter 7 Post-Adoption	4.088**	5.447***	4.505**	5.994***
	(2.11)	(2.82)	(2.27)	(3.08)
Past Performance		0.188***		0.174***
		(2.86)		(2.74)
Employee Fixed Effect	Yes	Yes	Yes	Yes
Quarter Fixed Effect	Yes	Yes	Yes	Yes
Division Fixed Effect	No	No	Yes	Yes
Adjusted R-squared	0.372	0.463	0.377	0.471
Observations	760	612	758	612