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It's About Time – A Longitudinal Adaptation Model of High-Performance Work Teams

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Work teams have become an essential part of organizations, but how implementation of work teams influences performance outcomes over time still remains unclear. This study aims to explore this issue by examining implementation of high-performance work teams (HPWTs) in a manufacturing context. We draw upon team development and adaptation literature and organizational change literature to propose a 2-phase adaptation model whereby the growth rates of performance outcomes initially decline after implementation of HPWTs and later increase and become higher than the rates before implementation. Over a 4-year period, a field quasi-experiment was conducted in 20 plants producing automation and control equipment for a Fortune 500 firm and collected monthly data regarding plant-level labor productivity and inventory turnover before and after implementation of HPWTs. Results based on piecewise growth modeling indicate that the growth rate of labor productivity declines immediately after conversion to HPWTs and recovers to the original level but not higher, whereas the growth rate of inventory turnover does not decline significantly but shows a long-term improvement. We discuss the effects of HPWT implementation on the 2 dependent variables and provide implications for practices and future research.

Keywords: adaptation and change, high-performance work teams, longitudinal effect, piecewise growth modeling

Fast-changing global markets and competitive challenges have required many companies to redesign their organizational structures. A Deloitte (2016) survey of more than 7,000 companies showed that 92% of managers believe that work redesign is essential; consequently, 62% are using team-based work systems rather than traditional structures. An Ernst and Young (2013) survey found that more than 90% of companies agree that teams promote employee participation and lead to superior performance. Thus, contemporary business organizations are tending toward team-based work designs (Kozlowski & Bell, 2013; Mathieu, Maynard, Rapp, & Gilson, 2008; Sundstrom, McIntyre, Halfhill, & Richards, 2000).

Driven by the popularity of team-based work systems in practice, team researchers have devoted attention to studying the effectiveness of implementing work teams in organizations (e.g., Banker, Field, Schroeder, & Sinha, 1996; Cohen & Ledford, 1994; Cohen, Ledford, & Spreitzer, 1996; Cordery, Mueller, & Smith, 1991; Wall, Kemp, Jackson, & Clegg, 1986). The focus of this stream of research is on how effective work teams are compared with traditional work designs (Cohen & Bailey, 1997; Sundstrom et al., 2000). For example, Cohen and Ledford (1994) examined the effectiveness of self-managing teams compared to traditional groups by conducting a quasi-experiment. Team effectiveness was assessed along the dimensions of productivity, quality of work life, and group member behavior. Other studies used similar designs to examine the effects of work teams on employee attitudinal (e.g., job satisfaction and organizational commitment) and behavioral outcomes (e.g., absenteeism, turnover, and individual performance) as well as team outcomes (e.g., productivity, quality, and safety; e.g., Cohen et al., 1996; Cordery et al., 1991; Griffin, 1988; Kemp, Wall, Clegg, & Cordery, 1983; Wall & Clegg, 1981; Wall et al., 1986).

As a specific form of worker participation, work teams have been theorized to benefit team members and enhance team performance by providing job autonomy, encouraging communication, and combining the skills of employees (Cohen & Bailey, 1997). Consistent with this contention, researchers have found general support for the positive effects of the use of work teams on employee attitudes (e.g., Cohen & Ledford, 1994; Cohen et al., 1996; Cordery et al., 1991; Jin, 1993; Kemp et al., 1983; van Mierlo, Rutte, Kompier, & Doorewaard, 2005; Wall & Clegg, 1981). However, work teams' impact on behavioral and performance outcomes remains ambiguous and needs to be further explored in at least three aspects.

First, previous research has found inconsistent results about the performance effects of work team implementation. For example,

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although some researchers found positive effects of work teams on performance outcomes (e.g., Janz, 1999; Marks, Mirvis, Hackett, & Grady, 1986), Wall and colleagues (1986) studied the effects of implementation of autonomous work teams and found no effect on performance outcomes. Banker and colleagues (1996) also showed mixed evidence, with teams affecting the manufacturing performance of only one of the two production lines. A possible explanation for the mixed findings is that previous research relying on a cross-sectional design (e.g., Cohen et al., 1996) or examining team effectiveness only for a short time period (e.g., Banker et al., 1996) could not fully capture the enduring effects of work team implementation and thus might lead to different conclusions. Therefore, it is important to integrate time into work team implementation research to reflect the complex and adaptive nature of work teams (e.g., Gully, 2000; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Mathieu et al., 2008; Mathieu, Hollenbeck, Van Knippenberg, & Ilgen, 2017).

Second, although team researchers have theorized that work teams take time to develop and become effective (e.g., Burke, Stagl, Salas, Pierce, & Kendall, 2006; Kozlowski, Gully, Nason, & Smith, 1999; Morgan, Salas, & Glickman, 1993; Tuckman, 1965), relatively little empirical work has examined how the performance effects of work team implementation unfold and change over time. For example, Kozlowski and Bell (2013) summarized 11 group and team development models proposing that work teams develop in different stages (e.g., forming, storming, norming, and performing, in Tuckman, 1965) and concluded that the literature could not inform us on the basic questions such as how long it takes for a team to be effective and how the effects of work teams evolve over time. Mathieu and colleagues (2017) raised a similar concern and encouraged researchers to "revisit the fundamental temporal nature of team evolution and dynamics" (p. 460). In so doing, researchers cannot only test the theoretical models of team development and adaptation but also help understand the temporal dynamics of team effectiveness in practice.

Third, previous research concerning the effects of work team implementation has primarily focused on individual and team outcomes (Cohen & Bailey, 1997; Kozlowski & Ilgen, 2006; Mathieu et al., 2008). For instance, van Mierlo et al. (2005) reviewed 28 quasi-experimental studies on the effects of work teams, and all of those studies examined outcomes at the individual level or the team level. However, work teams are embedded within the wider organizational context and should influence performance outcomes at higher organizational or unit levels (Baard, Rench, & Kozlowski, 2014; Gully, 2000; Mathieu et al., 2008). The issue is theoretically important for understanding how work teams follow a compilation process in contributing to broader, higher-level organizational outcomes (Kozlowski & Bell, 2013; Kozlowski et al., 1999; Kozlowski & Klein, 2000; Mathieu et al., 2008).

To address the three research needs mentioned above, we analyze data from a 4-year field quasi-experiment conducted by top management in a division of a Fortune 500 firm producing control equipment. The division implemented high-performance work teams (HPWTs) in 10 plants and used another 10 plants as a control group. It also provided monthly data for all plants on two plant-level operational outcomes (i.e., labor productivity and inventory turnover) during the 4-year research period. In this analysis, we aim to make three contributions to the literature of work team implementation. First, our design allows us to examine the longitudinal effects of HPWT implementation (Grant & Wall, 2009), and thus go beyond previous research that could only examine the cross-sectional or short-term effects of work teams, to provide a more complete understanding of the effects of work team implementation. Second, we draw upon prior research on team development and adaptation (Burke et al., 2006; Kozlowski & Bell, 2013; Kozlowski et al., 1999) and organizational change (e.g., Lewin, 1947; Ployhart & Hale, 2014; Schein, 1964) to examine a two-phase adaptation model of implementation of HPWTs and offer insight into how the effects of implementation of HPWTs may change over time. Third, we respond to the call for incorporating higher-level organizational outcomes into team research (Mathieu et al., 2008) and provide empirical evidence for organizational benefits of implementing work teams. In the following sections, we first introduce HPWTs as a specific team-based work system. We then propose a two-phase adaptation model (as shown in Figure 1) and derive hypotheses regarding the effects of implementing HPWTs on two operational outcomes at different stages after implementation.

Theoretical Background and Hypotheses

Introduction of HPWTs

Work teams are collections of employees with complementary skills, committed to common purposes, performance goals, and approaches for which they hold themselves mutually accountable (Katzenbach & Smith, 1993; Sundstrom, De Meuse, & Futrell, 1990). In practice and in the academic literature, work teams are of various types. An HPWT, which is one type of work team implemented at the research site, is defined as a group of employees (typically five to 15) who have the responsibility and the authority as a team to determine the process by which core task performance is completed (Banker et al., 1996). More specifically, HPWTs are characterized by clearly articulated values and goals, shared responsibility among all members, open communication and information sharing, participative decision-making, and rapid response to change in the internal and external environment (Nash, 1999). These characteristics make HPWTs similar to high-involvement work systems that emphasize enriched job design, job autonomy,

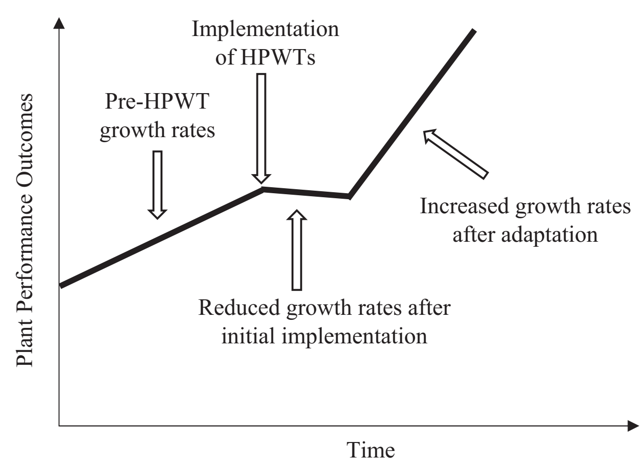

Figure 1. Theoretical model. HPWT = High-performance work team.

employee participation in decision-making, information sharing, and collaboration among employees (e.g., Batt, 2002; Guthrie, 2001; Lawler, 1986; Pil & MacDuffie, 1996; Wood, Van Veldhoven, Croon, & De Menezes, 2012). Similar to high-involvement work systems, the purpose of implementing HPWTs in our research sites was to reverse the narrow job specifications, rigid divisions of labor, and centralized decision-making in the original manufacturing process.

How do we differentiate an HPWT from other forms of work teams? In general, teams can be examined and differentiated along the dimensions of purpose, duration, and membership (Lawler, 1996). First, work teams vary according to purposes and goals. For example, they may be geared to product development, quality improvement, problem-solving, or reengineering. In the plants we studied, HPWTs have the primary objective of involving employees to improve performance and solve problems. Second, work teams can be either permanent or temporary, based on duration. Compared with temporary teams including task forces and project teams, HPWTs are implemented as permanent teams that continue to be in use and are built into the organizational structure at the plants. Third, team membership can be either functional or cross-functional in work teams. An HPWT is composed of workers from the same production line. Team membership is mandated by management and is not voluntary.

Moreover, HPWTs differ from other widely implemented teams in manufacturing contexts such as quality circles and autonomous or self-managing teams (Banker et al., 1996). Quality circles are consultative; they may provide advice but have limited authority to implement it, whereas HPWTs are institutionalized forms of work teams with substantive participation and decision-making capability (Levine & Tyson, 1990). HPWTs have a significant amount of control over their activities with the authority to implement decisions about how to manage work processes including planning, scheduling, staffing, and producing. Autonomous or self-managing teams possess a higher degree of autonomy than HPWTs, and design and manage the entire range of production processes from receipt of raw material through the manufacture of the end products as well as packaging and shipping of the finished products. They also have control over the management and execution of supportive activities, such as quality control and maintenance, whereas HPWTs are involved only in core production processes as mentioned above.

Theoretical Effects of HPWTs

Despite the mixed evidence to date on the effectiveness of work team implementation, the theoretical literature on work teams posits a positive relationship between HPWTs and performance for two primary reasons (Ledford, Lawler, & Mohrman, 1988; Mohrman & Novelli, 1985). First, participation in HPWTs results in job variety, autonomy, discretion, increased skills, top management recognition, increased feelings of involvement and accomplishment, and social rewards from being on a team. These outcomes and conditions can motivate workers to perform better on the job, which leads to higher productivity and effectiveness (e.g., Chen & Kanfer, 2006; Chen, Kirkman, Kanfer, Allen, & Rosen, 2007). Second, HPWTs encourage employees to combine their knowledge and skills to generate ideas for solving problems and improving work activities (e.g., Appelbaum, Bailey, Berg, & Kalleberg, 2000; Hackman & Oldham, 1980; Lawler, 1994; Robinson & Schroeder, 2009). Team members meet and generate ideas, the ideas are implemented, and implementation of the ideas may lead to improvements in performance outcomes. In this study, we examine the effects of implementation of HPWTs on two key indicators of operational performance in the manufacturing context: labor productivity and inventory turnover.

Labor productivity, generally defined as total output divided by labor input (Samuelson & Nordhaus, 1989), has been commonly examined as a crucial operational outcome directly related to human capital and effort (Dyer & Reeves, 1995). HPWTs motivate employees to improve their individual performance by offering autonomy and control over their job. Because employees on the same subassembly line typically work on similar tasks, team productivity may emerge from individual performance through an additive composition process (Chan, 1998; Kozlowski & Klein, 2000; Morgeson & Hofmann, 1999). The increased team productivity can further reduce process losses and contribute to labor productivity of the whole plant because of the sequential interdependence among subassembly lines (Kozlowski & Klein, 2000).

Moreover, HPWTs are set up as a framework in which manufacturing problems can be addressed by lower-level employees who have the greatest intimacy with production processes. Employees may be better able to suggest how to improve the work of individual employees, such as providing additional training to certain employees or replacing tools for particular positions. In this case, these ideas may first influence individual performance and then have an impact on subsequent team and plant productivity through the emergent process discussed above (Kozlowski & Klein, 2000). Team members may also focus on how to enhance team productivity or plant productivity directly rather than relying on the emergence process through employees. Specifically, in the manufacturing context, one of the standard frameworks used to understand and improve processes is the 5M Model (Weeden, 2015). The five 'M's that contribute to the productivity of the process are Man/people, Machine, Material, Method, and Measure. HPWTs have the potential to improve labor productivity from each of these perspectives by engaging employees to propose and implement new ideas. For example, HPWTs can identify improved methods of manufacturing—as in the case presented by Robinson and Schroeder (2009), where ideas from front-line staff can have an impact on productivity. In a Coca Cola filling plant, the idea from a front-line worker to reduce the surface of contact between the bottle and the machine resulted in significant savings for the company. Another example was provided by a plant manager we interviewed. A pin box product takes a welder 41 min to manually weld from start to finish. One welder questioned why a side plate requires a full weld around the plate when it also gets bolted down. His suggestion was to only weld the four corners of the plate instead of the entire plate, which shaved off eight of the 41 min and represented a considerable increase in labor productivity for the plant.

Another important indicator of operational effectiveness is inventory turnover, which refers to the cost of goods sold divided by the average inventory including raw material, work-in-process, and finished products (Gaur, Fisher, & Raman, 2005; Sundar, Balaji, & Kumar, 2014). Compared with labor productivity which is directly influenced by labor activities (Dyer & Reeves, 1995), inventory turnover is a more of a multidimensional measure of operational performance, which can be affected by other aspects such as material productivity and sales activities. HPWTs may influence inventory turnover by their impact on the numerator (sales) or the denominator (inventory) or a combination of both. On the sales side, although manufacturing workers are not directly involved in the sale of products, HPWTs provide autonomy for employees to coordinate manufacturing schedules with planned sales and promotions. By motivating employees to work effectively in these aspects, HPWTs can make plants better able to fulfill customer orders, leading to sales growth and expedited processes for satisfying customer demands (Lancioni, Schau, & Smith, 2005). On the inventory side, plants strive to reduce overcapacity of raw materials and products in order to have a relatively high level of inventory turnover. A production line with quality problems is prone to having stockpiles of inventory at certain stations while the next stations wait for inputs. HPWTs may help reduce inventory by encouraging employees to enhance product quality. Moreover, identification and solving of problems is one of the overarching goals of HPWT implementation. This tends to have effect on both sales (increased plant output) and decreased inventory. For example, teams may discuss how to improve projection of product plans to avoid excess raw material and overproduction, or how to reduce work-in-progress inventory by improving transportation between working stations (e.g., Sundar et al., 2014). When planning and scheduling their own manufacturing tasks, teams also need to work with the sales personnel to improve the accuracy of forecasting production needs (Gunasekaran & Kobu, 2007). For these reasons, HPWTs also have the potential to positively influence inventory turnover.

Conversion to HPWTs: A Two-Stage Adaptation Model

Although HPWTs are theorized to enhance performance outcomes by increasing employee motivation and facilitating idea generation and implementation, both mechanisms suggest that one of the critical aspects to observing the impacts might be the maturity of teams. That is, the potential benefits of HPWTs might be a function of how long teams have been in place and HPWTs may not have positive effects on the two plant-level performance outcomes immediately after implementation (Burke et al., 2006; Kozlowski & Bell, 2013; Kozlowski et al., 1999; Lewin, 1947; Ployhart & Hale, 2014; Schein, 1964).

In our research setting, the adoption of HPWTs represents a radical change in the way the plants organize work activities (Appelbaum et al., 2000; Hackman & Oldham, 1980; Lawler, 1994; Pil & MacDuffie, 1996). First, before the HPWTs were implemented, the plants were traditionally hierarchically structured: plant managers made decisions and resolved work issues. They seldom discussed work-related issues or shared plant information with production workers. Our discussions with management and front-line workers revealed that HPWTs were implemented because of corporate desires to give front-line workers control and autonomy, to allow them to participate in production processes, and to empower them to make decisions that might save costs and improve processes. As a result, team members may have greater autonomy and perform a broader range of job tasks including those previously carried out by supervisors (e.g., scheduling jobs, diagnosing problems, and identifying solutions). Second, HPWTs facilitate interactions and collaborations among team members. In addition to completing their individual jobs, employees need to communicate more frequently and in greater depth to make work-related decisions and combine their skills to implement those decisions.

The adaptation and change literature provides theoretical foundations for understanding how HPWT implementation as a radical change in job design influences performance outcomes over time. First of all, team development and adaptation theories suggest that work teams develop through phases over time (Burke et al., 2006; Kozlowski et al., 1999; Morgan et al., 1993; Tuckman, 1965). For example, Tuckman's (1965) classic model of group development states that a brand new team goes through four sequential stages (i.e., forming, storming, norming, and performing). The essence of Tuckman's model and many others based on it (e.g., Caple, 1978; Hill & Gruner, 1973; Kormanski & Mozenter, 1987; Tuckman & Jensen, 1977) is that groups struggle to define group members' roles and regulate their interpersonal interactions before they finally make progress toward the goal (Kozlowski & Bell, 2013). Kozlowski and colleagues (1999) proposed a team compilation model that integrates team development with a performance perspective. In the first phase of the model, team performance is not the appropriate focus; instead, members are seeking information to reduce ambiguity about interpersonal issues and to understand the fundamental nature of the team. In the later phases, members develop task knowledge, form role expectations, and gradually learn to cooperate to enhance team performance. Burke and colleagues (2006) focused on team adaptation and argued that employees need to develop new shared mental models by formulating and executing plans to adapt to new work requirements. During the transition period, performance outcomes may initially decline because the previous state is misaligned with the new demands, but will increase after teams achieve realignment.

The team adaptation perspective is consistent with organizational change research. The stage models of organizational change suggest that a planned organizational change is followed by three stages (Lewin, 1947; Schein, 1964). The unfreezing phase is a sudden shock that breaks current states and task processes so that employees must deal with uncertainty and anxiety rather than focusing on regular tasks. Consequently, performance outcomes may drop after the change. In the moving phase, employees acquire more information, allowing them to understand and accept the changes, reduce uncertainty, and align their behavior with the change. As a result, performance outcomes should show an upward trend. Finally, in the refreezing phase, employees have learned how to act appropriately in the new environment and have established new routines to complete work efficiently. Thus performance may gradually increase to a level higher than before the change. Similarly, organizational learning curves suggest that when organizations adapt to environment changes, they are first engaged in an unlearning process to get rid of previous operating routines and then in a learning process to establish new work routines (e.g., Hedberg, 1981; March, 1991; Tsang & Zahra, 2008; Tushman & Anderson, 1986). Unlearning old routines and introducing new ones is costly, although the new ones may positively affect long-term performance outcomes (Pil & MacDuffie, 1996).

Taken together, the theories of team development and adaptation and organizational change suggest that the effects of HPWT implementation on performance outcomes may follow a nonlinear pattern of change over time. More specifically, as we explain in more detail below, workers experience at least two distinct phases after implementation of HPWTs, such that the growth rates of performance outcomes may initially decline after the implementation, and then gradually improve as employees adapt to HPWTs.

The literature has suggested three primary reasons for the initial decrease in performance growth rates after implementation of HPWTs. First, implementation of HPWTs may create uncertainty about the work environment because employees lack sufficient information to understand the purpose of this change and its potential impact on their individual work and collective outcomes (Lewin, 1947; Milliken, 1987; Schein, 1964). Under this situation, employees may have concerns about HPWTs and even resist the change (Kirkman, Shapiro, Novelli, & Brett, 1996). For example, prior research has shown that when employees were about to experience a team-based reorganization, they expressed concerns including the desirability of team-related assignments (Orsburn, Moran, Musselwhite, Zenger, & Perrin, 1990), the possibility of increased conflicts or confrontations with teammates (Dyer, 1987), the fairness of compensation outcomes and decision-making procedures (Kirkman et al., 1996), and management's commitment to team implementation (Banker, Field, & Sinha, 2001). Such concerns may suppress the positive effects of HPWTs on employee motivation and idea generation, and even distract employees from performing their work.

Second, implementation of HPWTs disrupts prior work routines and forces employees to adapt to new performance demands (Burke et al., 2006). An obvious change following HPWTs is that employees are involved in decision-making and coordination rather than simply working on their own production tasks. These new activities not only take time from production but also require employees to learn new roles and new ways to complete their work (Pil & MacDuffie, 1996). Another feature of this new work arrangement is that it gives employees opportunities to make suggestions and solve work-related problems. However, research has indicated that suggestions made by employees tend to be unfocused and of little value initially after implementation of HPWTs (e.g., Robinson & Schroeder, 2009; Savageau, 1996). Before employees learn how to make relevant and valuable suggestions through the trial-and-error process, their participation may not improve or may even impede the growth of performance outcomes.

Third, HPWTs affect interpersonal relationships by requiring higher levels of interaction. Although employees may know each other before implementation, higher interaction levels require greater interpersonal knowledge (Kozlowski et al., 1999). For example, employees may have different working styles. More frequent interactions may highlight the differences, causing new problems and inhibiting effective communication. Team development research has suggested that interpersonal conflict is likely to occur in the early stage of team development because employees lack established norms to resolve their differences (Ellis & Fisher, 1975; Tuckman, 1965). The increased interpersonal conflict may produce tension among employees, decrease their satisfaction, and increase the time it takes to perform their jobs (De Dreu & Weingart, 2003; De Wit, Greer, & Jehn, 2012).

Although the literature has not explicitly indicated how long the decline in performance growth rates will last, the general rule is that this kind of adaptation cannot be completed in a short time period. For example, Ahearne, Lam, Mathieu, and Bolander (2010) examined the longitudinal influences of a new customer relationship management system on salesperson performance. They found that after the implementation of this system, sales performance continues decreasing for about five months before it starts to increase. Focusing on high-involvement work practices, Pil and MacDuffie (1996) also suggested that returns from such practices are quite low in the short term because switching to the new practices entails not just introducing a new work structure, but destroying employees' experience with the old structure. The return from such practices can only grow over time after employees adapt to the new structure. For all these reasons, we hypothesize:

> *Hypothesis 1:* The growth rates of (a) labor productivity and (b) inventory turnover will initially decline after implementation of HPWTs.

The decline in performance growth rates will not last indefinitely after the implementation of HPWTs. We posit that the initially reduced growth rates of labor productivity and inventory turnover will gradually increase after employees adapt to HPWTs (e.g., Burke et al., 2006; Kozlowski et al., 1999; Lewin, 1947; Schein, 1964). First, after employees have had the time to assimilate information about HPWTs, their initial uncertainty may be significantly reduced. Indeed, employees tend to have less uncertainty about technical changes when they know the impact of the changes (e.g., Kwahk & Lee, 2008). Reduced uncertainty may increase the likelihood that HPWTs will be accepted and that employees can devote more attention to work tasks rather than concerns about potential adverse effects. Second, employees may establish effective work routines to address the demands over time (Burke et al., 2006; Mathieu, Kukenberger, & D'Innocenzo, 2014). In this phase, employees have learned about the new work environment and have developed a shared understanding of appropriate work behaviors; thus they can shift attention from learning and adapting to focusing on performance goals. Third, interpersonal relationships may improve after employees work closely together for an extended period (Bradley, White, & Mennecke, 2003; Kozlowski et al., 1999). The enhanced interpersonal relationships may facilitate employees to develop a shared mental model of the performance situation (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000), become familiar with one another's knowledge and skills (Wegner, Erber, & Raymond, 1991), and build shared commitment to their teams (Arrow & McGrath, 1995). As a result, they are more likely to cooperate to improve performance outcomes (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008).

As team members learn and adapt to the new work structure, HPWTs are more likely to exert positive effects on labor productivity and inventory turnover, as mentioned above—that is, HPWTs motivate employees to perform better individually and collectively by providing job autonomy, and engage them in decision-making and problem-solving by combining their knowledge and skills. Through these theoretical mechanisms, we expect that the initially reduced performance growth rates will be overturned after adaptation and become higher than the growth rates before implementation of HPWTs.

Hypothesis 2: The initially reduced growth rates of (a) labor productivity and (b) inventory turnover will be followed by increased growth rates that are higher than the preimplementation growth rates.

Method

Sample and Procedure

To examine the effects of HPWT implementation on the two performance outcomes, we conducted a longitudinal field quasi-experimental study. As noted by Grant and Wall (2009), random assignment is often not achieved in field quasi-experiments. "Often this type of research is an opportunistic process. One finds out about an organizational experiment and 'parachutes in' to find out about its impact" (Evans, 1976, p. 99). One of the authors was in close contact with management of a division of a global leader in the manufacture of control equipment, which allowed us to examine our hypotheses using a sample of 20 plants of the division.

The plants included are located in close proximity, are of similar size, use the same technology and manufacturing for making similar products, and operate in a unionized environment under a common general manager but with different plant managers. They are governed by the same management policies and labor contracts but function as independent units. The products manufactured fall under Standard Industrial Classification (SIC) code 3822: automatic controls for regulating residential and commercial environments and appliances. Each plant has several subassembly lines corresponding to the basic components of the end products. Each subassembly line incorporates parts into semifinished products, which then pass to the next subassembly line until all components are incorporated into the end products.

Implementation of HPWTs was a mandatory corporate initiative. To prepare workers for this implementation, the company organized all workers to participate in 10 training sessions. Each module was focused on a particular aspect of HPWTs (e.g., team dynamics, team goals, effective listening, feedback, conflict resolution, and problem-solving). After workers finished the modules, they returned to their production lines and practiced and implemented what they had learned. Typically, each team met every week in the team room to discuss a range of issues from problems on the line to ideas for improvement to meet customer expectations and goals. Often the brainstorming led to solutions of problems and improvement of manufacturing processes. A team leader, chosen from the production workers of each line, conducted the meetings and assigned members to resolve specific problems or implement certain action plans based on discussions. These team activities are consistent with the definition of HPWTs—that is, team members have the authority to solve problems and improve production processes.

Management had bought into the idea of implementing HPWTs across all 20 plants, so it was just a matter of time before all plants would have implemented HPWTs. However, as a matter of practical feasibility in roll-out they sought volunteer plants to start the process. The plant managers at the plants that went first were most enthusiastic about HPWTs. Other than this fact, there were no systematic reasons for selection of the experimental and control plants. This approach is commonly used in other quasi-experiments in management research because researchers cannot deliberately manipulate variables in such experiments, and in many situations quasi-experiments are based on changes that are naturally occurring rather than manipulated (Grant & Wall, 2009). Specific to this study, the company implemented HPWTs in 10 plants at different time points during the study period, and used the other 10 plants that had not implemented HPWTs as a control group. The company provided us with the information on when HPWTs were implemented in each of the 10 experiment plants as well as monthly data on the two performance outcomes for all 20 plants during the research period.

From an academic and research standpoint we wanted to isolate the performance effect to HPWTs. Management for their part also wanted to have a clear picture and therefore consciously did not make any process changes other than HPWT implementation. For example, the company avoided introducing new products at the 20 plants during the period of the study. Further, although quality remains an important goal and competitive advantage for the company, it did not launch any new quality programs. The existing programs had been in place for many years before implementation of HPWTs. Moreover, major human resource policies such as staffing and compensation were the same across the plants and remained stable during the study period.

Measures

Implementation of HPWTs. We considered implementation of HPWTs to be a change event and followed the piecewise growth modeling approach to code two recommended variables related to time and a change event (Bliese & Lang, 2016; Hoffman, 2015; Singer & Willett, 2003). The first variable represents the linear change process in a typical growth model, coded by assigning a value of $t - 1$ to each plant for the month t until implementation of HPWTs, and maintaining the preimplementation value for the rest of the time period. Second, we coded the second variable as 0 for any month before and including the month of implementation. This value then increased with the month following implementation of HPWTs until the end of the 4-year period. Table 1 further shows the coding of the variables using an example in which HPWTs are implemented in the 24th month of the study period. We used pre-HPWT and post-HPWT to represent the two time variables related to implementation of HPWTs.

Performance outcomes. The company gave us monthly data on labor productivity and inventory turnover. The company measures *labor productivity* as the ratio of standard direct labor hours to actual total shop floor labor hours (Banker, Datar, & Rajan, 1987). This measure is typical among many manufacturing organizations. The numerator is an aggregate measure of what output should be if everyone worked at the "standard" pace based on industrial engineering standards for time and work. These established standards dictate how much time the manufacturing of each product should take. The numerator is the weighted sum based on the actual volume of different products. The weights here reflect the standard requirements for labor for each product. The numerator is the "standard" and the denominator is the "actual." Per-

Table 1
Coding and Interpretation of Change Variables in the Piecewise Growth Models (an Example for Implementation of High-Performance Work Teams in the 24th Month)

			For labor productivity		For inventory turnover	
Months	Pre-HPWT	Post-HPWT	Post-HPWT (Stage 1)	Post-HPWT (Stage 2)	Post-HPWT (Stage 1)	Post-HPWT (Stage 2)
1	0	0	0	0	0	0
2	1	0	0	0	0	0
3	2	0	0	0	0	0
. . .	. . .	. . .	. . .	. . .	. . .	. . .
22	21	0	0	0	0	0
23	22	0	0	0	0	0
24	23	0	0	0	0	0
25	23	1	1	0	1	0
26	23	2	2	0	2	0
27	23	3	3	0	3	0
. . .	. . .	. . .	..	. . .	. . .	. . .
33	23	9	9	0	9	0
34	23	10	10	0	10	0
35	23	11	11	0	11	0
36	23	12	12	0	12	0
37	23	13	13	0	13	0
38	23	14	13	1	13	1
39	23	15	13	2	13	2
. . .	. . .	. . .	. . .	. . .	. . .	. . .
46	23	22	13	9	13	9
47	23	23	13	10	13	10
48	23	24	13	11	13	11

Note. HPWT = high-performance work team.

centages of this variable were used in the analysis.[1] A higher value of this variable indicates improved labor productivity. The second performance outcome is *inventory turnover*. This company uses the ratio of cost of goods sold to the cost of inventories including raw material, work-in-process, and finished goods, to measure inventory turnover, an approach commonly used to measure inventory productivity (Gaur et al., 2005; Gunasekaran & Kobu, 2007). A higher level of inventory turnover is typically desirable because it indicates a lower overcapacity of materials and products, more efficient operational management, and better sales performance.

Control variables. We incorporated several control variables that potentially impact the two performance outcomes. *Workforce turnover*, assessed as the ratio of new employees to total headcount, is expected to have a negative sign because labor turnover has detrimental effects on labor productivity (e.g., Hale, Ployhart, & Shepherd, 2016). *Overtime labor*, operationalized as the percentage of the workforce that worked overtime, could be negative if it indicates fatigue and stress factors or positive if it indicates higher output (e.g., Hayes & Clark, 1985). The dollar value spent training workers was a measure of *on-the-job training*, which can positively affect long-run productivity and quality. We controlled for 11 dummies indicating the different months to capture seasonal factors that may affect performance outcomes. Finally, we created a dummy variable to indicate whether a plant implemented HPWTs during the study period (0 = experimental plants; 1 = control plants). We controlled for this dummy variable and its interaction with pre-HPWT to rule out the potential differences in the mean levels and pre-HPWT growth rates of the two dependent variables between the two groups. We did not control for plant characteristics such as age and size because of the similar characteristics of those plants.

Analytical Methods

We used the piecewise growth models (Bliese & Lang, 2016; Hoffman, 2015; Singer & Willett, 2003) to examine our hypotheses. Because we expected the growth rates of the two performance outcomes to first decline and then increase after implementation of HPWTs, we used two break points to split the time span into three pieces. We first viewed HPWT implementation as a naturally occurred break point separating the growth rates of the performance outcomes before and after implementation. We then used an iterative search procedure to statistically estimate the break point separating the two different growth rates of the performance outcomes after implementation of HPWTs (Crawley, 2012). This iterative approach runs a piecewise regression for each possible break point and identifies the break point for the model that has the lowest residual mean squared error (e.g., Crawley,

[1] The following numerical example illustrates the metric used to measure labor productivity. The plant produces three products: A, B, and C. The standard time established for producing one unit of each is 1 hour, 2 hours, and 3 hours, respectively. (This might not be the actual time it takes to produce a product; rather, it indicates the time it should take the worker who is working at the "standard" pace established by work and time studies.) For the given month, the plant produced 1000, 2000, and 3000 units of products A, B, and C, respectively. So, the numerator for the month will be $(1000 \times 1 + 2000 \times 2 + 3000 \times 3) = 14{,}000$ hours. For calculating the denominator, we assume that all workers put in 15,000 total hours for the month. The labor productivity for the month is computed to be $(14{,}000/15{,}000) = 0.933$ or 93.3%.

2012; Jones & Molitoris, 1984; Muggeo, 2003). The results suggested that the post-HPWT break points for labor productivity and inventory turnover both occurred at the 13th month after implementation of HPWTs. We then divided the post-HPWT time into two pieces at the identified break points for the two performance outcomes. More specifically, we recoded the post-HPWT variable into two variables: post-HPWT (stage 1) and post-HPWT (stage 2). The post-HPWT (stage 1) was coded as 0 for any month before and in the month of implementation of HPWTs, increased with each subsequent month until the identified break point, and maintained the value of the break point for the rest of the time period. The post-HPWT (stage 2) was coded as 0 for any month before and at the identified break point in the post-HPWT period, and increased with each subsequent month until the end of the 4-year period (see Table 1).

We conducted the analyses in *RStudio* (available at https://www.rstudio.com/) by using the nonlinear and linear mixed-effect model (nlme) package for R. We modified the R codes provided by Bliese and Lang (2016) and used the two-level mixed-effect models with restricted maximum likelihood (REML) estimation. In our investigation, we had 960 measurement occasions (i.e., 48 months × 20 plants) of each performance outcome at Level 1 nested within 20 plants at Level 2. Because we did not propose any Level 2 variables in the hypotheses, we only examined performance outcomes with all predictors at Level 1.

Results

Table 2 presents the descriptive statistics and correlations of the variables. Table 3 shows the results of the hypothesis tests. To confirm the appropriateness of using growth modeling to examine our hypotheses, we examined whether a model allowing a random intercept fit the data better than a model without any random effect (Bliese & Ployhart, 2002). In the analyses, we included pre-HPWT as the only predictor and found that the models allowing intercepts to randomly vary among plants fit the data better than the simple models without random effects (likelihood ratios were 1659.68 [$df = 1$, $p < .01$] and 4.60 [$df = 1$, $p < .05$] for labor productivity and inventory turnover, respectively). The results suggest that it is appropriate to consider the random effects to predict the dependent variables and use growth modeling to test hypotheses.

Hypotheses 1 and 2 posit that the growth rates of the two performance outcomes will initially decline after implementation of HPWTs and then increase and become higher than growth rates before implementation. We first examined a baseline model by including all control variables and pre-HPWT. As shown in Model 1 of Table 3, there was a statistically significant interaction between pre-HPWT and control plants ($b = -.64$, $SE = .09$, $p < .01$), suggesting that the growth rate of labor productivity before implementation of HPWTs was lower in the control plants than in the experimental plants. We then examined a more complex model (i.e., Model 2 of Table 3) by adding post-HPWT (stage 1) and post-HPWT (stage 2) to the baseline model. We found that in the experimental plants labor productivity had a statistically significant and positive growth rate before implementation of HPWTs ($b = .76$, $SE = .09$, $p < .01$); after implementation the growth rate first became significantly negative ($b = -.61$, $SE = .16$, $p < .01$) and then became significantly positive ($b = .78$, $SE = .16$, $p < .01$). We used a log likelihood ratio test of the difference in deviance to compare the two models, which is based on a chi-squared distribution using the degrees of freedom associated with the number of model differences between the two models (Bliese & Ployhart, 2002). The statistically significant result showed that Model 2 with two different linear growth rates after HPWT implementation fit the data better than Model 1 (likelihood ratios = 22.62, $df = 2$, $p < .01$). We also examined the Akaike Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (BIC) to compare model fit (Bliese & Lang, 2016). With smaller AIC and BIC indices, Model 2 fit the data better than Model 1.

Testing Hypotheses 1 and 2 also requires us to compare the preimplementation growth rate with the two linear growth rates after implementation of HPWTs. We used the z formula provided in Paternoster, Brame, Mazerolle, and Piquero (1998) to compare the regression coefficients of pre-HPWT with post-HPWT (stage 1) and post-HPWT (stage 2) separately. The results showed that the initial decline in the growth rate of labor productivity was statistically significant (i.e., difference between pre-HPWT and post-HPWT [stage 1], $z = 2.74$, $p < .01$) but the later growth rate was not significantly higher than preimplementation growth rate (i.e., difference between pre-HPWT and post-HPWT [stage 2], $z = .04$, *ns*). The results provided support for our Hypothesis 1a but not for Hypothesis 2a. To help interpret the piecewise growth modeling results, we drew a plot in Figure 2, assuming that implementation of HPWTs occurs in the 24th month. Figure 2 shows that the growth rate of labor productivity changes from positive to negative

Table 2
Descriptive Statistics and Correlations

Statistic	Mean	*SD*	1	2	3	4	5	6	7
1. Labor productivity	52.61	35.59							
2. Inventory turnover	22.53	48.94	−.02						
3. Pre-HPWT	20.21	12.59	−.03	−.01					
4. Post-HPWT	3.29	7.54	.12**	.04	−.12**				
5. Workforce turnover	.06	.08	.05	−.06	−.21**	.07*			
6. Overtime	1.91	1.57	.07*	.07*	.08*	.02	.01		
7. Training	477.58	995.88	.11**	−.03	−.24**	−.14**	.20**	−.07*	
8. Control plants	.50	.50	−.29**	.13**	.26**	−.44**	−.25**	.16**	−.31**

Note. $N = 20$ for plants. Time = 48 months. HPWT = high-performance work team. For the dummy variable of control plants, 0 = experimental plants, 1 = control plants.
* $p < .05$. ** $p < .01$.

Table 3
Piecewise Growth Model Results for the Longitudinal Effects of Implementation of High-Performance Work Teams

	Labor productivity		Inventory turnover	
Variable	Model 1	Model 2	Model 3	Model 4
Intercept	48.56** (10.58)	46.42** (10.60)	28.51** (7.71)	15.17 (8.33)
Workforce turnover	−1.88 (5.63)	−1.37 (5.55)	−22.44 (19.96)	−19.58 (19.80)
Overtime	0.19 (0.38)	0.13 (0.38)	1.64 (1.02)	1.25 (1.02)
Training	0.00 (0.00)	0.00 (0.00)	−0.00 (0.00)	0.00 (0.00)
Months (11 dummy variables)	Included	Included	Included	Included
Control plants	−8.53 (14.74)	−6.68 (14.76)	−0.59 (6.66)	10.85 (7.19)
Pre-HPWT × Control plants	−.64** (.09)	−.82** (.10)	.64* (.28)	.20 (.31)
Pre-HPWT	.60** (.08)	.76** (.09)	−.65** (.23)	−.19 (.26)
Post-HPWT (stage 1)		−.61** (.16)		−.40 (.53)
Post-HPWT (stage 2)		.78** (.16)		2.18** (.57)
−2 Res Log Likelihood	3747.38	3736.07	5046.20	5036.78
df	20	22	20	22
Likelihood ratio	22.62**		18.85**	
AIC	7534.76	7516.14	10132.41	10117.56
BIC	7631.14	7622.10	10229.37	10224.17

Note. $N = 20$ for plants. Time = 48 months. The estimates reported are unstandardized coefficients; standard errors are reported in parentheses. The coefficients of the 11 dummy variables of month are available upon request. HPWT = high-performance work team; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.
$^{*} p < .05$. $^{**} p < .01$.

right after implementation of HPWTs and then becomes positive but not higher than preimplementation growth rate.

Models 3 and 4 in Table 3 present the results for inventory turnover. As shown in Model 4, we found the absence of growth in inventory turnover before implementation of HPWTs ($b = -.19$, $SE = .26$, *ns*). After implementation, the linear growth rate remained negative and nonsignificant ($b = -.40$, $SE = .53$, *ns*) and then became positive and statistically significant ($b = 2.18$, $SE = .57$, $p < .01$). Compared with Model 3, Model 4 fit the data better with a significant likelihood ratio (18.85, $df = 2$, $p < .01$) and smaller AIC and BIC values. We further compared the regression coefficients of pre-HPWT with post-HPWT (stage 1) and post-HPWT (stage 2) and found a nonsignificant difference between pre-HPWT and post-HPWT (stage 1; $z = .24$, *ns*) and a statistically significant difference between pre-HPWT and post-HPWT (stage 2; $z = 2.60$, $p < .01$). Figure 3 shows how the growth rate of inventory turnover changes after implementation of HPWTs. The results provided support for Hypothesis 2b but not Hypothesis 1b.

Discussion

The purpose of this study was to examine the longitudinal effects of implementation of HPWTs over time. By conducting a field quasi-experiment using 20 plants within a manufacturing division during a 4-year period, we found that the growth rates of two plant-level performance outcomes may follow a nonlinear curve after introduction of HPWTs. The findings were observed after considering a control group and controlling for various contextual variables that could also impact the performance outcomes. Our findings provide important research and practical implications for understanding the longitudinal effects of work team implementation.

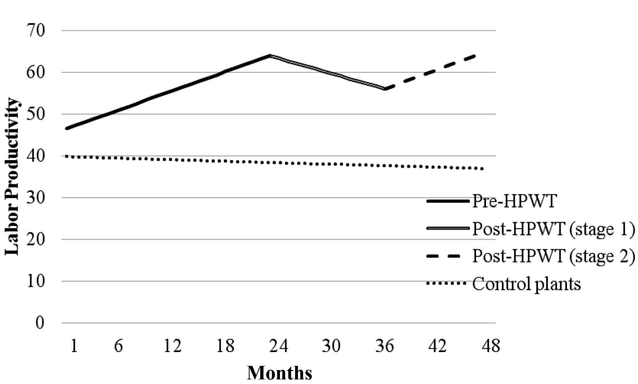

Figure 2. The effect of implementation of high-performance work teams on labor productivity. HPWT = High-performance work team.

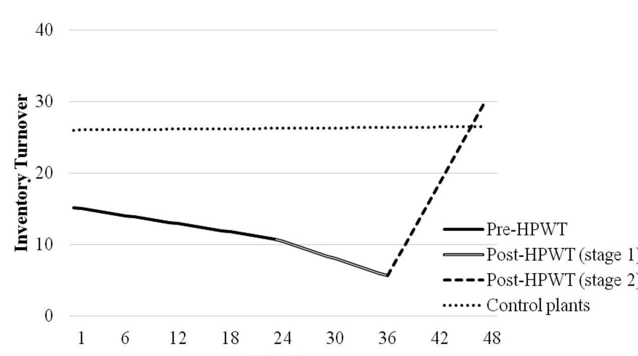

Figure 3. The effect of implementation of high-performance work teams on inventory turnover. HPWT = High-performance work team.

Research Implications

This work has three main research implications. First, by considering the role of time in theorizing and examining the longitudinal effects of HPWT implementation, we help reconcile the mixed findings on the effects of work team implementation. Previous research focused on whether or not implementation of work teams influences performance outcomes (e.g., Banker et al., 1996; Cohen & Ledford, 1994; Janz, 1999; Marks et al., 1986; Wall et al., 1986). We develop an adaptation model to argue that the relationships between HPWT implementation and performance outcomes are nonlinear rather than simply positive or negative. We further argue that implementation of HPWTs follows two phases in influencing performance outcomes, such that the growth rates of performance outcomes first decrease and then increase and become higher than preimplementation growth rates. For labor productivity, we found that the growth rate significantly declined right after implementation of HPWTs. We also found that the growth rate became significantly positive after the initial decline but not higher than the preimplementation rate. For inventory turnover, the results showed that there was a nonsignificant initial decline in the growth rate, which was followed by a more positive growth rate than the preimplementation rate. For both performance outcomes, our findings suggest that the performance impact of HPWTs may follow a nonlinear curve as employees adapt, and may not immediately occur after implementation. These findings may help explain the different results regarding the effects of work team implementation in the literature. For example, Cohen and Ledford (1994) found no difference in the objective customer satisfaction measure between self-managing and traditionally managed small business office teams over an 8-month period, whereas Marks et al. (1986) found significant differences in productivity measures between participants and nonparticipants of quality circles at about 24 months after introduction. If the effect of work teams is examined only at a particular time point, the results may not accurately reflect the dynamic nature of this relationship.

Second, our study adds empirical support to the team development and adaptation literature claiming that it takes time for work teams to develop and mature (e.g., Kozlowski et al., 1999; Mathieu et al., 2008; Morgan et al., 1993). This research not only examines the largely ignored dynamic relationship between work team implementation and performance outcomes but also quantifies how long it will take before benefits are realized. For example, the manufacturing plants we studied showed that the growth rate of inventory turnover declined for about 13 months after implementation of HPWTs, and it took about another three months for inventory turnover to exceed the level based on the pre-HPWT growth rate. The findings suggest that the adaptation to HPWT implementation is indeed a long process and may not be completed in a short time period. However, our analyses on the plant-level outcomes cannot directly examine the developmental stages proposed in the classic team development models (Kozlowski & Bell, 2013). Future research can further explore team dynamics by leveraging multiple methodologies such as qualitative approaches and social network analysis (Mathieu et al., 2017).

Third, our research provides an empirical examination into the effects of HPWT implementation on plant-level performance outcomes. Prior research on work team implementation has primarily focused on outcomes measured at the individual levels (e.g., Cohen & Ledford, 1994; Wall et al., 1986) and at the team level (e.g., Banker et al., 1996, 2001). Our research differs from previous studies in that we focus on the effects of HPWT implementation operating at the team level on performance outcomes at the higher level. These bottom-up cross-level effects may occur through an additive composition process such that individual performance affected by HPWT implementation is first aggregated to the subassembly lines and then to the entire plants. HPWT implementation may also affect plant-level outcomes directly through the new ideas and suggestions proposed by employees. Moreover, HPWT implementation may instigate a mindset of communication, cooperation, and coordination by focusing on collective performance. If this mindset spills over to other parts of the organization (e.g., marketing, sales, and supply chain), it may influence the plant-level outcomes through more complex processes. We consider our findings one of the first steps on a path toward understanding the bottom-up effects of work team implementation on higher-level outcomes, and we encourage more research efforts to explore the underlying emergence processes in the future.

Moreover, we want to acknowledge the different nonlinear effects of HPWT implementation on the two performance outcomes and suggest implications for future research. Compared with inventory turnover, labor productivity was more negatively affected by implementation of HPWTs in the initial stage. A possible explanation is that labor productivity is a proximal outcome of human resource management (HRM) practices and workforce characteristics (Delery & Shaw, 2001; Dyer & Reeves, 1995). Therefore, conversion from a traditional job design to HPWT is primarily a disruption to the labor component of performance. For example, it entails removing workers from production lines and engaging them in learning how to coordinate and make decisions. During our site visits, we noticed that when there is a production problem, a light goes off so everyone is aware of the problem. Then workers get together and collaborate to resolve the problem. As a result, there might be a benefit on quality and inventory metrics although the labor productivity numbers might suffer temporarily. Because the time spent on developing coordination and decision-making cannot translate easily into high performance, working in a team environment may be a waste of productive time and reduce plant labor productivity in the short term (Nahavandi & Aranda, 1994). In practice, companies have been found to reduce team participation after workers reported that their performance suffered from too many team meetings and their inability to generate appropriate decisions (Zemke, 1993). In contrast, inventory turnover is a multidimensional outcome that can be influenced by factors other than HRM practices and workforce efforts (Demeter & Matyusz, 2011; Gunasekaran & Kobu, 2007; Sundar et al., 2014). Those factors (e.g., supply of raw materials or sales of finished goods) may buffer against the short-term disruptive effect of HPWT implementation on inventory turnover and make the initial decline less significant. Future research can look into this issue and explore whether other factors that could not be measured in the current study can help explain the effects of HPWT implementation on different performance outcomes in the disruption stage.

The positive effects of HPWT implementation after adaptation were also different for the two dependent variables. The postimplementation growth rate was significantly higher than the preimplementation rate for inventory turnover but not for labor productivity. It is possible that the traditional job design already works well to maintain productive efficiency in the assembly line manufacturing environment like our research setting, which leaves limited room for HPWTs to further enhance the growth rate of plant labor productivity. By contrast, inventory turnover depends more on the coordination between manufacturing workers and other related departments. As a result, inventory turnover may benefit more from HPWT implementation in the long run because HPWTs allow employees to coordinate work activities that enhance plant inventory turnover.

The two dependent variables employed in the study might be capturing two fundamentally different dimensions of performance to varying degrees: efficiency and effectiveness. A colloquial way to characterize the distinction between these two dimensions is that effectiveness is about doing the right thing whereas efficiency is about doing the thing right. Labor productivity is primarily associated with measurement of efficiency of the front-line workers. On the other hand, inventory turnover is related more to effectiveness as well as efficiency. Studies in the manufacturing domain have demonstrated a link between low inventory and better quality (Sundar et al., 2014). This is because inventory can be a buffer against quality issues on the shop floor, and this makes it difficult to identify and eliminate quality problems. Shop floors that are very lean with lower inventory levels are thus associated with better quality. This leads to an interesting and academically worthwhile conjecture about the differential impact of HPWTs on efficiency-oriented measures versus effectiveness-oriented measures of performance. We hope that this spurs future research in examining these nuances in evaluating success of HPWTs.

Practical Implications

Our research findings also provide important implications for managers and practitioners. Most studies examining the effects of work teams evaluate whether or not there is a significant relationship at a certain point in time. In other words, those studies can only capture the abstraction of reality in a snapshot. However, our research attempts not only to examine whether HPWTs influence performance outcomes but also to explore when organizations can expect to benefit from their investment in the team-based design. The findings suggest that time is needed to realize the potential of HPWTs. Therefore, the timing of the evaluation is very crucial in assessing true benefit from the adoption of team-based designs. Failure to account for the temporal nature of the effects may potentially result in erroneous conclusions. Moreover, managers need to understand that the implementation of HPWTs is a multilevel phenomenon as HPWTs are implemented at the team level but can influence higher-level performance outcomes. They need to develop a broad picture to manage multiple teams as a whole to achieve higher-level impact of HPWTs. In addition, the effects of HPWT implementation may be different depending on the type of performance outcomes. Managers should not expect all performance criteria to benefit from implementation of HPWTs.

Limitations and Directions for Future Research

As with all research, our study is subject to several limitations that lead to directions and opportunities for future research. First, like other field quasi-experiments (Grant & Wall, 2009), we did not randomly assign the plants to implement HPWTs during our study period. It is possible that the plants that went first to implement HPWTs were more enthusiastic about HPWTs and thus more motivated and able to take advantage of HPWTs. To further rule out the alternative explanations for our findings, we encourage future research to randomly assign work units to implement HPWTs when such kind of opportunity exists.

Second, we examined the influence of HPWT implementation on performance outcomes by examining performance growth rates before and after implementation of HPWTs. In this setting, we only knew the *when* but not the *how* of implementation of HPWTs in each plant. It is possible that each plant implemented HPWTs to a different extent, which might influence the effects on performance outcomes, although this is minimized to a large extent because of the controlled environment (similar plants within the same division). Future research may collect repeated measures of HPWTs to enable a more rigorous examination of their longitudinal effects on performance outcomes.

Third, our study only examined how the outcomes are affected by implementation of HPWTs. It is possible that the teamwork training offered before HPWTs might also have influenced production workers' skills and motivation, especially in the early stage of HPWT implementation. We cannot rule out this possibility as the training was provided to prepare workers for implementation of HPWTs. However, such training was only offered once, whereas HPWTs were built into the organizational structure permanently. Therefore, it may be more reasonable to attribute the changes in performance outcomes over time to implementation of HPWTs. Relatedly, we cannot perfectly rule out all alternative explanations (e.g., other changes during the study period) for the effects of HPWT implementation in this study, but the control plants we included in the analyses may help reduce the concern about alternative explanations.

Fourth, work team research suggests that teams influence organizational outcomes by affecting employee behavior and attitudes (e.g., Kozlowski et al., 1999; Mathieu et al., 2008). Our hypotheses also assume that it is employees who adapt to HPWT implementation and make a subsequent contribution to operational performance. However, we were not able to measure employee outcomes directly in this research. Future research can extend our study by collecting repeated measures of employee outcomes and examining whether the trajectories of employee outcomes follow a pattern similar to the adaptation model, and whether employee outcomes mediate the longitudinal influence of HPWT implementation on performance outcomes.

Fifth, we posit a two-phase change in performance outcomes after implementation of HPWTs. In reality, it is possible that the trajectories of performance outcomes may follow a cubic trend or other temporal trends. For example, Ployhart and Hale (2014) suggest that there is some point at which performance outcomes reach a peak and then begin to decline. Accordingly, we conducted some supplementary analyses and found that there was not a cubic trend of performance outcomes in our sample.[2] Perhaps a performance window of 48 months may not be long enough to identify

[2] In the supplementary analyses, we first replaced post-HPWT (stage 1) and post-HPWT (stage 2) with post-HPWT and its quadratic term. For both labor productivity and inventory turnover, we found statistically significant and positive coefficients of the quadratic term. The results suggested U-shaped changes in the postimplementation growth rates. We then included a cubic term of the post-HPWT and found nonsignificant results for both outcomes.

the cubic growth trend. Future research can collect performance data for a longer time period to further explore the longitudinal effects of work team implementation.

Sixth, although our sample of similar plants helps control for contextual factors that may influence research results, it limits our ability to examine potential moderators of the longitudinal HRM effects on performance outcomes. For example, team composition in terms of cognitive ability and personality may influence how quickly employees can adapt to the change in work teams (e.g., LePine, 2003, 2005). By examining the potential moderators, future research can help understand the boundary conditions of the effects of HPWT implementation over time.

A final limitation concerns the ability to generalize the findings to other manufacturing plants or industries. Because the data analyzed were from manufacturing plants that were not selected randomly, the findings reported may not be generalized to other types of organizations. For example, manufacturing units often have standardized work rules and procedures to ensure efficiency and safety (Combs, Liu, Hall, & Ketchen, 2006). This standardization may make it difficult and costly to adapt to a new team-based work system. Future research can verify our research findings by studying large and random samples from different work contexts.

Conclusion

This study draws upon the literature of team development and adaptation and organizational change to theorize and examine the longitudinal effects of HPWT implementation on two plant-level performance outcomes. Our findings suggest that implementation of HPWTs may not have a positive influence on organizational performance immediately after the implementation. Instead, it may take time for organizations to realize the full value of their investment in HPWTs. The study contributes to work team implementation research by clarifying how the effects of HPWT implementation on performance outcomes change over time. Our study also provides implications for future research on longitudinal effects of work teams. We encourage more studies to verify and extend our research findings in the future.

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