ABSTRACT

Title of Dissertation:	THE ANTECEDENTS OF SAFETY LEADERSHIP
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Although a growing body of research shows that safety leadership is a strong predictor of safety outcomes in the construction industry, the factors that affect safety leadership are under-explored. Consequently it is unclear how to develop effective interventions to promote safety leadership. This dissertation addresses this void by adopting the Job Demand-Resource (JD-R) model grounded in positive psychology to identify what and examine how organizational and personal factors influence construction leaders' engagement in safety leadership.

This dissertation consists of three parts. The first part presents the theoretical model, which draws on the JD-R framework, used to investigate the antecedents of safety leadership. The model includes risk perception, work autonomy, and social support as organizational factors, as well as psychological capital (PsyCap) as a personal factor, that could affect leaders' engagement in safety leadership. The second part tests the model using data from a survey of 383 construction leaders in a large U.S. construction firm. Structural equation modeling showed that work engagement significantly influences safety leadership, while psychological capital

(PsyCap), social support, work autonomy, and risk perception significantly contribute to work engagement. These results indicate that the JD-R model can be extended to study safety leadership, and that improving work engagement, by enhancing organizational and personal resources, is critical for promoting safety leadership. In addition, PsyCap was found to moderate the relationship of social support on work engagement as a substitute interaction. This means that work engagement can be improved by either enhancing social support or PsyCap. The third part of this study further tests the direct effect of the organizational and personal factors studied in the second part on safety leadership. Multiple regression showed that PsyCap, social support, and work autonomy are important for safety leadership. PsyCap is particularly influential in strengthening safety leadership.

THE ANTECEDENTS OF SAFETY LEADERSHIP

By

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Chapter 1: Introduction

1.1 Review of safety leadership literature

1.11 Definition of safety leadership

In recent years, interest in safety leadership has increased as researchers have consistently found that leadership is an important antecedent of employees' safety perceptions, attitudes and behaviors that drive safety outcomes (Barling, Loughlin, & Kelloway, 2002; Conchie & Donald, 2009a; Kelloway, Mullen, & Francis, 2006). Safety leadership generally refers to a set of leadership behaviors that influence subordinates' behaviors to attain particular safety goals. Specifically, safety leadership can affect subordinates' behaviors on handling safety issues in both direct and indirect ways. The indirect ways could be the establishment of norms relating to safety practices and procedures, thus cultivating a particular safety culture. The direct ways could relate to their reinforcement of employees' safe behaviors through monitoring and control. As a result, these leader behaviors directly and indirectly influence subordinates' expectations and motivations, thus influencing subordinates' safe or unsafe behaviors (Flin & Yule, 2004).

1.12 Safety leadership in terms of transactional and transformational leadership

To further develop the theoretical concepts of safety leadership, researchers have tried to explain effective safety leadership in terms of various leadership styles studied in leadership literature. Transformational and transactional leadership are the

two most frequently cited (Clarke, 2013; Inness et al., 2010; Zohar & Tenne-Gazit, 2008). Transactional and transformational leadership are well-grounded theories in leadership literature (Bernard M. Bass, 1985), providing a conceptual foundation for all leadership (Flin & Yule, 2004).

According to Bass's (1985) model, transactional leadership encompasses three components. The first component is contingent reward, which means leaders set expectations and reward followers for meeting expectations. The second component is management-by-exception active, which means leaders monitor followers' performance and correct their actions prior to the occurrence of serious problems. The third component is management-by-exception passive. It means leaders monitor followers' performance and take corrective actions once problems have occurred. Bass argued that this transactional relationship between leaders and subordinates is likely to produce expected performance because this relationship sets goals and creates aspirations. Leaders use various transactional component in their daily interactions with subordinates; however, according to Bass, only leaders of the highest performing team show transformational behaviors in addition to transactional behaviors.

Transformational leadership consists of four dimensions. First, individualized consideration takes place when leaders show interest in subordinates' personal and professional development and listen to their needs and concerns. Second, idealized influence occurs when leaders behave in admirable ways that lead subordinates to believe that they can be understood by their leaders. The third dimension is inspirational motivation, which means leaders inspire others towards goals, provide

meaning, and articulate visions that sound attractive and inspirational to others. Finally, intellectual stimulation takes place when leaders challenge assumptions and encourage others to tackle problems in different ways.

Figure 1 shows how transformational leadership builds on transactional leadership through the so-called augmentation effect. The effective use of transformational leadership can motivate subordinates to set higher goals and to make additional effort to accomplish them. As a result, transformational leadership can help to improve performance beyond expected levels. In other words, transformational leadership can explain unique variance in extraordinary performance over and above what transactional leadership can do.

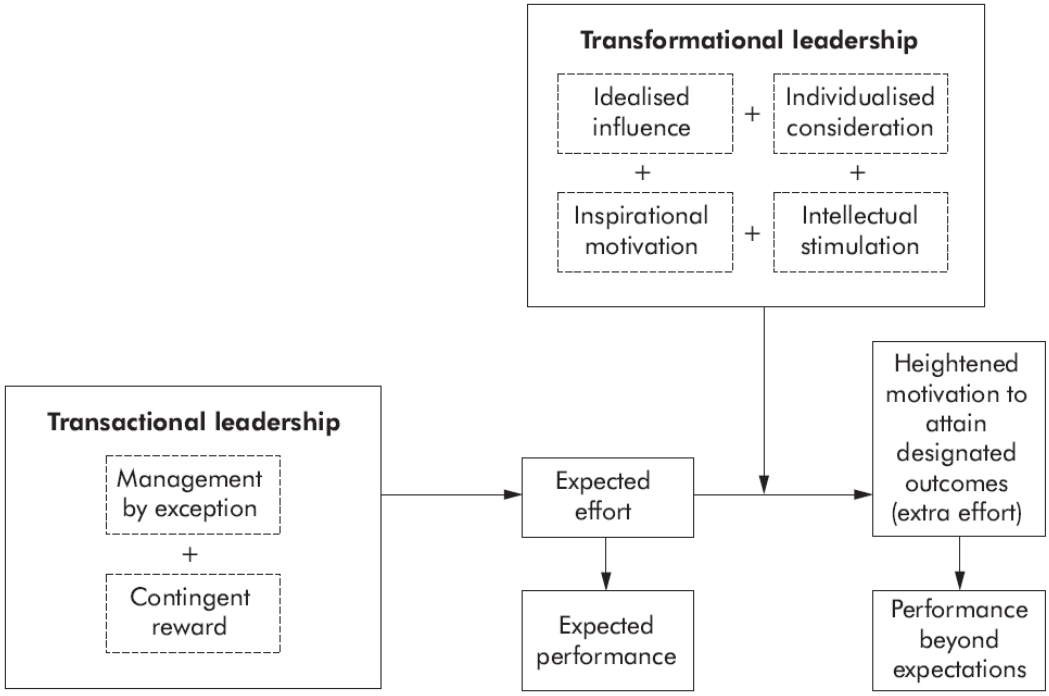


Figure 1 The augmentation effect of transformational on transactional leadership (adapted from Bass and Avolio, 1990, p.238)

As mentioned earlier, safety leadership is mostly explained in terms of the effects of transactional and transformational leadership. Flin & Yule (2004) categorized safety leadership behaviors in terms of transactional and transformation leadership as shown in figure 2.

Leadership behaviours for safety

	Transactional behaviours	Transformational behaviours
Supervisors	Monitoring and reinforcing workers' safe behaviours Participating in workforce safety activities (can also be transformational)	Being supportive of safety initiatives Encouraging employee involvement in safety initiatives
Middle managers	Becoming involved in safety initiatives (can also be transformational)	Emphasising safety over productivity Adopting a decentralised style Relaying the corporate vision for safety to supervisors
Senior managers	Ensuring compliance with regulatory requirements Providing resources for a comprehensive safety programme	Demonstrating visible and consistent commitment to safety Showing concern for people Encouraging participatory styles in middle managers and supervisors Giving time for safety

These behaviours have been drawn from the empirical research reviewed in this paper and classified according to transactional/transformational leadership theory.[10]

Figure 2 Leadership behaviors for safety (adapted from Flin and Yale, 2004, p.46)

By using transactional and transformational leadership to explain safety leadership, researchers have examined how these two types of leadership style may relate to different safety behaviors and outcomes. For instance, Zohar & Tenne-Gazit (2002; 2008) found that transformation leadership is the predictor of safety climate. Inness et al. (2010) concluded that transformational leadership is positively related to safety participation as transformational leaders are good at encouraging subordinates to participate in safety activities. Zohar (2002) report that transactional leadership is associated with lower accident rates. Clarke (2013) conducted a meta-analytic review of 103 safety studies and found that transactional leadership is important to safety

compliance, whereas transformational leadership is important to safety participation. Hoffmeister et al. (2014) investigated how each dimension of transactional and transformational leadership influenced five safety outcomes: safety climate, safety compliance, safety participation, injury and pain. The results showed that the dimension of idealized attributes and behaviors under transformational leadership accounted for the most variance across all safety outcomes, whereas active management-by-exception under transactional leadership consistently accounted for the least amount of variance. This could imply that transformational leadership is more predictive than transactional in leadership for driving better safety outcomes.

1.13 Safety-Specific transformational leadership

With the growing amount of safety literature revealing the importance of transformational leadership on safety performance, Barling, Loughlin and Kelloway (2002) developed a construct called safety-specific transformational leadership (SSTL) to capture the variance in safety outcomes beyond the variance accounted for by general transformational leadership. (Barling et al., 2002). In particular, SSTL consists of five components: idealized influence, inspirational motivation, intellectual stimulation, individualized consideration and contingent reward. The first four components are from transformational leadership, whereas the last component, contingent reward, is from transactional leadership. Contingent reward was included in the construct because the factor analysis suggested that contingent reward consistently loads together with the four components of transformational leadership

In SSTL, leaders with high 'idealized influence' demonstrate their own personal commitment to safety, thus facilitating higher levels of follower trust that management considers safety important. Leaders demonstrate 'inspirational motivation' when they challenge followers to go beyond their personal needs for the collective well-being. For instance, leaders convince their followers to achieve high levels of safety standards, using stories to clarify their mission. By using 'intellectual stimulation', leaders challenge their followers to question long-held assumptions and motivate them to think about creative ways that could improve occupational safety. In addition, leaders manifesting 'individualized consideration' express an active interest in their followers' well-being, including their work safety. Lastly, leaders make use of 'contingent reward' to encourage and reinforce followers' safety behaviors.

Numerous studies have found a strong and positive association between SSTL and safety outcomes. For example, Koster, Stam, & Balk (2011) found that SSTL is negatively associated with accident rate. (Conchie & Donald, 2009) suggested that SSTL had a significant effect on subordinates' safety citizenship behavior. Mullen & Kelloway (2009) reported that SSTL is positively related to safety climate. Kelloway et al., 2006) found that SSTL is positively associated with safety climate and safety consciousness.

1.2 Research purpose and objectives

Unsafe work practices such as falls, electrocutions, and stuck by object continue to pervade in the construction industry of the United States, resulting in high fatalities, work related injuries and occupational diseases. For instance, according to the Occupational Safety and Health Administration (OSHA), 899 construction

workers were killed on the job in 2014. As a result, the construction industry had the highest count of fatal occupational injuries in 2014 among all industries (as shown in Figure 3). It also ranked fifth among industries in the number of cases of occupational injuries and illness (as shown in Figure 4).

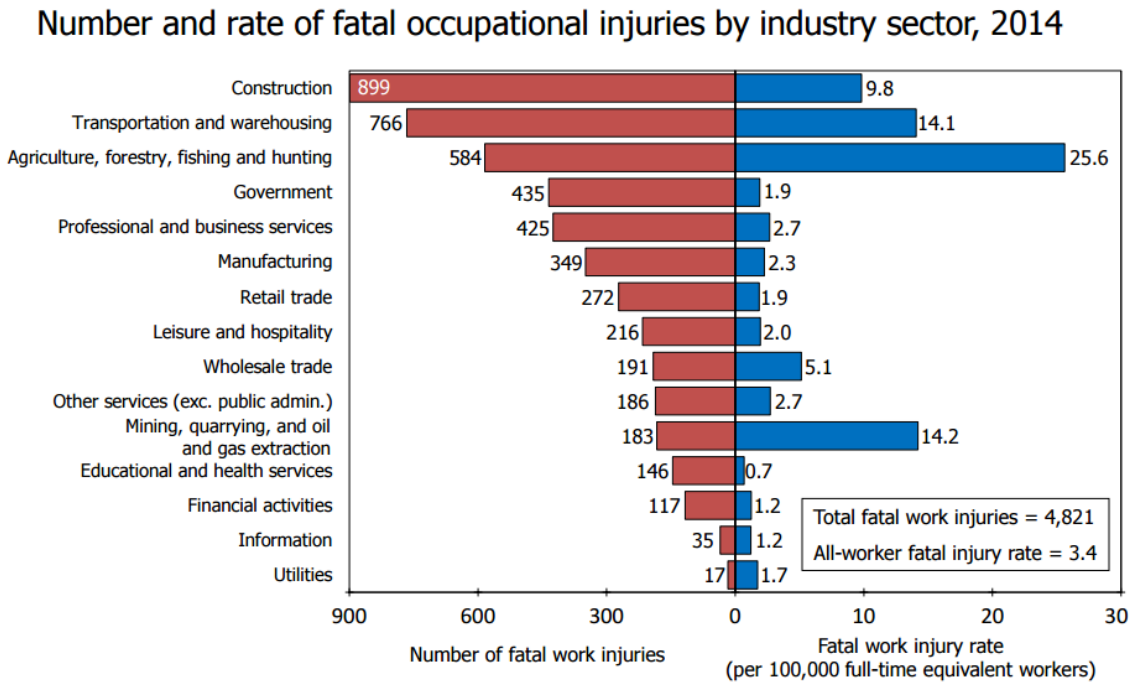


Figure 3 Number and rate of fatal occupational injuries by industry section, 2014, adapted from OSHA

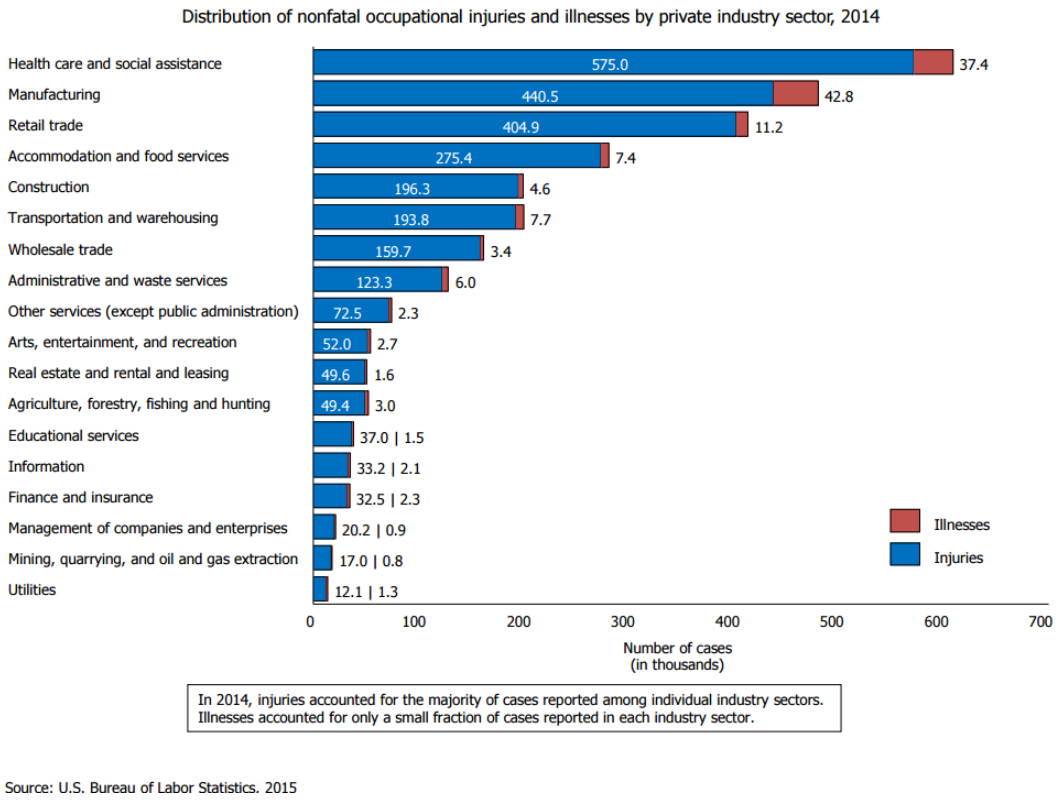


Figure 4 Number of occupational injuries and illness (adapted from OSHA, 2014)

Preventing occupational deaths, injuries and illnesses to achieve better safety performance should be, and is, a major concern for any industry; however, the need for attention and action may be higher in the construction industry than in other industries. To tackle the issue, researchers have recently identified safety leadership as a key factor in moderating the prevalence of accidents and injuries in the workplace (e.g., Slates, 2008; Wu et al., 2011; Yule, Flin, & Murdy, 2007).

Safety leadership generally refers to a set of leadership behaviors that influence subordinates' behaviors to attain particular safety goals. Considering these positive goals, safety leadership can regarded as a positive organizational behavior. Additionally, safety leadership is often explained in terms of transactional and

transformational leadership styles. Barling et al. (2002) found that transformational leadership (Bass, 1985) is positively associated with safety climate when the leadership behavior is particularly focused on safety. Hence, Barling and his colleagues developed a new construct called safety-specific transformational leadership (SSTL) culled from general transformational leadership. Recent empirical evidence suggested that SSTL more specifically accounts for variance in safety outcomes beyond the variance accounted by general transformational leadership (Kelloway et al., 2006). Numerous studies indicate that SSTL is positively related to various safety outcomes. For instance, Koster, Stam, & Balk (2011) found that SSTL is negatively associated with accident rate. Conchie & Donald (2009) suggested that SSTL had a significant effect on subordinates' safety citizenship behavior. Mullen & Kelloway (2009) reported that SSTL is positively related to safety climate. While the effectiveness of safety-specific transformational leadership is well established, precisely what factors and how they affect leaders' engagement in SSTL is unclear.

Without knowing what factors promote SSTL significantly hinders us from developing effective interventions that target resources toward enhancing these factors. In addition, by understanding the antecedents of SSTL, we can examine the underlying mechanisms of how different factors affecting SSTL. By doing so, we can build a more comprehensive model of SSTL to achieve better safety performance. As such, the research objectives are as follows:

1. Identify what organizational and personal factors affect SSTL.
2. Investigate why those factors are important to SSTL.
3. Understand how those factors might influence SSTL.

1.3 Dissertation structure

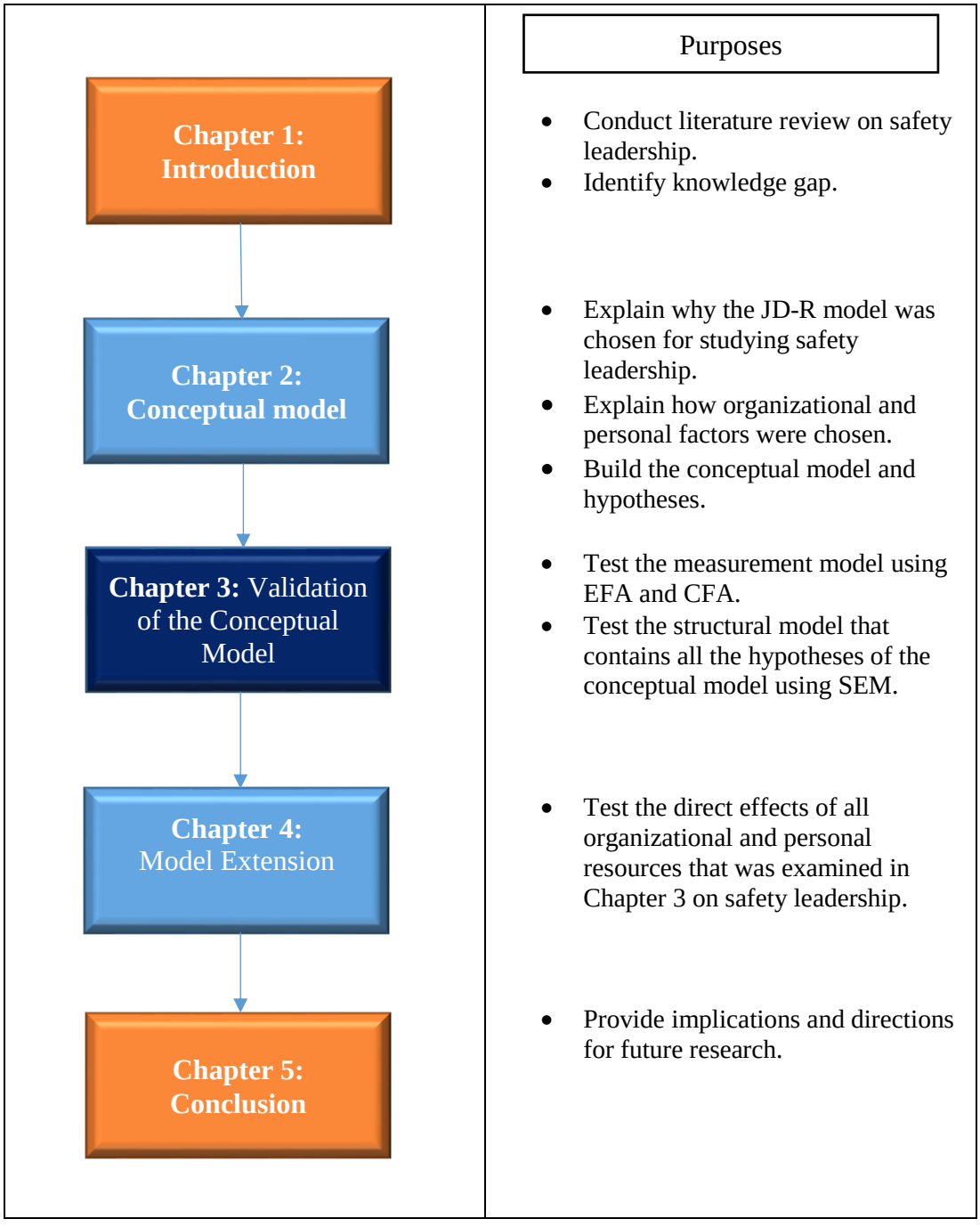


Figure 5 Dissertation structure by chapter

Chapter 2: What predicts safety leadership? A positive psychology perspective.

2.1 Introduction

This is a theoretical literature review that examines how personal factors and organizational context may affect construction leaders' engagement in safety leadership. Construction leaders are professionals who help manage construction work. Some leaders work in the top management level to oversee a company's strategies and portfolios of construction projects, while others work at the frontend with construction workers to ensure construction activities are on schedule and budget. All construction leaders are related to safety leadership as construction work is hazardous by nature. Safety leadership is generally regarded as leadership behaviors that have positive impact on employees' safety behaviors. In this paper, we extend other overviews of safety leadership research (e.g., Clarke, 2013; Flin & Yule, 2004) to specifically consider how the Job Demands-Resources (JD-R) model grounded in positive organizational behavior theory can inform our understanding of the potential factors and mechanisms that drive safety leadership behavior.

Over the past few decades, numerous studies have pointed out that safety leadership is a critical factor closely linked to safety climate and safety outcomes. For instance, in a review of two decades of safety climate research, Flin et al. (2000) found that 72% of the literature had concluded that leadership is central to cultivating a safety climate. Their findings suggest that leaders' day-to-day behavior reflects their priority on safety, and employees interpret those behaviors to generate norms and

perceptions on how they should handle safety at work. Building on this foundation, Wu et al. (2011; 2008) found that safety leadership positively affects safety performance through the cultivation of a safety climate.

In spite of the growing interest in safety leadership, there has been minimal research on what affects leaders' engagement in this role (Clarke, 2013; Conchie, Moon, & Duncan, 2013). This gap could significantly hinder us from developing effective interventions that target resources toward enhancing the contributing factors of safety leadership. To successfully design these interventions, we need to investigate two key issues: (1) what factors lead to one's engagement in safety leadership behavior; (2) how those factors relate to one another to drive safety leadership behavior. Therefore, the aim of this paper is to identify an underlying mechanism that can explain how various factors could affect an individual's engagement in safety leadership. Our point of departure is that the JD-R model, a widely-used theoretical framework in studying positive organizational behavior. In particular, we propose that the JD-R model explains how and why certain personal and organizational factors could foster construction leaders' engagement in safety leadership.

To sum up, this paper is based on the framework of the JD-R model shown in Figure 6. Figure 7 illustrates the selected theoretical concepts that have the potential to explain what drives construction leaders' engagement in safety leadership and related mechanisms. The arguments and associated hypothesis will be illustrated in the following sections in a concept-by-concept manner.

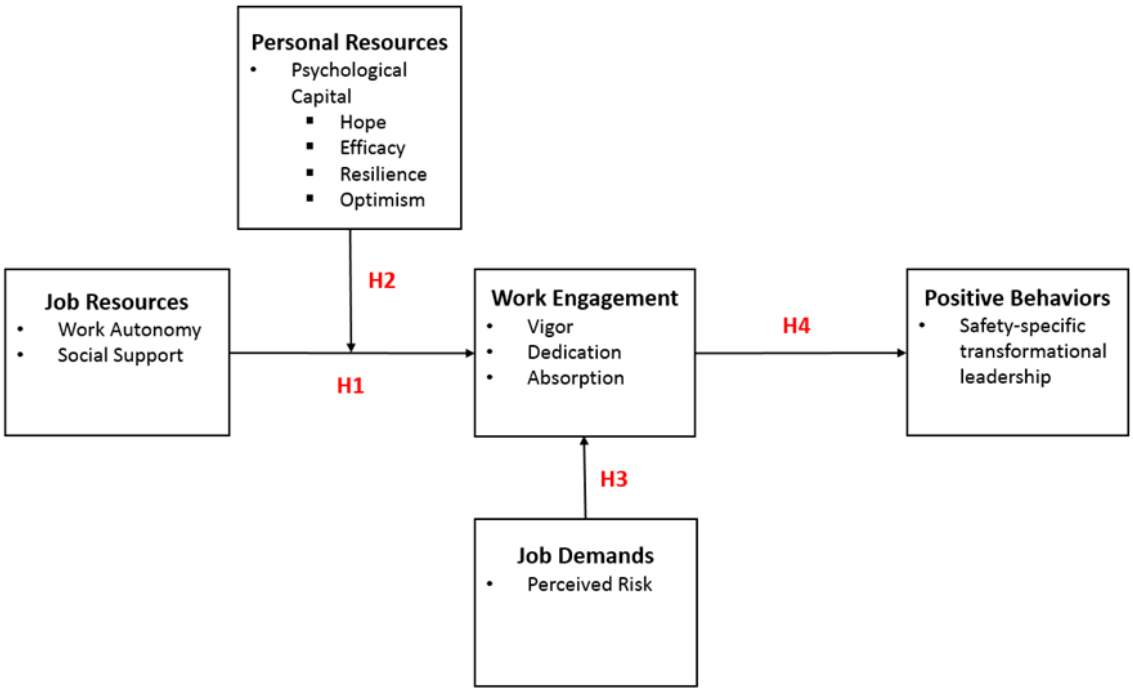


Figure 6 Proposed model linking social support, work autonomy, PsyCap and perceived risk to work engagement and safety leadership

2.2 Applying the JD-R model to safety leadership

Safety leadership is generally defined as leaders' positive behavior in handling organizational safety issues (e.g., Mullen & Kelloway, 2009; O'Dea & Flin, 2001; Slates, 2008). While safety leadership is regarded as a positive organizational behavior, the JD-R model, grounded in positive organizational behavior theories and first introduced by Demerouti and her colleagues in 2001, has been widely used to study various positive organizational behaviors including safety behavior (see Table 1). Thus we believe that the JD-R model could be a fruitful approach to understand what and how factors are related to safety leadership.

Figure 6 summarizes the JD-R model. At the heart of the JD-R model, it assumes that work behaviors result from an interaction among work characteristics,

personal resources, and work engagement (Schaufeli & Taris, 2014). In particular, it proposes every occupation has its work characteristics associated with job-related stress. These factors can be classified into the two general categories: job demands and job resources (Schaufeli & Bakker, 2004a). Job demands refers to "physical, psychological, social, or organizational aspects of the job that require sustained physical and/or psychological (cognitive and emotional) effort or skills and are therefore associated with certain physiological and/or psychological costs" (Demerouti & Bakker, 2011, p.2). Job resources, on the other hand, refer to "those physical, psychological, social, or organizational aspects of the job that are: (1) functional in achieving work goals; (2) reduce job demands and the associated physiological and psychological cost; or (3) stimulate personal growth, learning, and development' (Demerouti & Bakker, 2011, p.2). In addition, the JD-R model assumes that each individual possesses different levels of personal resources that help him or her to control and impact the environment successfully (Xanthopoulou et al., 2007).

To generate positive organizational behavior, the JD-R model posits the underlying psychological processes that are motivational in nature. It is assumed that job and personal resources have motivational potential and lead to high work engagement and thus positive behavior. However, job demands may play a negative role in this motivational process because they could lead to exhaustion and excessive stress, which deplete one's energy and capacity to engage in work. In other words, job demands may negatively affect work engagement (Schaufeli & Taris, 2014). Indeed, work engagement is defined as an active and positive work-related state of

mind, which is the centerpiece of the JD-R model (Schaufeli & Bakker, 2004). It links work characteristics (job demands and job resources) and personal resources with various positive work behaviors as listed in Table 1.

By using the JD-R model as a framework, the following sections explain why and how job resources (work autonomy and social support) and personal resources (psychological capital) may affect construction leaders' engagement in safety leadership.

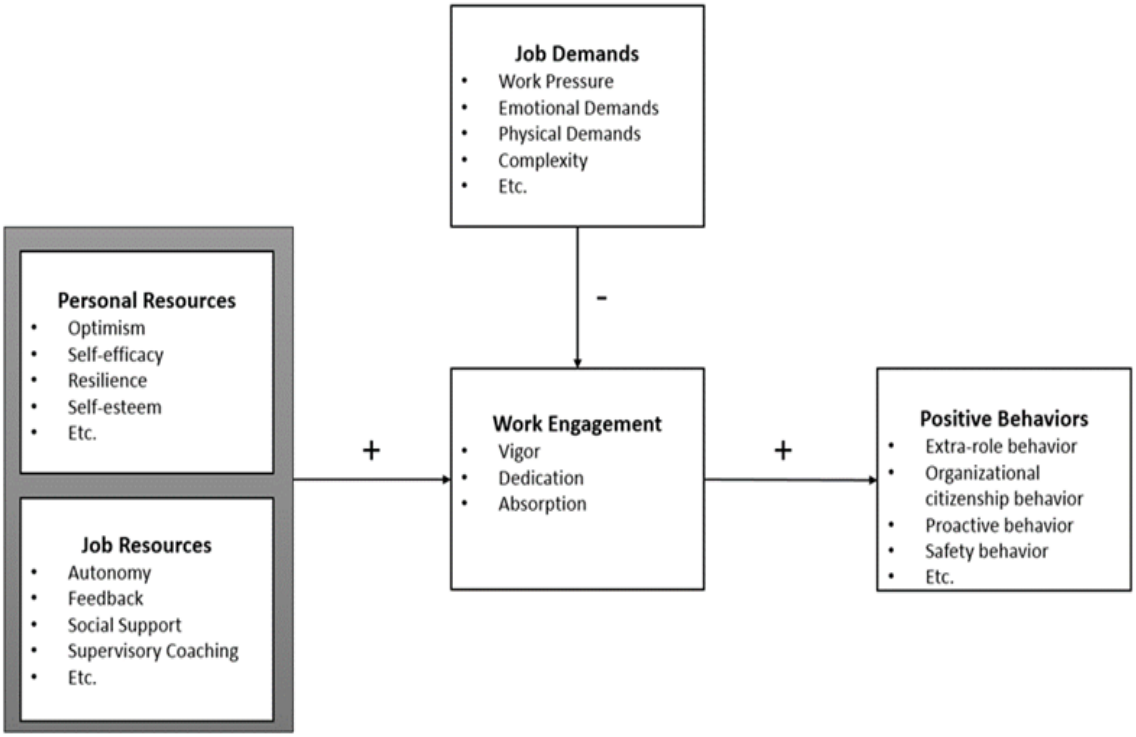


Figure 7 JD-R model based on Bakker and Demerouti (2007)

Positive Organizational Behavior	Example References
1. Extra-role behavior	Albrecht (2012), Bakker & Bal (2010), Bakker, Demerouti, & Verbeke (2004)
2. Job satisfaction	Nielsen et al. (2011); Tims, Bakker, & Derks (2013)
3. Job crafting behavior	Bakker, Albrecht, & Leiter (2011)
4. Organizational citizenship behavior	Babcock-Roberson & Strickland (2010)
5. Organizational commitment	Brunetto et al. (2012); Hakanen, Schaufeli, & Ahola (2008)
6. Personal Initiatives	Hakanen, Perhoniemi, & Toppinen-Tanner (2008)
7. Proactive behavior	Salanova & Schaufeli (2008)
8. Safety behavior	Conchie et al. (2013); Hansez & Chmiel (2010); Li et al. (2013); Nielsen et al. (2011); Turner et al. (2010)
9. Type A behavior (extrinsically motivated behavior)	Hallberg, Johansson, & Schaufeli (2007)
10. Work Identity	De Braine & Roodt (2011)

Table 1 Example studies using the JD-R model to analyze positive organizational behavior

2.3 Job Resources: work autonomy and social support

Job resources refer to working conditions that provide resources for individual employees to achieve work goals, to reduce negative job demands, and to stimulate personal growth (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001a). In other words, job resources can foster individual learning and thereby increase job competence, which is the ability to complete work tasks (Bakker & Bal, 2010). According to social cognitive theory (Bandura, 1997), when people believe that they are capable of completing their work tasks, they are more likely to perform their work energetically and stay focused when handling challenges along the way. In short, job resources enable people to engage in their tasks and perform well. Thus the JD-R

model proposes that higher levels of job resources lead to higher work engagement, and vice versa.

In fact, the two most frequently examined job resources in the JD-R model are work autonomy and social support. Work autonomy refers to the extent that an individual feels in control of the ways to get his or her job done (Breaugh, 1999). People with high levels of work autonomy have strong ownership of their behavior, strong relatedness to their organizations, and strong belief in their competence in performing the work (Edward & Ryan, 1985). This positivity enables them to dedicate their energy and abilities to their work tasks, which results in high levels of engagement.

Social support can come from supervisors (Turner et al., 2010; Zohar & Luria, 2003) or co-workers (Cheyne et al., 1998). Social support could play an intrinsic motivational role because it fosters employees' growth, learning, and development (Bakker & Bal, 2010). For instance, supportive supervisors give constructive feedback to employees and provide them with necessary training for achieving work goals. In such conditions, employees are more motivated to put in their energy and apply their capabilities in doing their jobs, thus leading to high levels of work engagement.

Indeed, work autonomy has been found to promote safety in general. Work autonomy has been related to lower injury rates, taking over safety responsibility, and properly handling safety risk (Grote & Künzler, 2000; Leplat, 1984; Shannon, Mayr, & Haines, 1997). Furthermore, Grote (2007) concluded that autonomy has the strongest impact on safety when desired behavior is not rule-based and when there is

a high level of uncertainty. Interestingly, based on the focus group study conducted by Conchie et al. (2013), effective safety leadership in the construction industry is often defined as behavior performed beyond formal role obligations under the dynamic nature of construction work. These studies indicate that work autonomy might be expected to be a job resource that promotes construction leaders' engagement in safety leadership.

Social support was also found to be related to safety. Specifically, it is one of the most consistent resources that leads to individuals' engagement in safety across different industries (Nahrgang et al.,2011). In general, social support refers to the support from supervisors and co-workers. For instance, Zohar and Luria (2003) concluded that supervisor support results in positive changes in workers' safety behavior and safety climate scores. In the same vein, Turner et al. (2010) suggested that when workers perceive high levels of supervisor support, they have a lower number of hazardous work events. He also found that co-worker support is critical for the maintenance of employee safety performance.

The above findings suggest that social support is important for promoting construction leaders' engagement in safety leadership. For example, when construction falls behind schedule, support from management to expedite the process without sacrificing work safety would help construction leaders to engage in safety leadership even under significant production pressure. With these insights from the research reviewed in mind, we propose work autonomy and social support as the key job resources that promote construction leaders' engagement in safety leadership. This leads to our first research hypothesis (see Figure 2.1):

H1. Job resources (social support and work autonomy) relates positively to work engagement.

2.4 Personal resources: psychological capital

Personal resources are generally defined as personal characteristics that are positively linked to resilience and contribute to an individual's ability to control and influence his or her environment successfully (Hobfoll et al., 2003). In the JD-R model, personal resources are considered to affect the association between job resources and work engagement in two main ways. One, personal resources *mediate* the relationship between job resources and work engagement. For instance, Xanthopoulou et al. (2007) found that personal resources (self-efficacy, optimism, and self-esteem) partially mediate the positive relationship between job resources and work engagement. And two, personal resources *moderate* the relationship between job resources and work engagement. For example, Van den Broeck et al. (2011) report that personal resources (intrinsic work motivation and learning opportunities) increased the positive effect of job resources (work autonomy) on work engagement. In this paper, we focus on the moderation effect of personal resources, as it aligns with the Person-Environment (P-E) fit literature, which suggests that employees' values can alter the influence of job characteristics.

Among personal resources, Psychological Capital (PsyCap) has emerged as the most important personal resource studied in positive organizational behavior due to its significant impact on desirable work behaviors, such as job satisfaction,

organizational commitment, and organizational citizenship (Larson & Luthans, 2006; Lifeng, 2007; Luthans & Jensen, 2005). In addition, Buitendach (2013), Hodge (2010), and Spence et al. (2012) reported that PsyCap is positively related to work engagement.

PsyCap is defined as an individual's positive psychological state of development (Luthans et al., 2007). It is a high-order construct that consists of four psychological resources, namely hope, optimism, resilience, and self-efficacy (Luthans et al., 2004). PsyCap yields higher correlations with performance outcomes than any one of its four constructs independently (Avolio et al., 2007). More importantly, PsyCap can be developed and improved through training (Luthans et al., 2010).

When PsyCap is high, individuals appraise situations and circumstances in more positive, opportunistic, adaptive, and focused ways (Avey et al., 2010). Consequently, individuals are likely to perceive that they are capable of achieving work goals, and thus are more engaged in their job (Buitendach, 2013). That explains why PsyCap could have a positive impact on work engagement.

In addition to the positive influence on work engagement, PsyCap is also found to affect safety in general. For instance, Bergheim et al. (2013) and Hystad et al., (2013) concluded that PsyCap is positively related to safety climate in safety critical organizations. Bergheim et al. (2015) reported that PsyCap is related to safety perception in the maritime industry. As safety climate and safety perception are highly related to safety leadership (e.g., Flin, 2003; Yule, Flin, & Murdy, 2007), we therefore expect that PsyCap could foster construction leaders' engagement in safety

leadership. From this perspective, we propose to study PsyCap as personal resources in our model. In the following section, we will define the four constructs of PsyCap and explain how they may affect safety leadership.

Hope refers to an individual's 'willpower' and 'waypower' (Snyder et al., 1996). Willpower is one's determination to set and achieve goals, and waypower is an individual's ability to generate alternative pathways and contingency plans in order to achieve a goal in the face of obstacles (Snyder et al., 1991). In short, hope enables individuals to stay motivated in the process of achieving success by looking for the best pathway. From this perspective, we expect that construction leaders who are hopeful tend to set higher safety targets. To achieve those targets, they are highly motivated to engage in different safety leadership behaviors, such as establishing safety responsibility systems, acting on safety policies, and recognizing employees' safety behaviors.

Optimism is defined by persistence and pervasiveness which are two key dimensions of how people explain events (Seligman, 2011). Optimistic people tend to regard success as something with internal, stable and global attributions, whereas they interpret failure as something with external, unstable and specific attributions. As a result, optimistic people often see setbacks as opportunities that can eventually lead to success (Luthans et al., 2005). It is our view that optimism forms an important part of a construction leader's resource capacities as his or her optimistic approach to stressful and challenging construction situations could potentially make him or her stay enthusiastic and focused on performing safety leadership.

Resilience refers to one's ability to bounce back from adversity (Luthans, 2002). In the construction industry, construction leaders are constantly under great production pressure from various sources, such as tight project delivery schedules, constant changes requested by clients, and all sorts of technical issues. All these can distract them from managing work safety. However, with high levels of resilience, construction leaders are more able to bounce back from such work pressure, and thus regain the capacity to engage in safety leadership.

Self-efficacy is defined as an individual's conviction in his or her ability to mobilize the motivation, cognitive resources, and course of actions that are necessary to complete a specific task within a given context (Stajkovic & Luthans, 1998). It implies that individuals have the confidence to take on and put in the necessary effort to complete their work even if the work is challenging. In construction organizations, construction leaders must feel confident that they have the necessary skills and knowledge required to understand the risks and dangers involved in work operations, and the necessary leadership skills and self-confidence to manage safety issues. Thus self-efficacy can be regarded as fundamental to safety leadership.

As described above, previous research has found personal resources to be a mediator or moderator of the relationship between job resources and work engagement. Yet in this paper we focus on the moderation effect of personal resources, as it better aligns with the Person-Environment (P-E) fit literature, which suggests that employees' values could alter the influence of job characteristics. From this follows our second research hypothesis (see Figure 2.1).

H2. Personal resources (psychological capital) moderates the relationship between job resources and work engagement. That is, the effect of job resources on work engagement is strengthened when the level of psychological capital is high, and vice versa.

2.5 Job-Demands: risk perception

In the JD-R model, job demands are work conditions including the physical, psychological, social, or organizational dimensions that potentially impose strain if they go beyond the employee's adaptive capability, and thus cause depletion of one's work engagement. Therefore it is associated with physiological and/or psychological costs. Examples of job demands include high work pressure, destructive work environment, and emotionally demanding interactions (Bakker & Demerouti, 2007; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001).

With regard to occupation-specific job demands, the construction work environment is said to be hazardous because in this industry, the workplace can change daily, and the type of work varies greatly, from new construction, repairs or renovation, and building demolitions to reconstruction following natural disasters. In addition, the sector is also characterized by high numbers of unskilled and temporary workers, and construction sites with very changeable working environments due to weather conditions. All these produce great risks and dangers on construction processes include but are not limited to: fire, explosions, structural collapse, and accidents associated with slips, trips, and falls. Based on a sample of Spanish construction workers, Rodríguez-Garzón et al. (2015) reported that the construction

workers' risk perception is high although the hazards and accidents mentioned above may only take place on an irregular and infrequent basis. Therefore, risk perception seems to be a significant stressor in construction companies (Hallowell, 2010; Perlman, Sacks, & Barak, 2014). From this perspective, we propose to study risk perception as a source of job demands in our model.

Specifically, perceived risk is often regarded as the perceived likelihood that an individual will experience the effect of danger (Short, 1984). In fact, risk perception can be defined as a multidimensional construct that is a combination of one's evaluation of the likelihood of experiencing an accident or injury caused by exposure to risk, and emotions and cognitions related to it (Rosenbloom, 2003).

Although there has been limited research on how an individual's risk perception could affect his or her leadership behaviors in the context of safety, the impact of risk perception on worker behaviors has been widely studied. Numerous empirical studies (e.g., Frone, 1998; M. Goldenhar et al., 2003; Nahrgang et al., 2011) have reported that risk perception is negatively related to employees' engagement in safety activities, compliance, and job satisfaction because high levels of risk perception leads to burnout that is the opposite psychological state of engagement (González-Romá et al., 2006). Based on the above findings, we expect the relationship between risk perception and the engagement of safety leadership to follow a similar track. When construction leaders experience high levels of risk perception, they may become so overwhelmed by exposure to risk in their work environment that they experience excessive stress that in turn leads to burnout and disengagement in safety leadership. From this follows hypothesis four:

H3: Job demands (risk perception) relates negatively to work engagement.

2.6 Work engagement

Work engagement is the centerpiece of the JD-R model. It transforms work characteristics and personal resources into a psychological state that captures a positive, fulfilling, and work-related state of mind, resulting in various work behaviors (Schaufeli and Bakker, 2004). In particular, work engagement is characterized by vigor, dedication, and absorption. 'Vigor' refers to having high energy levels and mental resilience during work, being willing to put effort in one's work, and persevering even in adverse situations; 'dedication' is characterized by having a strong involvement in one's work and experiencing a sense of significance, enthusiasm, inspiration, pride, and challenge; and 'absorption' refers to being totally concentrated on and happily engrossed in one's work while time passes quickly, and one has difficulties in detaching oneself from work (Schaufeli and Bakker, 2004). In short, engaged employees have high levels of energy and are enthusiastic about their work. Thus, they are fully immersed in their work and thus don't notice the passage of time.

Work engagement as a positive state of mind is found to predict various positive work behaviors as listed in Table 2.1. With respect to safety, studies show that work engagement leads to desirable safety behavior. For instance, Hansez & Chmiel (2010) reported that higher work engagement is associated with lower "routine" and "situational" safety violations. Consistent with this view, Nahrgang et

al. (2011) found that work engagement is negatively related to unsafe behavior. These findings suggest that highly engaged workers are more likely to believe that they have more control over the work situation, and thus they are more able to mobilize their energies to comply with safety standards that lead to safe behaviors. In the same vein, we expect that highly engaged construction leaders are more likely to regard safety as an important and manageable aspect of their job, and thereby devote the necessary effort to manage safety issues through practicing safety leadership.

2.7 Safety leadership

Safety leadership is generally defined as leaders' positive behavior in handling organizational safety issues (e.g., Mullen & Kelloway, 2009; O'Dea & Flin, 2001; Slates, 2008). Because of its positive relationship to safety performance, safety leadership has sparked an interest in uncovering what leadership styles are effective in realizing such positive outcomes. In particular, transactional and transformational leadership styles have been particularly studied in the literature. Transactional leadership refers to employing rewards and punishment to motivate followers (Podsakoff, Todor, & Skov, 1982), while transformational leadership refers to using influence and enthusiasm to motivate followers to work for the benefit of an organization (Bass, 1990). For example, Barling et al. (2002) and Inness, et al. (2010) found that transformational leadership behavior predicts employee safety performance. In a meta study conducted by Clarke (2013), she suggested that active transactional leadership is critical for achieving compliance with safety rules and

regulations, whereas transformational leadership is important in encouraging employee participation in safety. Furthermore, Hoffmeister et al. (2014) concluded that transformational leadership, or more accurately, safety-specific transformational leadership, was a more predictable indicator of safety outcomes than transactional leadership in the construction industry. In light of Hoffmeister's findings, we decided to further examine safety-specific transformational leadership (SSTL) in our model.

SSTL refers to transformational leadership behaviors that specifically promote and develop a safe work environment (Barling et al., 2002). According to Barling et al. (2002), SSTL has five components: idealized influence, inspirational motivation, intellectual stimulation, individualized consideration, and contingent reward. In particular, leaders with high 'idealized influence' demonstrate their own personal commitment to safety, thus facilitating higher levels of follower trust that management considers safety important. Leaders demonstrate 'inspirational motivation' when they challenge followers to go beyond their personal needs for the collective well-being. For instance, leaders convince their followers to achieve high levels of safety standards, using stories to clarify their mission. By using 'intellectual stimulation', leaders challenge their followers to question long-held assumptions and motivate them to think about creative ways that could improve occupational safety. In addition, leaders manifesting 'individualized consideration' express an active interest in their followers' well-being, including their work safety. Lastly, leaders make use of 'contingent reward' to encourage and reinforce followers' safety behaviors. From this follows hypothesis three (see Figure 2.1):

H4: Work Engagement relates positively to safety-specific transformational leadership.

2.7 Implications for future research

The conceptual framework shown in Figure 8 not only offers new insights into understanding what and how different contextual and personal factors could affect construction leaders' engagement in safety leadership, but it also points to a few directions for future empirical research. First, the conceptual model was built upon the framework of the JD-R model shown in Figure 3.2. The JD-R model posits that job demands, job resources, and personal resources influence work behaviors through work engagement. We explained in the above sections why and how our proposed model expands upon the JD-R model. Thus, our conceptual model demonstrates the applicability of the JD-R model in conducting behavior-based safety research.

Second, we may need different levels and/or combinations of contextual and personal factors for supporting upper and lower management to engage in safety leadership. For instance, front-line supervisors may need more social support than top management in order to engage in safety leadership, because front line supervisors generally have fewer resources and leadership experience. Therefore, future research could develop and test the conceptual model by conducting a multi-level study.

Last, to empirically test the validity of our conceptual model in future studies, we suggest using survey designs and independent outcome measures, coupled with structural equation modelling (SEM) for data analysis. Basically, all the variables in the conceptual model have their own existing measurements, for example, work

engagement can be measured by the well-established Utrecht Work Engagement Scale (Schaufeli et al., 2002). Furthermore, we propose using SEM as the statistical method for testing our model for two reasons: 1) SEM can examine a series of dependence relationships simultaneously while other multivariate techniques cannot. For instance, in our conceptual model, increasing job and personal resources could increase work engagement, and work engagement could increase the application of safety leadership. Thus, work engagement is both a dependent and independent variable. In other words, a hypothesized dependent variable becomes an independent variable in a subsequent dependent relationship. To our knowledge, no multivariate techniques other than SEM is able to assess these relationships, and SEM also allows us to test both measurement properties and the key theoretical relationships using one technique.

2.8 Conclusions

Our main focus in this paper has been to develop a conceptual model for understanding what and how contextual and personal factors could affect construction leaders' engagement in safety leadership, and thus it provides us with insights into how safety leadership could be better supported and promoted. Our central argument is twofold. First, the application of safety leadership is positively affected by work engagement. Second, by supporting job resources (social support and work autonomy) and personal resources (psychological capital), and properly calibrating job demands (risk perception), organizations potentially set a positive wheel of work engagement and safety leadership for delivering better safety outcomes.

Chapter 3: Using the Job-Demands Resources Model to investigate safety leadership in the construction industry: An multi-level approach

3.1 Introduction

According to the Occupational Safety and Health Administration (OSHA), the construction industry has been classified as one of the most hazardous industries in the United States in terms of both fatal and non-fatal accidents. For instance, in 2014, 899 construction workers lost their lives during production, accounting for 20% of occupational fatalities of that year (OSHA, 2014). Given the high financial and human costs involved in occupational injuries, researchers have devoted considerable effort to studying workplace safety. They have repeatedly pointed out that safety leadership is a critical factor affecting safety performance because leaders' behavior reflects the extent that safety is a priority at the workplace, and employees interpret those behaviors to generate norms and perceptions on how they should handle safety at work (e.g., Flin & Yule, 2004; Wu et al., 2011; Yule, Flin, & Murdy, 2007).

Although ample research has been conducted on safety leadership, few attempts have been made to understand how organizational and personal factors can affect construction leaders' engagement in this role (Clarke, 2013; Conchie et al., 2013a). In this paper, construction leaders refer to professionals who help manage construction work. Some leaders work in the top management level to oversee a company's strategies and portfolios of construction projects, while others work at the front end with construction workers to ensure construction activities are on schedule

and budget. Without knowing what drives them to engage in safety leadership significantly hinders us from developing effective interventions that can target resources toward enhancing the contributing factors of safety leadership.

In general, safety leadership is defined as leaders' positive behavior in handling organizational safety issues (e.g., (Mullen & Kelloway, 2009b; O'Dea & Flin, 2001; Slates, 2008), which in turn is regarded as a positive organizational behavior. Models relating job-related and personal factors to positive organizational behavior are prevalent (e.g., Bakker & Demerouti, 2008). The job-demand resources (JD-R) model as shown in Figure 8 is one of the well-established models that serves this purpose. Yet, little attention has been given to apply such a model in studying the potential factors affecting safety leadership.

In this paper, we aim to use the JD-R model framework to model how work-related factors in the forms of work autonomy, social support, and risk perception may affect construction leaders' engagement in safety leadership. Using contemporary leadership theories, we consider that the model's effects could be different across upper and lower management level. Thus, a multi-level approach is used in this study.

3.11 Overview of the job demands-resources (JD-R) model

The centerpiece of the JD-R model assumes that positive work behaviors result from work engagement, while work engagement is affected by job-related and personal factors (Schaufeli & Taris, 2014). Figure 8 shows the framework of the JD-R model. For job-related factors, the model categorizes them into the two types: job

demands and job resources (Schaufeli & Bakker, 2004a). Job demands refers to "physical, psychological, social, or organizational aspects of the job that require sustained physical and/or psychological (cognitive and emotional) effort or skills and are therefore associated with certain physiological and/or psychological costs" (Demerouti & Bakker, 2011, p.2). On the contrary, job resources refer to "those physical, psychological, social, or organizational aspects of the job that are: (1) functional in achieving work goals; (2) reduce job demands and the associated physiological and psychological cost; or (3) stimulate personal growth, learning, and development' (Demerouti & Bakker, 2011, p.2). In addition, the JD-R model assumes that each individual possesses different levels of personal resources that help him or her to control and impact his or her environment successfully (Xanthopoulou et al., 2007).

To generate positive organizational behaviors, the JD-R model posits the underlying psychological processes that are motivational in nature. It is assumed that job and personal resources have motivational potential and thus lead to high work engagement and positive behaviors. However, job demands may play a negative role in this motivational process because they could lead to exhaustion and excessive stress, which deplete one's energy and capacity to engage in work. In other words, job demands may negatively affect work engagement (Schaufeli & Taris, 2014). Work engagement is the center of the JD-R model. It is defined as an active and positive work-related state of mind (Schaufeli & Bakker, 2004), linking work characteristics (job demands and job resources) and personal resources with various positive work behaviors, such as safety behaviors, extra-role behaviors and proactive

behaviors (Albrecht, 2012; Hansez & Chmiel, 2010; Salanova & Schaufeli, 2008) . Although safety leadership is regarded as a positive organizational behavior, its antecedents have not been considered for study using the JD-R model. We believe that this study is the first empirical test whether work engagement processes relate to safety leadership, and thus whether the JD-R model can be extended to study safety leadership.

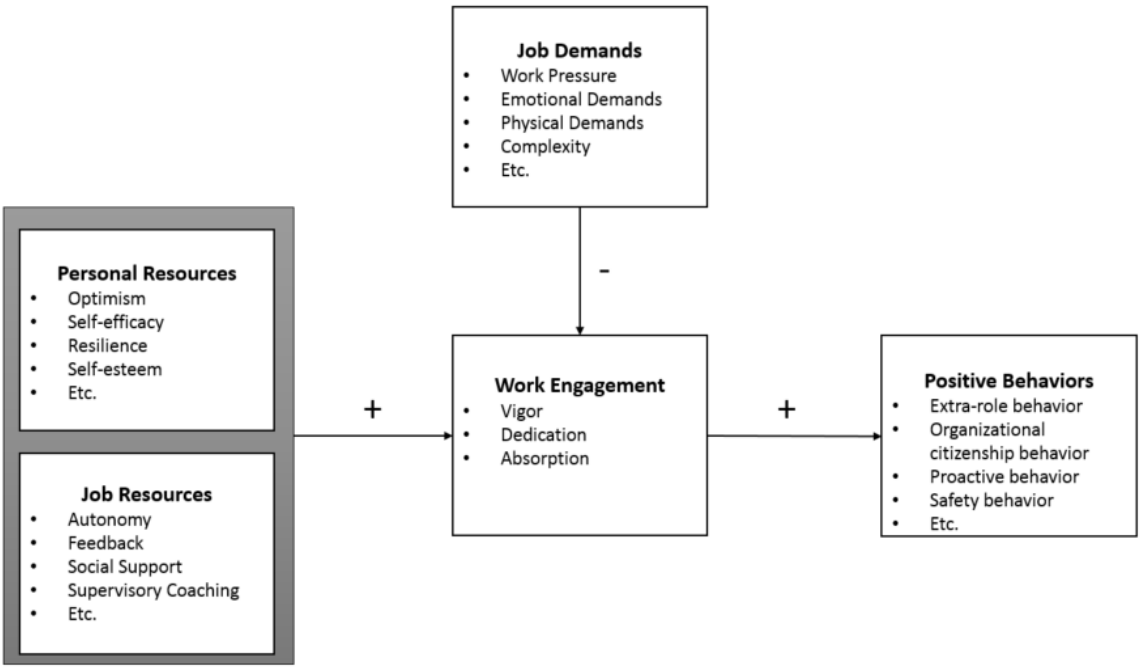


Figure 8 Job-demands resources (JD-R) model based on Bakker and Demerouti (2008)

3.12 Safety Leadership

As one of the positive organizational behaviors, safety leadership is generally defined as leadership behavior that has positive impact on employees' safety behavior. The importance of safety leadership is underscored by Clarke's (2013)

meta-analysis, which showed a generalizable association between safety leadership and safety performance across industries.

The two most studied leadership styles in the safety leadership literature are transactional and transformation leadership. Transactional leadership refers to the use of rewards and punishment to motivate followers (Podsakoff et al., 1982), while transformational leadership refers to employing influence and enthusiasm to motivate followers to work for the benefit of an organization (Bernard M. Bass, 1990). In this study, we focus on transformational leadership, or more precisely, safety-specific transformational leadership (SSTL), because it is a more predictable indicator of safety outcomes than transactional leadership in the construction industry (Hoffmeister et al., 2014). In particular, SSTL refers to transformational leadership behaviors that specifically promote and develop a safe work environment (Barling et al., 2002). Numerous studies find a strong association between SSTL and safety outcomes (e.g., Conchie, 2013; Conchie & Donald, 2009)

According to Barling et al. (2002), SSTL consists of five components: idealized influence, inspirational motivation, intellectual stimulation, individualized consideration and contingent reward. Leaders with high 'idealized influence' demonstrate their own personal commitment to safety, thus facilitating higher levels of follower trust that management considers safety important. Leaders demonstrate 'inspirational motivation' when they challenge followers to go beyond their personal needs for the collective well-being. For instance, leaders convince their followers to achieve high levels of safety standards, using stories to clarify their mission. By using 'intellectual stimulation', leaders challenge their followers to question long-held

assumptions and motivate them to think about creative ways that could improve occupational safety. In addition, leaders manifesting 'individualized consideration' express an active interest in their followers' well-being, including their work safety. Lastly, leaders make use of 'contingent reward' to encourage and reinforce followers' safety behaviors.

3.2 Hypotheses

3.21 Relationship of job resources to work engagement

The JD-R model proposes that higher levels of job resources evoke a motivational process that leads to higher levels of work engagement, and vice versa. Job resources are regarded as working conditions that can be found in every organization (Schaufeli et al., 2009). It includes physical, psychological, social, or organizational aspects of the job that help employees to achieve work goals, reduce work stress, and/or stimulate personal growth and development. As a result, job resources help to improve job competence, which is the ability to complete work tasks (Bakker & Bal, 2010). Based on Bandura's social cognitive theory (1997), when people believe that they are able to complete their work tasks, they are more likely to perform their work energetically and stay focused when handling challenges along the way, which leads to high levels of work engagement.

As regards work engagement specifically, it is defined as a psychological state that captures a positive, fulfilling, and work-related state of mind, resulting in various positive work behaviors (Schaufeli and Bakker, 2004). Work engagement is characterized by vigor, dedication, and absorption. 'Vigor' refers to having high

energy levels and mental resilience during work, being willing to put effort in one's work, and persevering even in adverse situations; 'dedication' is characterized by having a strong involvement in one's work and experiencing a sense of significance, enthusiasm, inspiration, pride, and challenge; and 'absorption' refers to being totally concentrated on and happily engrossed in one's work while time passes quickly, and one has difficulties in detaching oneself from work (Schaufeli and Bakker, 2004).

In this study, we look at how job resources in the form of work autonomy and social support could affect construction leaders' engagement in SSTL. Work autonomy and social support are the two most frequently examined job resources in the JD-R model. In fact, they are also repeatedly found to promote safety in general, such as lower accident rates, taking safety responsibilities, and properly handling safety risk (Grote & Künzler, 2000; Leplat, 1984; Turner et al., 2010).

Work autonomy refers to the extent that an individual feels in control of the ways to get his or her job done (Breaugh, 1999). People with high levels of work autonomy have strong ownership of their behavior, strong relatedness to their organizations, and strong belief in their competence in performing the work (Edward & Ryan, 1985). This positivity enables them to dedicate their energy and abilities to their work tasks, which results in high levels of engagement. Grote (2007) concluded that autonomy has the strongest impact on safety when desired safety behavior is not rule-based and when there is a high level of uncertainty. Because effective safety leadership in the construction industry is often defined as behavior performed beyond formal role obligations under the dynamic nature of construction work (Conchie et

al., 2013), we therefore believe that work autonomy can boost one's engagement in safety leadership.

Social support can come from co-workers, supervisors and top management (Turner et al., 2010; Zohar & Luria, 2003a). Support at work plays an intrinsic motivational role because it fosters employees' growth, learning, and development (Bakker & Bal, 2010). As a result, employees are more motivated to put in their energy and apply their capabilities in doing their jobs, thus leading to high levels of work engagement. Social support also promotes safety. For instance, (Zohar & Luria, 2003a) showed that supervisor support helps to improve workers' safety behaviors and safety climate. Turner et al. (2010) found that co-worker support is important for the maintenance of employee safety performance. In the same vein, we believe that social support could promote construction leaders' engagement in safety leadership. In the construction industry, production and safety could be valued unequally in practice. When the pressure for production is on, there is the potential for safety to be compromised. Yet social support, especially from management, to expedite the production without sacrificing work safety could help construction leaders to engage in safety leadership even under significant production pressure.

Based on the above insights from the research reviewed in mind, we thus expect that work autonomy and social support are key job resources positively associated with work engagement (refer to figure 9).

Hypothesis 1a: Work autonomy is positively correlated with work engagement.

$$H_0: \beta_{WA} = 0$$

$$H_1: \beta_{WA} > 0$$

Hypothesis 1b: Social support is positively correlated with work engagement.

$$H_0: \beta_{SS} = 0$$

$$H_1: \beta_{SS} > 0$$

3.22 Moderating Role of Personal Resources on Job Resources and Work Engagement

In the JD-R model, personal resources are generally considered as a mediator Xanthopoulou et al. (2007) or moderator ((Van den Broeck et al., 2011) affecting the relationship between job resources and work engagement. In this study we focus on the moderation effect of personal resources, as it better aligns with the Person-Environment (P-E) fit literature, which suggests that employees' values could alter the influence of job characteristics. In particular, personal resources are defined as personal characteristics that are positively linked to resilience and contribute to an individual's ability to control and influence his or her environment successfully (Hobfoll et al., 2003).

In this study, we examine how personal resources, specifically measured as psychological capital (PsyCap), could moderate the association between job resources (work autonomy and social support) and work engagement. In fact, there are two types of moderation effects: substitution and complementary effects. When two variables interact as substitutes, the marginal benefit of each variable decreases as one of the variables increases (Voss, Godfrey, & Seiders, 2010). For example, given a positive effect of job resources (work autonomy and social support) on work engagement, a substitute interaction between job resources and PsyCap reduces or even eliminates the positive effect of job resources on work engagement. From a

management perspective, substitute interactions suggest that engagement can be improved by allocating resources to either enhancing job resources or PsyCap. Statistically, substitute interactions are represented with a negative interaction term.

In contrast, when two variables interact as complements, the marginal benefit of each variable increases as one of the variables increases (Voss et al., 2010). For example, given a positive effect of job resources (work autonomy and social support) on work engagement, a complementary interaction between job resources enhances the positive effect of job resources on work engagement. From a management perspective, complementary interactions suggest that we need to enhance work engagement by investing simultaneously in job resources and PsyCap. Statistically, complementary interactions are represented as getting a positive interaction term.

In particular, PsyCap has emerged as the most important personal resources studied in positive organizational behavior (Donaldson & Ko, 2010). According to Luthans et al., (2007), it is a high-order construct that consists of four psychological resources, namely hope, optimism, resilience, and self-efficacy. A person high in PsyCap is characterized as: (1) having the confidence (self-efficacy) to put in necessary effort to complete challenging tasks; (2) making positive attributions (optimism) about succeeding now and in the future; (3) persevering toward goals, and redirecting paths to goals (hope) in order to succeed whenever necessary; and (4) bouncing back and even beyond original states (resilience) to achieve success when encountering adversity.

We consider PsyCap to be a potentially important avenue that affects the relationship between job resources and work engagement. For example, given the

same levels of job resources, work autonomy and social support, construction leaders high in PsyCap could behave differently in several ways. First, as they are more hopeful, they are likely to set higher safety standards and are motivated to make their followers comply with the standards, which relates to the vigor component of work engagement. Second, their efficacious and optimistic beliefs about succeeding with those safety goals lead them to put in the effort and persistence required to succeed, which relates to the dedication and absorption components of work engagement. Finally, when they encounter challenges, their high levels of resilience enable them to bounce back from adversity and redirect their energy back to handle safety matters, which relates to the vigor and dedication components of work engagement. In sum, we propose that PsyCap could alter the relationship between job resources and work engagement (refer to Figure 9).

Hypothesis 2a: PsyCap moderates the relationship between work autonomy and work engagement.

$$H_0: \beta_{PsyCap.WA} = 0$$

$$H_1: \beta_{PsyCap.WA} \neq 0$$

Hypothesis 2b: PsyCap moderates the relationship between social support and work engagement.

$$H_0: \beta_{PsyCap.SS} = 0$$

$$H_1: \beta_{PsyCap.SS} \neq 0$$

3.23 Relationship of Job Demands to Work Engagement

The JD-R model proposes that high levels of job demands could develop excessive job stress, and thus lead to depletion of one's work engagement. Like job resources, job demands are regarded as working conditions that can be found in every organization (Schaufeli et al., 2009). In contrast to job resources, job demands refers to the "physical, psychological, social, or organizational aspects of the job that require sustained physical and/or psychological (cognitive and emotional) effort or skills and are therefore associated with certain physiological and/or psychological costs" (Demerouti & Bakker, 2011, p.2).

In this study, we test how risk perception as a key job demand could affect construction leaders' engagement in safety leadership. Risk perception is generally defined as the perceived likelihood that an individual will experience the effect of danger and the severity of the danger (Short, 1984; Rosenbloom, 2003).

We propose to study risk perception as a source of job demands in our model because it is regarded as a significant work stressor in the construction industry (Hallowell, 2010; Perlman et al., 2014). Indeed, the construction work environment is widely viewed as risky and hazardous because the production processes can involve such as fire, explosions, structural collapse, and accidents associated with slips, trips, and falls. Although the hazards and accidents mentioned above may only take place on an irregular and infrequent basis, Rodríguez-Garzón et al. (2015) found that construction workers' risk perception remain high.

There has been limited research on how an individual's risk perception could affect one's leadership behaviors in the context of safety; however, the impact of risk

perception on worker behaviors has been widely studied. Numerous empirical studies (DeJoy et al., 2004; Frone, 1998; M. Goldenhar et al., 2003) have reported that risk perception is negatively related to employees' engagement in safety activities, compliance, and job satisfaction because high levels of risk perception leads to burnout that is the opposite psychological state of engagement (González-Romá et al., 2006). Based on the above findings, we expect the relationship between risk perception and construction leaders' engagement of safety leadership could follow a similar track. When construction leaders' experience high levels of risk perception, they may become so overwhelmed and experience excessive stress that in turn leads to burnout and disengagement in safety leadership (refer to Figure 9).

Hypothesis 3: Risk perception is negatively correlated with work engagement.

$$H_0: \beta_{Risk} = 0$$

$$H_1: \beta_{Risk} < 0$$

3.24 Relationship of Work Engagement to Safety-Specific Transformational Leadership (SSTL)

In the motivational process of the JD-R model, work engagement plays a mediational role in linking job and personal resources to positive organizational behaviors (e.g., Salanova & Schaufeli, 2008a; Hansez & Chmiel, 2010). Therefore, work engagement is positively associated with positive behaviors. As previously discussed, safety-specific transformational leadership (SSTL), is generally defined as leaders' positive behavior in handling organizational safety issues (e.g., (Mullen &

Kelloway, 2009b; O'Dea & Flin, 2001; Slates, 2008), which in turn is regarded as a positive organizational behavior. Based on the motivational process of the JD-R model, we thus expect that work engagement is positively associated with SSTL (refer to Figure 9).

Hypothesis 4: Work engagement is positively correlated with SSTL.

$$H_0: \beta_{WE} = 0$$

$$H_1: \beta_{WE} > 0$$

3.25 Multi-level approach

Although leadership by nature is a multi-level phenomenon (Chun et al., 2009), hardly any literature has investigated safety leadership with a multi-level approach. Pavett and Lau (1983) pointed out the influence of hierarchical level on managerial roles, and required skills and resources. For instance, upper management focuses considerable attention on formulating business strategies, making implementation plans, and being a figurehead that links the external environment to the organization. On the other hand, site management is concerned with daily operating issues and maintaining workflow. Compared to upper management, site management has less autonomy and authority to allocate company resources. With all these differences in mind, we propose that the relationships posited in the structural model will be different between upper and site management level (refer to Figure 9).

Hypothesis 5: *The structural model between site and lower management level is different.*

$$H_0: \rho_{\,chi-sqaure\ test} \geq 0.05$$

$$H_1: \rho_{\,chi-sqaure\ test} < 0.05$$

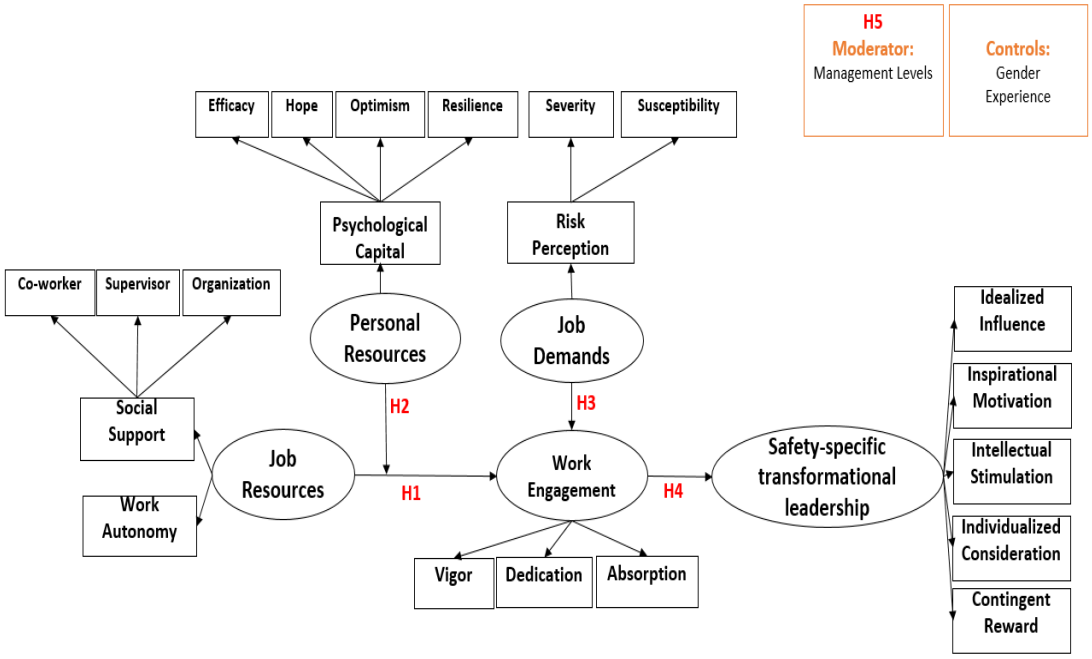


Figure 9 Theoretical model showing hypothesized relations between social support, work autonomy, PsyCap. risk perception, work engagement and SSTL.

3.3 Method

3.31 Sample and Procedure

The study took place in a large privately owned construction company in the United States. In October 2016, an online survey was sent to all of the company's 639 in management positions. A total of 386 questionnaires were returned, thus producing

a response rate of 60%. Deletion of missing values and unengaged responses resulted in a usable sample of 383 employees (60%), of which 90% (N=345) were male. With respect to race, this sample was predominantly white (89%, N=340), with a few Asian (1%, N=4), Black (2%, N=7), Hispanic (5%, N=21), and unknown (3%, N=11) respondents. The workforce was relatively experienced with 72% (N=274) having worked in the construction industry for over ten years. Regarding job status, all participants are in managerial level positions with job titles distributed as follows: construction executive (4%, N=14), director (1%, N=2), executive (2%, N=7), manager (2%, N=6), project executive (10%, N=40), project manager (20%, N=77), safety director (1%, N=4), safety manager (4%, N=17), senior project manager (15%, N=59), senior safety manager (3%, N=13), senior superintendent (7%, N=25), senior vice president (3%, N=11), superintendent (18%, N=69), and vice president (10%, N=39). Those job titles were then categorized into two groups: upper management level (51%, N=201) and lower management level (49%, N=182). The main difference between upper and lower management is that lower management is in charge of handling daily operations with construction workers at construction sites.

3.32 Measures

1. Social Support

We measured social support according to three different sources: perceived organization support, perceived supervisory support and perceived coworker support.

a. Perceived organizational support

This scale consisted of the three highest-loading items adapted from the Management Attitude Toward Safety Scale built by Mueller et al. (1999). A sample item was: "Top management seems to care about my safety." Respondents answered items on a 5-point scale (strongly disagree to strongly agree), with a higher score indicating stronger perceived management support. The Cronbach alpha of the scale was 0.82.

b. Perceived supervisory support

This scale consisted of the three highest-loading items adapted from Management Attitude Toward Safety Scale built by Mueller et al. (1999). A sample item was: "My supervisor seems to care about safety." Respondents answered items on a 5-point scale (strongly disagree to strongly agree), with a higher score indicating stronger perceived supervisory support. The Cronbach alpha of the scale was 0.93.

c. Perceived co-worker support

This scale consisted of the three highest-loading items adapted from Management Attitude Toward Safety Scale built by Mueller et al. (1999). A sample item was: "People in my work group emphasize working safely and make sure others do the same." Respondents answered items on a 5-point scale (strongly disagree to strongly agree), with a higher score indicating stronger perceived co-worker support. The Cronbach alpha of the scale was 0.87.

2. Work Autonomy

We used the three-item work autonomy scales developed by Breaugh (1999) to measure work autonomy. A sample item was: “I am allowed to decide how to go about getting my job done.” Respondents answered items on a 5-point scale (never to always), with a higher scale score indicating high level of work autonomy. The Cronbach alpha of the scale was 0.93.

3. Psychological Capital (PsyCap)

PsyCap is a higher order construct made up of four related and mostly state-like dimensions: Hope, Efficacy, Resilience and Optimism. To measure these dimensions, we used the Luthans and his colleagues' (2007) 24-item Psychological Capital Questionnaire (PCQ). Each dimension was measured by 6 items. A sample item of hope was “At the present time, I am energetically pursuing my work goals”, efficacy was “I feel confident presenting information to a group of colleague”, resilience was “I can get through difficult times at work”, and Optimism was “when things are uncertain for me at work I expect the best”. Respondents answered items on a 6-point scale (strongly disagree to strongly agree), with a higher scale score indicating higher level of PsyCap. The Cronbach alpha was 0.83 for hope, 0.84 for efficacy, 0.86 for resilience, and 0.84 for optimism.

4. Risk Perception

Risk Perception is a higher order construct that consists of two dimensions: susceptibility and severity. We adapted Rimal and Real's (2003) 4-item scale of perceived risk. We modified the scale to make it useable in the context of the construction industry. Each dimension of the construct was measured by 2 items. A sample item of susceptibility was "my likelihood of getting injured at work is" with respondents answering items on a 5-point scale (from not at all likely to completely likely). A sample item of severity was "work-related injury is a serious matter that can be fatal". Respondents answered items on a 5-point scale (strongly disagree to strongly agree). A higher scale score indicates higher level of risk perception. The Cronbach alpha was 0.69 for susceptibility and 0.71 for severity.

5. Work Engagement

Work Engagement is a higher order construct that consists of three dimensions: vigor, dedication, and absorption. We used Schaufeli and his colleagues' 9-item Utrecht engagement scale (UWES-9) to measure work engagement. Each dimension was measured by 3 items. A sample item of vigor was "At my work, I feel energetic", dedication was "My job inspires me", and absorption was "Time flies when I am working". Although the scale originally used a three factor measurement model as mentioned, Schaufeli et al. (2006) found that both a one factor (9-item scale) and three factor model (3-item scale) obtain similar model fit after analyzing data from 10 different countries because

the three dimensions of engagement are strongly inter-correlated. As a result, researchers such as De Bruin and Henn (2013) proposed that UWES-9 can be interchangeably used as an overall 9-item scale or three 3-item scales to measure work engagement, depending on the given a sample's characteristics. In this study, we used UWES-9 as an overall 9-item scale because it provided us with better measurement model fit indices. Respondents answered items on a 7-point scale (never to always). Higher scores indicate higher levels of work engagement. The Cronbach alpha of the scale was 0.92.

6. Safety-Specific Transformational Leadership (SSTL)

We used the 10-item safety-specific transformational leadership scale developed by (Barling et al., 2002) to measure SSTL. Although the scale covered five dimensions (idealized influence, inspirational motivation, intellectual simulation, individualized consideration, and contingent reward), it was used as an unidimensional measurement because those dimensions are highly correlated ((Barling et al., 2002). A sample item of idealized influence was "I show determination to maintain a safe work environment, inspiration motivation was "I talk about my values and beliefs regarding the importance of safety", intellectual simulation was "I suggest new ways of doing jobs more safely", individualized consideration was "I spend time showing my subordinates the safest way to do things at work", and contingent reward was "I make sure that my subordinates receive appropriate rewards for achieving safety targets on the job". Respondents

answered items on a 5-point scale (not at all to always). A higher score indicates a higher level of SSTL. The Cronbach alpha of the one-factor scale was 0.86.

7. Control variables

In line with previous research on work engagement and safety leadership (e.g., Schaufeli et al., 2006; Sonnentag, 2003; Wu et al.,2008), the following controls were included: gender (1=male, 0=female), and work tenure in the construction industry. We created three dummy variables to capture work tenure as follows: long experience (>20 years), moderated experience (>5 years and < 20 years), using short experience (<5 years) as the reference group.

8. Multi-level variables

Based on the job titles of respondents, we categorized them into two groups: upper management level (51%, N=201) and lower management level (49%, N=182). The main difference between upper and lower management is that lower management is in charge of handling daily operations with construction workers at construction sites while upper management does not participate in daily operations.

3.33 Statistical analysis

1. Selection and application of statistical techniques

In our model, all the variables are latent variables or factors which means they are unobserved constructs that cannot be measured directly. It can only be measured

by using indicators or items. For example, SSTL is one of the latent variables in our model. We measured it by using the 10-item scale mentioned in section 3.32. In total, we have six latent factors which were measured by 59 items using surveys. Because several items were used to measure each latent factor, we need statistical techniques to test the reliability and validity between a latent factor and its related items. Otherwise, we may measure something that we did not intend to measure and draw an invalid conclusion when we test our hypotheses later on. Additionally, a hypothesized dependent variable in our model becomes an independent variable in a subsequent dependent relationship. For instance, increasing social support could increase work engagement, and work engagement could increase the application of SSTL. So, we wanted to examine a series of dependence relationships simultaneously. Note that in this section the terms factors, constructs and variables are used interchangeably.

While most multivariate techniques can only handle observable variables and investigate one relationship at a time (Hair et al., 2013), structural equation modeling (SEM) is a technique that can help us to exam latent factors and interrelationships between multiple independent and dependent variables in our study. As such, we chose to use SEM to perform our statistical analysis.

In particular, SEM is a technique that subsumes a wide range of multivariate analysis techniques including multiple regression, factor analysis, and analysis of variance. Yet, it is distinguished by three characteristics: 1) it can estimate of multiple and interrelated dependence relationships; 2) it has the ability to account for measurement error in the estimation process; and 3) it can assist in defining a model

to depict the entire set of relationships (Hair et al., 2013). Technically, SEM includes two components: a measurement model and a structural model. The measurement model consists of the relationship between the latent factors and the items. The structural model shows the path direction and strengths of relationships among latent variables. The structural model is used to evaluate the hypothesized relationships among latent variables.

In the measurement model of SEM, confirmatory factor analysis is used to test how well the measured items represent the factors (Hair et al., 2013). With CFA, we need to specify both the number of factors that exist for a set of items and which factor each item will load on before we can compute the results. As mentioned in section 3.32, all our measures were validated in previous studies. Thus, we knew the number of factors, and which items should be loaded to which factor. With this, we had enough information to conduct a CFA. However, because not all the measures were validated in the context of the construction industry, which is our population of interest, we should perform an exploratory factor analysis (EFA) before performing a CFA. An EFA helps to validate whether items load on the expected factors based on their correlations. With this test, we know whether those measures are applicable to our new population. Figure 10 summarizes the process of our statistical analysis.

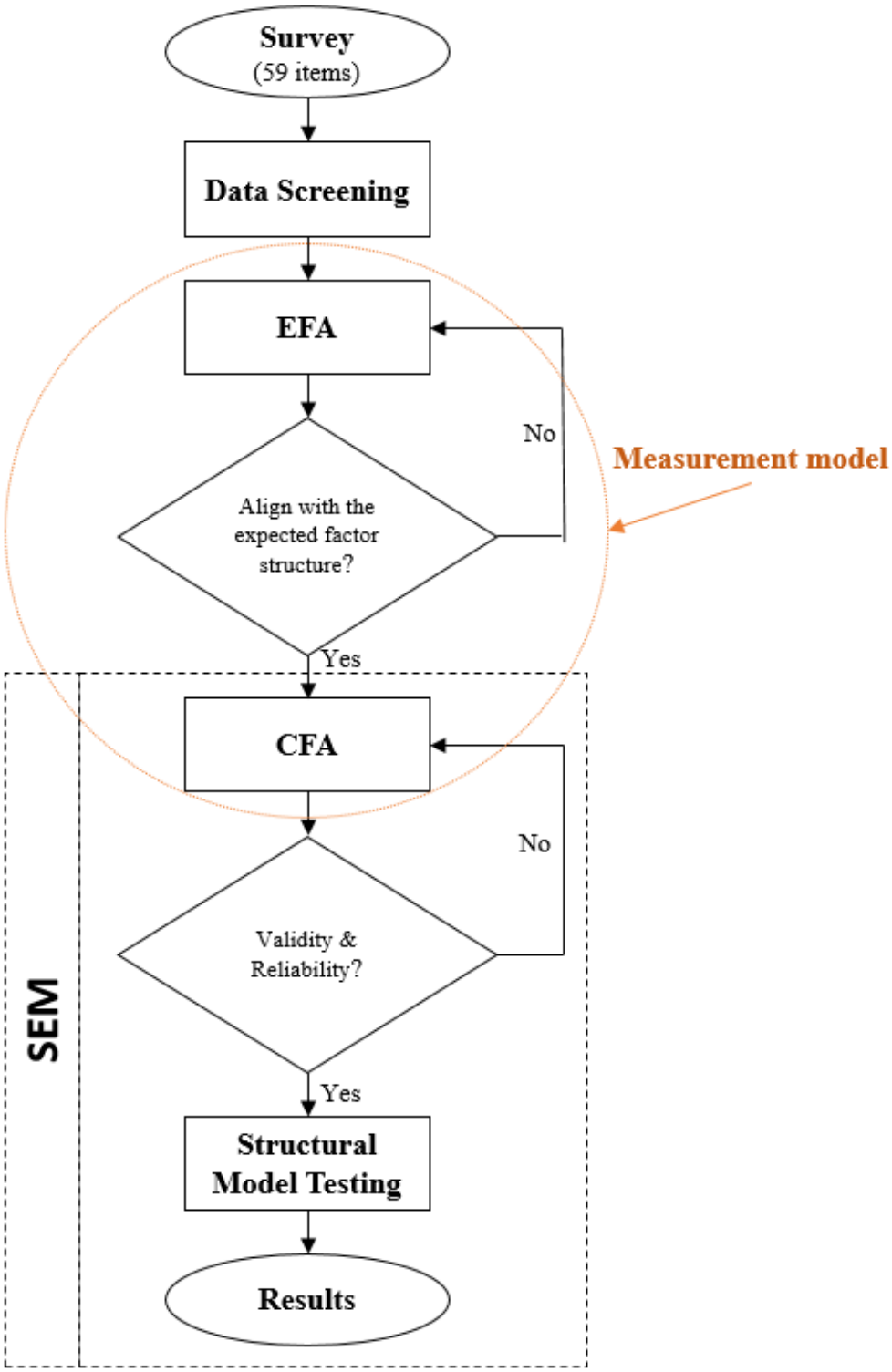


Figure 10 The summary of the statistical analysis.

After the measurement model was confirmed to have sufficient construct validity and model fit, control common method variance, and passed the invariance test in the CFA, we proceed to test the structural model in AMOS. To test for moderation in our model, we followed Ping's (1995) approach, the steps of which described by Cortina et al. (2001). Specifically, we have two hypothesized interaction effects in our model. For each hypothesized interaction effect, we tested a model that included three exogenous variables (e.g., PsyCap, social support, and the interaction between PsyCap and social support) and one endogenous variable, work engagement. In total, we test two different models, one for each possible interaction between job resources (social support and work autonomy) and personal resources (PsyCap) included in our study. Each exogenous variable had a factor score, and was the standardized (centered) scale score of the respective variable. The interaction variable was the multiplication of the standardized scale scores of each job resources and personal resources tested. For example, the model that tested the interaction effect of PsyCap and social support on work engagement included one PsyCap variable (whose factor score was the z score of the PsyCap scale), one social support variable (whose factor score was the z score of the social support scale), and the interaction variable (whose factor score was the multiplicative product of the z-score of PsyCap and the z-score of social support). In addition, we also include two control variables, gender and experience, in the structural model. Figure 4.6 graphically represents the structural model in the study.

Finally, the goodness of fit statistics were examined. After obtaining sufficient model fit, we proceeded to test whether each hypothesized relationship in the model

has a significant p-value and R-square. Additionally, we tested the model to check whether we got different model fit and results of the hypothesized relationships between upper and lower management levels. To do so, chi-square difference tests were performed. The results of the structural model are presented in the next section.

2. Data Screening

Before running an EFA, we evaluated missing values, outliners, and normality. All usable responses were complete. There was one response that had missing values and two responses that had unengaged answers. They were removed prior to subsequent analyses. The useable sample is 383. As all our variables are ordinal (5-point, 6-point and 7-point Likert-scale), extreme value outliers do not exist. Due to employing short interval ordinal scales, skewness is not a major issue, but kurtosis could affect our results due to insufficient variance. Our kurtosis test showed that one item for social support (SS), one item for organizational support (OS), one item for dedication (DE), two items for absorption (AB), three items for self-efficacy and three items for resilience (RS) had kurtosis values that are slightly greater than 2.2. However, we opted to retain these items because their communalities during the EFA were sufficiently large (>0.400), which means they were likely to load significantly on certain factors. Moreover, as the kurtosis items are all from previous validated measurements, eliminating them at this stage without further validation in EFA and CFA would have affected the reliability and validity of those factors.

3.4 Results

3.41Measurement model

1. Exploratory Factor Analysis (EFA)

An EFA was used to identify the underlying factor structure of items based on their correlations. In the EFA, we examined the number of factors extracted by using different combinations of factor extraction and rotation methods, checked the loading performance of each factor, and performed a reliability test.

Number of factors extracted

In our reflective measurement model, there are six latent factors: work autonomy, PsyCap, social support, risk perception, work engagement, and SSTL. Among these six factors, two of them (work autonomy and SSTL) are first-order factors that were measured in one dimension, and four of them (PsyCap, social support, work engagement and risk perception) are second-order factors that are measured multi-dimensionally. For example, PsyCap was measured in four dimensions: hope, efficacy, resilience, and optimism. Figure 3.2 depicts the factors and its related dimensions. Each dimension was measured by different items in the survey.

We used SPSS 24 to run the EFA. In SPSS, we cannot conduct an EFA with second-order factors. The remedy is to treat each dimension of a second-order factor as an individual factor. Following this line of thought, we have 14 factors in our model. Based on the EFA results, we checked whether items are loaded on the expected 14 factors. Using 20 different combinations of factor extraction and rotation methods to perform EFAs, we got a consistent result of getting a 12-factor structure.

We found that all items were loaded to their respective factors. Yet, work engagement was loaded as a one-factor instead of a three-factor model. In particular, UWES-9 is a 9-item scale developed by Schaufeli et al. (2002), and used to measure work engagement in the three dimensions of vigor, dedication, and absorption. In fact, Schaufeli et al. (2006) found that both a one factor (9-item scale) and three factor (3-item scale) model of UWES-9 did obtain similar model-fit. He concluded that the result was due to high inter-correlations among the three dimensions. De Bruin and Henn (2013) indicated that UWES-9 can be interchangeably used as an overall 9-item scale or three 3-item scales. As such, we decided to treat work engagement as a one-factor model and use the 12-factor model proposed by EFA for conducting the CFA. The total variance explained by the 12-factor model was 59.13%.

Factor loadings

In addition, by using Maximum Likelihood (factor extraction method) and Promax (factor rotation method), we got the pattern matrix of factor loadings as shown in Figure 11. Factor loading is the correlation of the item and the factor. Thus, the larger the absolute size of factor loading, the more important the item in interpreting the factor (Hair et al., 2013). After dropping two items of hope and two items of resilience due to poor loading or failing to load with the expected factor, all loadings were above the 0.30 threshold recommended by Hair et al. (2013) for sample sizes greater than 350 (our sample size is 383). In fact, the four deleted items were reported as kurtosis items in the data screening section.

Pattern Matrix[a]

Cronbach's Alpha-->	Factor											
	0.918	0.863	0.841	0.837	0.931	0.933	0.886	0.835	0.819	0.798	0.712	0.691
SSTL_1		0.633										
SSTL_2		0.555										
SSTL_3		0.767										
SSTL_4		0.721										
SSTL_5		0.686										
SSTL_6		0.676										
SSTL_7		0.739										
SSTL_8		0.424										
SSTL_9		0.614										
SSTL_10		0.364										
WA_1						0.885						
WA_2						0.930						
WA_3						0.903						
OS_1									0.596			
OS_2									0.798			
OS_3									0.772			
SS_1					0.762							
SS_2					0.915							
SS_3					0.953							
CS_1							0.633					
CS_2							0.967					
CS_3							0.836					
Suscept_1												0.756
Suscept_2												0.754
Severity_1											0.768	
Severity_2											0.790	
VI_1	0.801											
VI_2	0.752											
VI_3	0.865											
DE_2	0.939											
DE_3	0.872											
DE_4	0.561											
AB_2	0.598											
AB_3	0.539											
AB_4	0.564											
SE_1			0.721									
SE_2			0.799									
SE_3			0.582									
SE_4			0.613									
SE_5			0.590									
SE_6			0.686									
HP_3										0.324		
HP_4										0.595		
HP_5										0.761		
HP_6										0.618		
RS_3								0.495				
RS_4								0.647				
RS_5								0.956				
RS_6								0.702				
OP_1				0.679								
OP_2				0.521								
OP_3				0.849								
OP_4				0.598								
OP_5				0.414								
OP_6				0.718								

Extraction Method: Maximum Likelihood.

a. Rotation converged in 8 iterations.

Figure 11 Pattern matrix

Reliability Test

Finally, we assessed the reliability of the factors by using Cronbach's alphas, which that measure internal consistency. Internal consistency means how closely a set of items are related as a group (Hair et al., 2013). Cronbach's alphas can be written as:

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i=1}^{k} \sigma_{yi}^2}{\sigma_x^2}\right) \quad (3\text{-}1)$$

K refers to the number scale items

σ_{yi}^2 refers to the variance associated with item i

σ_x^2 refers to the variance associated with the observed total scores

For our model, each of the 12 factors had its only Cronbach's alpha. They are reported in Figure 3.4. All the factors' Cronbach's alphas, except for susceptibility (0.691) are above the recommended threshold of 0.700 (Fornell & Larcker, 1981). Because this study is exploratory, we decided to retain susceptibility as it is only slightly below the threshold.

2. Confirmatory Factor Analysis (CFA)

CFA is to test the extent to which a theoretical pattern of factor loadings on pre-specified factors represent the actual data. Because CFA results are combined with model fit statistics and construct validity tests, we can obtain a better understanding on the quality of the measurement model. Specifically, we conducted CFA using Maximum Likelihood in AMOS 24. The factor structure proposed by the EFA was used to run the CFA. Unlike conducting EFA in SPSS, we can conduct a CFA with second-order factors in AMOS. As such, by treating work engagement as a unidimensional factor, which was the result of the EFA, six factors were tested in the CFA, including three second-order factors and three first-order factors. Figure 12 shows the 6-factor measurement model tested in the CFA.

In the following sections, we tested the construct validity and the model fit of the measurement model using the CFA, followed by conducting an invariance test on the multilevel measurement model, controlling method biases in the measurement model and generating a factor score for each factor.

Construct validity and goodness of fit

Construct validity is defined as "the extent to which a set of measured items actually reflects the theoretical latent construct those items are designed to measure" (Hair et al, 2013, p.618). Construct validity is generally made up of two components, namely convergent validity and discriminant validity.

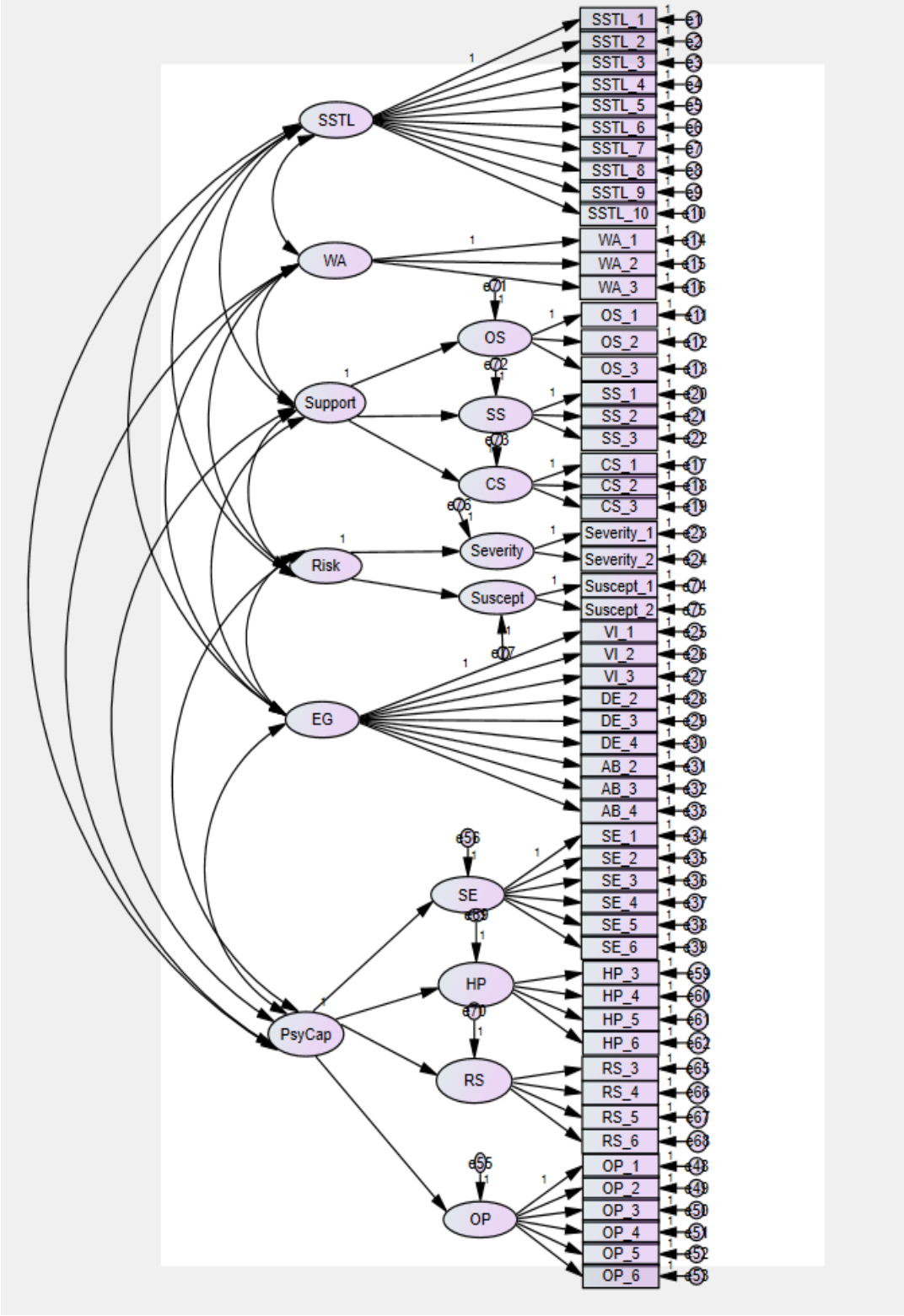


Figure 12 The 6-factor measurement model in the CFA

Convergent validity means the items of a specific construct or factor should share a high proportion of variance in common (Hair et al., 2013). The commonly used methods to estimating convergent validity are, average variance extracted (AVE) and construct or composite reliability (CR).

AVE is computed as the total of all squared standardized factor loadings divided by the number of items (Hair et al., 2013). The formula is written as:

$$AVE = \frac{\sum_{i=1}^{n} L_i^2}{n} \quad (3\text{-}2)$$

L_i refers to the standardized factor loading, i is the number of items

n refer to the number of items

Conceptually, it measures how much variation in items are explained by the corresponding factor verse by measurement error. For instance, an AVE of 0.7 means 70% of variation in items are explained by the corresponding factor, 30% of variation in items are explained by error variance. Therefore, higher AVE indicates that items converge on the latent factor because the factor explains their variations as in common. An AVE of 0.5 or higher is the threshold for achieving adequate convergence (Hair et al., 2013).

Construct or composite reliability (CR) is computed as the square sum of factor loadings for each construct divided by the total of the square sum of factor loadings for each construct and the sum of error variance for a construct (Hair et al., 2013). The formula is written as:

$$CR = \frac{(\sum_{i=1}^{n} L_i)^2}{(\sum_{i=1}^{n} L_i)^2 + (\sum_{i=1}^{n} e_i)} \quad (3\text{-}3)$$

L_i refers to factor loading

e_i refers to error variance terms for a construct e_i

Conceptually, it measures how the consistency of items represent the same latent factor. In fact, CR is generally regarded as a less biased estimate of reliability than Cronbach's Alpha. A CR of 0.7 or higher suggests good reliability (Hair et al., 2013).

Discriminant validity is another type of construct validity. It refers to the extent to which a construct is unique from other constructs (Hair et al., 2013). There are two common ways to assess the discriminant validity of a construct. The first way is to compare the fit of a two-construct model and a one construct model using a chi-square difference test. If the difference is statistically significant, then discriminant validity is supported. The second way is to compare the square root of AVE for any two constructs with the correlation estimates between these two constructs. The

square root of AVE estimates should be bigger than the correlation estimate. The logic here is that a latent construct should explain more of the variance in its own items than it shares with another construct.

(Square root of the AVE on the diagonal)

	CR	AVE	Risk	SSTL	WA	EG	PsyCap	SS
Risk	0.250	0.176	**0.420**					
SSTL	0.869	0.405	0.328	**0.636**				
WA	0.933	0.824	0.176	0.419	**0.908**			
EG	0.920	0.566	0.015	0.433	0.423	**0.752**		
PsyCap	0.855	0.598	0.295	0.471	0.533	0.739	**0.773**	
SS	0.837	0.632	0.357	0.392	0.423	0.487	0.499	**0.795**

*SSTL= Safety-Specific Transformational Leadership, Risk= risk perception WA= Work Autonomy, SS=Social Support, EG= Work Engagement

Table 2 Convergent and discriminant validity of the measurement model

Table 2 offers the AVE, CR and the correlation matrix between factors for testing convergent and discriminant validity. To establish reliability, the CR should be greater than 0.700. We met this threshold for all factors. To establish discriminant validity, the square root of the AVE should be less than any correlation with another factor. All our factors fulfilled this criterion. To establish convergent validity, the AVE should be greater than 0.5 (Kline et al., 2012). We met this threshold for all factors except SSTL and risk perception. Although SSTL is slightly below the recommended threshold, we opted to retain it because it has a high CR, and its square root of AVE is much higher than its correlation with other constructs. In other words, SSTL has sufficient reliability and discriminant validity. For risk perception, its AVE is far below the threshold. Indeed, risk perception is a second-order factor that consists of two dimensions: susceptibility and severity. Based on the results of the EFA, we knew the Cronbach's Alpha of susceptibility was lower than 0.700. Similar

to AVE, Cronbach's alpha is also a method to assess convergent validity. Therefore, to improve the AVE of risk perception, we decided to drop susceptibility. Table 9 shows the updated measurement model without susceptibility. The AVE of risk perception was improved dramatically to 0.599, which is above the recommended threshold.

(Square root of the AVE on the diagonal)

	CR	AVE	Risk	SSTL	WA	EG	PsyCap	SS
Risk	0.747	0.599	**0.774**					
SSTL	0.869	0.405	0.169	**0.636**				
WA	0.933	0.824	0.102	0.419	**0.908**			
EG	0.920	0.566	0.013	0.433	0.423	**0.752**		
PsyCap	0.855	0.598	0.213	0.470	0.543	0.721	**0.773**	
SS	0.837	0.632	0.232	0.392	0.423	0.487	0.510	**0.795**

*SSTL= Safety-Specific Transformational Leadership, Risk= risk perception WA= Work Autonomy, SS=Social Support, EG= Work Engagement

Table 3 Convergent and discriminant validity of the measurement model without susceptibility

Based on Table 3, we knew work engagement obtained sufficient discriminant validity because its square root of AVE is higher than the correlations with another construct. Yet, we found the value of its square root AVE (0.752) to be close to its correlation with PsyCap (0.721). To confirm whether work engagement and PsyCap are truly distinct from each other, we carried out a chi-square difference test between a five-factor and six-factor model. Work engagement and PsyCap were combined as one factor in the five-factor model, while work engagement and PsyCap were kept as individual constructs in the six-factor model. The results showed that these two models were significantly different. In other words, work engagement and PsyCap

should be kept as two individual factors in our model, thus retaining our 6-factor measurement model.

Finally, the goodness of fit statistics for the measurement model are shown in Table 4. All thresholds from Hu & Bentler (1999) are met, indicating we have sufficient model fit for our measurement model.

Model fit for measurement model		
Metric	**Observed value**	**Ideal Threshold**
CMIN/df	1.893	between 1 and 3
CFI	0.902	>0.900
RMSEA	0.048	<0.060
PCLOSE	0.822	>0.050
SRMR	0.051	<0.090

Table 4 Model fit of the measurement model

Invariance test for the multilevel measurement model

Because we needed to perform multilevel comparison, specifically upper management versus lower management, in our structural model, we should ensure the measurement models for these two levels are the same. Otherwise, we may find differences between two groups in the structural model, but not be sure whether the differences are from the measurement differences or other effects that we truly want to identify. To test whether the measurement model of upper management and lower management are the same, we carried out a configural invariance that examines whether the factor structure proposed in a CFA achieves sufficient fit when both groups are tested together and without any cross-group path constraints. Based on the

model fit statistics shown in Table 5, we concluded that the measurement model for upper and lower management levels is basically the same.

Model fit for the two measurement models		
Metric	**Observed value**	**Ideal Threshold**
CMIN/df	1.636	between 1 and 3
CFI	0.866	>0.900
RMSEA	0.041	<0.060
PCLOSE	1.000	>0.050
SRMR	0.065	<0.090

Table 5 Model fit for the two measurement models

Control of common method bias in the measurement model

Because all the variables in our study were collected from a single source, we are concerned about having common method variance (CMV) in our data. CMV refers to the amount of covariance shared among variables because of the common method used in data collection (Malhotra et al., 2006). This method variance makes the investigation of actual phenomenon difficult as we cannot differentiate measurement artifacts from it. To address this potential issue, we followed Lindell and Whitney's (2001) marker-variable technique by introducing a marker variable and common method factor in the CFA measurement model. According to Eichhorn (2014), there are several advantages to using the marker-variable technique. First, it allows measurement error in the method factor to be estimated. Second, the effects of biases can be measured directly rather than being inferred from the measures of the model. Last, the impacts of each item in the method factor are not constrained to be

equal. Thus, it is generally regarded as a more accurate method to estimate common method bias than the other major technique such as Harman's single factor test.

To implement the marker-variable technique, we included a marker variable, social desirability bias, in our study and data collection process. Social desirability bias was chosen for several reasons. First, it is theoretically unrelated to other variables in the study. Second, it has been widely proven to be an effective marker variable to extract CMV (Donaldson & Grant-Vallone, 2002). Third, we believe that our research participants may have the tendency to respond our survey questions in socially desirable ways. In particular, they may under-report behaviors deemed inappropriate by others, and over-report behaviors viewed as appropriate. As a result, we need to extract social desirability bias out from the measures. To measure social desirability bias, we included the short version of the Marlow-Crowne Social Desirability Scale (Strahan & Gerbasi, 1972) in the survey.

In particular, we added the marker variable and a common method factor into our measurement model in the CFA using AMOS. Figure 13 shows the updated measurement model. Conceptually, the common method factor was used to extract the CMV across all the items of variables including the marker variable, social desirability bias. By including social desirability bias in the model, we extracted the shared variance that related to social desirability bias. Then everything left to the loadings between the items and the respective factor are expected to be the actual traits. Based on these results, we extracted CMV-adjusted factor scores to test our structural model. The details are covered in the next section.

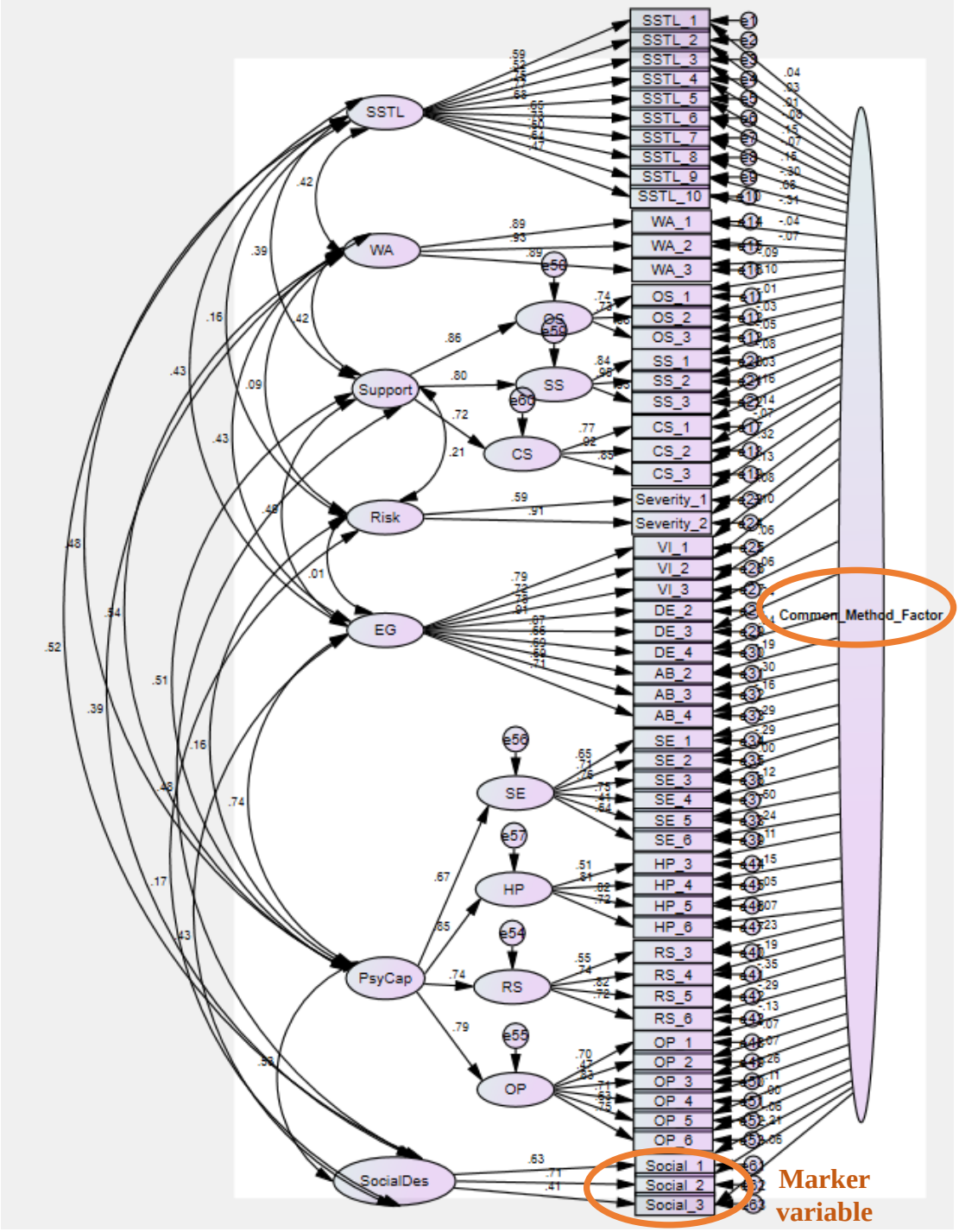


Figure 13 Control of common method bias in the CFA measurement model

Extracting factor score in the CFA

Before proceeding to test our structural model, we extracted factor scores from latent variables based on the measurement model in Figure 13. There are several different methods to estimate factor scores. We chose to use the regression method in AMOS because it is the standard method to extract maximum likelihood estimates of factor loadings. A vector of observed data, supplemented by vector of factor loadings for the *i*th subject is considered. The imputation process can be expressed as follows:

Joint distribution of the data Y_i and factor f_i is

$$\begin{pmatrix} Y_i \\ f_i \end{pmatrix} \sim N \left[\begin{pmatrix} \mu \\ 0 \end{pmatrix}, \begin{pmatrix} LL' + \psi & L \\ L' & 1 \end{pmatrix} \right] \tag{3-4}$$

Using this, we can calculate the conditional expectation of common factor score f_i given the data Y_i as express here:

$$E(f_i|Y_i) = L'(LL' + \Psi)^{-1}(Y_i - \bar{\mu}) \tag{3-5}$$

This suggests the estimator by substituting in the estimates for L and Ψ:

$$\widehat{f_1} = \hat{L}'(\hat{L}L' + \widehat{\Psi})^{-1}(Y_i - \bar{y}) \tag{3-6}$$

By using factor scores, we reduced the fully latent model into just one composite score per factor. The new composite score accounted for the factor

loadings of the latent variables and excluded the common method variances mentioned in the previous section, just as in the latent model shown in Figure 13.

As only one factor score per factor, the testing of the structural model is greatly simplified. The main drawback of this approach is that it decreases the number of degrees of freedom that could result in worse goodness-of-fit statistics; however, considering the complexity of our model, extracting factor scores to test the structural model is a more feasible choice. Our model contains not only the six latent factors, but also two interaction terms for testing moderation effects, and a common method factor for controlling common method variances (refer to Figure 13). Thus, it is difficult, if not impossible, to test our structural model by retaining it as a latent model in AMOS.

4.42 Structural Model

To test our hypotheses in the structural model, we first assessed the structural model fit statistics, and then examined the hypothesized dependence relationships using p-values and R squares. Table 6 shows the goodness-of-fit statistics of the structural model. Aside from the χ^2statistic, the results showed that a good model fit was achieved.

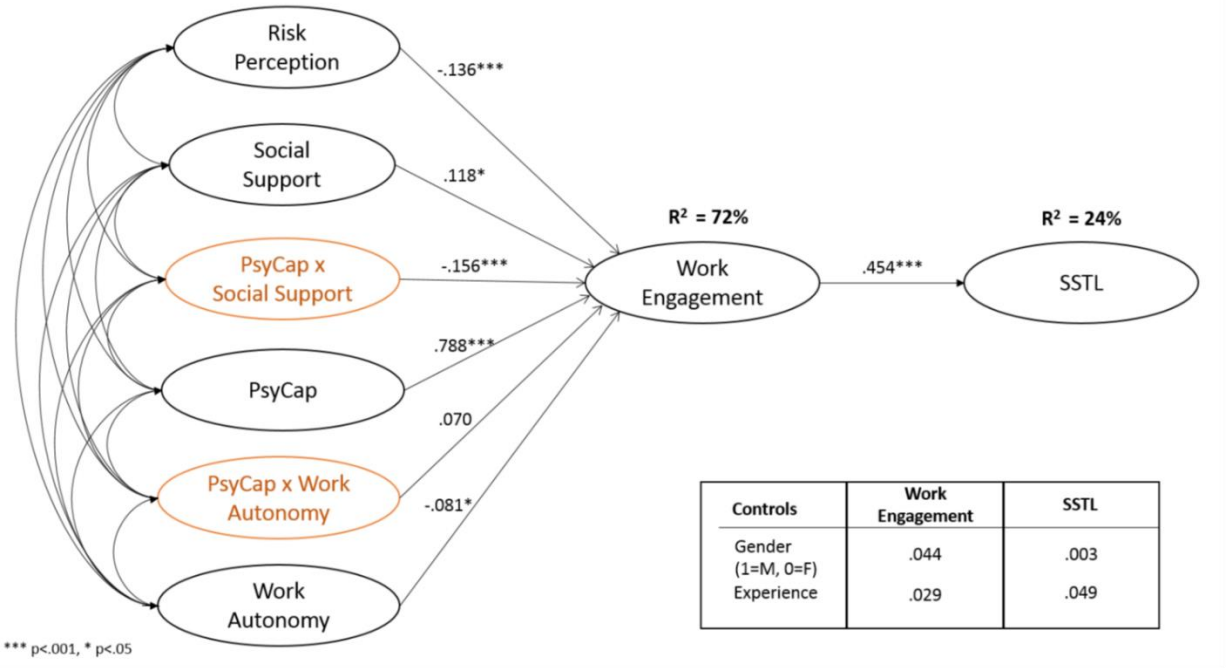
Model fit of the structural model		
Metric	**Observed value**	**Ideal Threshold**
CFI	0.972	>0.900
GFI	0.969	>0.900
NFI	0.970	>0.900
SRMR	0.0483	<0.090

Table 6 Model fit of the structural model

Figure 14 presents the test results of individual paths in our structural model. The total variance explained is satisfactory for the two endogenous variables, work engagement and SSTL. In addition, the R^2 of work engagement is 72%. That means 72% of its total variance is explained by risk perception, PsyCap, social support, the interaction between PsyCap and social support, work autonomy, the interaction between PsyCap and work autonomy, and the control variables. Yet, R^2 tends to increase with increasing number of independent variables. Adjusted R^2 attempts to correct this overestimation. It is calculated by dividing the residual mean square error by the total mean square error. The result is then subtracted from 1. So, adjusted R^2 might decrease if the additional independent variable does not improve the model. The adjusted R^2 of work engagement is 71%. As for the R^2 of SSTL, it is 24%. That

means 24% of its total variance is explained by work engagement and the control variables. The adjusted R^2 of SSTL is 23%. The control variables in the model are gender and experiences which are potentially confounding variables that we need to account for, but that don't drive our theory. To handle controls, we had gender and experiences regress on both work engagement and SSTL. The results were shown in figure 14.

Hypothesis 1 proposed a positive relationship between social support and work engagement (Hypothesis 1a) and a positive relationship between work autonomy and work engagement (Hypothesis 1b). The results in Figure 4.6 show that social support was positively related to work engagement ($\beta = 0.118$, $p < 0.05$), and work autonomy was negatively related to work engagement ($\beta = -0.081$, $p < 0.05$). This means hypothesis 1a is accepted and hypothesis 1b is rejected.



Controls	Work Engagement	SSTL
Gender (1=M, 0=F)	.044	.003
Experience	.029	.049

Figure 14 Results of the structural model

Hypothesis 2 proposed PsyCap moderates the relationship between social support and work engagement (Hypothesis 2a), and PsyCap moderates the relationship between work autonomy and work engagement (Hypothesis 2b). Figure 14 shows that the interaction coefficient for PsyCap and social support was significant ($\beta = -0.156$, $p < 0.001$), and the interaction coefficient for PsyCap and work autonomy was not significant ($\beta = 0.070$, $p = 0.078$). Thus, hypothesis 2a is supported and hypothesis 2b is rejected.

To further examine the significant interaction relationships of hypothesis 2a, we plotted a three dimensional graph as shown in Figure 15 using 3D Function Grapher (Kaskosz, 2004). In particular, Figure 15 is a work engagement cube that shows that when the level of social support decreases, the level of work engagement can be improved if we increase the level of PsyCap (indicated by the orange lines). Thus, PsyCap and social support have a substitute interaction effect. Figure 15 also indicates that PsyCap has a stronger effect on work engagement than social support. When PsyCap increases to its maximum, the level of work engagement achieved is much higher than the work engagement level achieved when social support is at its maximum level (indicated by the green lines). Last but not least, the level of engagement decreases if a person has high PsyCap and receives a high level of social support (indicated by the blue lines).

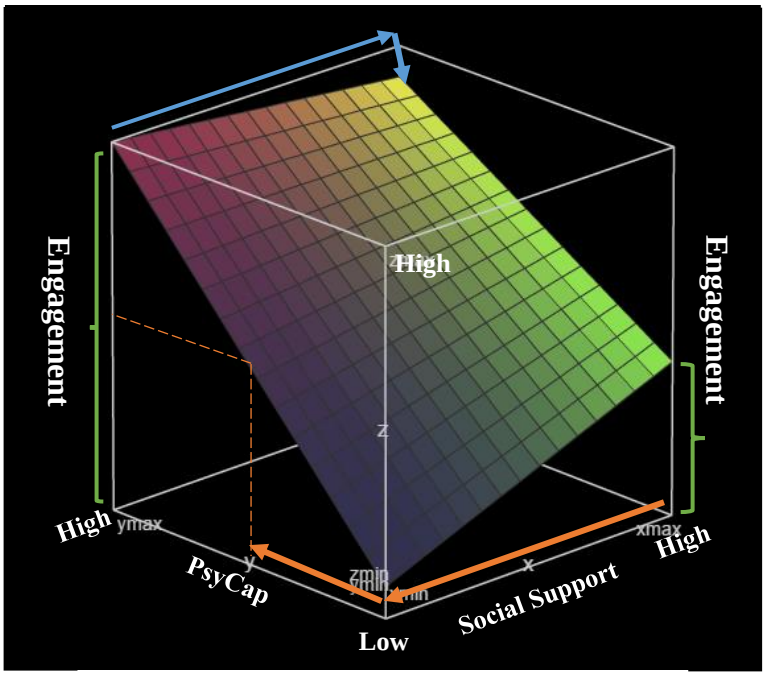


Figure 15 Work Engagement Cube

Hypothesis 3 proposed that risk perception has a negative relationship with work engagement. Figure 14 shows that risk perception was negatively related to work engagement ($\beta = -0.136$, $p < 0.001$). This provides support for hypothesis 3.

Hypothesis 4 proposed that work engagement has a positive relationship with SSTL. The results of figure 14 show that work engagement was positively related to SSTL (($\beta = 0.454$, $p < 0.001$). Therefore, hypothesis 4 is supported.

Hypothesis 5 proposed that the structural model between upper and lower management level is different. A chi-square difference test was performed between the upper management level and the lower management level of the structural model in AMOS. The results show a p-value of 0.155. Hence, there is no significant difference between levels. Hypothesis 5 is rejected. Table 7 summarizes the results of the hypothesis testing.

Factors/constructs	Standardized Beta	p-value	Hypotheses Testing Results
Engagement <--- Social_Support	0.118	0.001	H1a: positive relationship (accepted)
Engagement <--- Work_Autonomy	-0.081	0.021	H1b: positive relationship (rejected)
Engagement <--- PsyCap_x_SocialSupport	-0.156	***	H2a : interaction effect (accepted)
Engagement <--- PsyCap_x_WorkAutonomy	0.070	0.078	H2b: interaction effect (rejected)
Engagement <--- Risk_Perception	-0.136	***	H3: negative relationship (accepted)
SSTL <--- Engagement	0.454	***	H4: positive relationship (accepted)
Structural model between upper and lower management (Chi-square difference test)		0.155	H5:dffierent structural model (rejected)

Table 7 Summary of the hypothesis testing

3.5 Discussion

The JD-R model was used in this study to frame the relationships among job resources (work autonomy and social support), personal resources (PsyCap), job demands (risk perception), work engagement and SSTL. The SEM results indicate that the JD-R model could be extended to explain SSTL. In particular, work autonomy, social support, PsyCap, and risk perception could act through work engagement, and influence SSTL. Unexpectedly, contrary to the proposed positive relationship, there was a small negative correlation between work autonomy and work engagement. One possible explanation is that the effects of work autonomy and work engagement might be contingent on personal factors. An empirical study suggested that individuals who have higher levels of personal resources such as self-efficacy perceive their job resources more positively thus leading to higher levels of work engagement (Lorente et al. 2014).

Indeed, we also found a similar phenomenon in our model. When we used PsyCap as the moderator between work autonomy and engagement, we got a positive interaction coefficient. This could mean that high PsyCap people are more likely to perceive work autonomy as something positive and beneficial about their jobs, and thus become more engaged at work. Although we rejected this finding in our model as its p-value (0.078) is slightly higher than 0.05, it could still be a reference point for future exploratory research.

3.51 Theoretical implications

The findings of our research have theoretical implications for both the JD-R model and occupational safety research. First, our findings provide empirical support for the applicability of the JD-R model to safety leadership. Furthermore, while personal resources was added to the JD-R model in recent years (Bakker and Demerouti, 2008), researchers are still not clear on how to integrate this factor into the model (Bauer & Hämmig, 2013). In particular, there is relatively little research on the moderation effects of personal resources in JD-R research (Bakker & Sanz-Vergel, 2013). PsyCap has emerged as the most important measure of personal resources studied in the positive organizational behavior literature. Researchers have called for studying it in the JD-R model, but no empirical study has been done on the topic so far. The current study contributes to the JD-R literature by investigating how personal resources moderate the relationship between job resources and work engagement, as well as by exploring the effects of PsyCap in the JD-R model.

Furthermore, our finding is that work engagement plays an important role in safety leadership. We also found that PsyCap, social support, work autonomy, and

risk perception contribute significantly to work engagement. These are valuable discoveries because most of the safety research focuses on studying how safety leadership affects safety performance but not on the factors affecting safety leadership. Therefore, this study helps to enhance our understanding of safety leadership in with a more extended perspective.

Last but not least, we found that PsyCap and social support had a substitute interaction effect on work engagement. This finding is important because very few studies have examined this mechanism although social support has long been discussed as a key job resources in the JD-R model (Grote & Künzler, 2000; Leplat, 1984; Turner et al., 2010). In addition, we also found that when the level of social support increases, individuals who are high in PsyCap become less engaged in work. This finding may be better explained by the social support research conducted in social psychology (e.g., Bolger, Zuckerman, & Kessler, 2000; Howland & Simpson, 2010). Studies base in that discipline have found that receiving social support entails emotional costs like inefficacy and indebtedness. Thus, social psychology research suggests that the benefits of support may be maximized when it is given invisibly. Likewise, the emotional costs imposed by social support might be the reason why people become less engaged at work when they receive a higher level of social support. Thus, future research can further investigate how invisible support affects work engagement.

3.52 Management implications

The results of our study have some managerial implications. First, the substitute interaction effect between PsyCap and social support on work engagement

means engagement can be improved by allocating resources to either enhancing job resources or PsyCap. Based on Figure 4.7, we found that the marginal growth of work engagement is higher when we improve PsyCap instead of social support. As such, managers may focus their resources on PsyCap training in order to obtain optimal levels of engagement. In addition, we also found that when the level of social support increases, individuals who are high in PsyCap become less engaged in work. Under this circumstances, to maximize work engagement, managers should assign sub-ordinates who are high in PsyCap to work in projects or on teams with less social support, and vice versa.

Furthermore, similar to other previous research findings (Nahrgang, Morgeson, & Hofmann, 2011; Turner et al., 2010), our results confirmed the negative relationship between risk perception and work engagement. In addition, our model also found that work engagement is positively related to safety leadership. Therefore, when leaders encounter an increasing level of risk perception, his engagement in safety leadership diminishes, which could result in more occupational accidents and fatalities taking place. One solution to control risk perception is to train and prepare employees through various safety programs and thereby improve their overall impression of safety and their skills in handling safety issues.

3.6 Limitations and future research

Although the research provides a number of important insights, it has some limitations. First, the use of a cross-sectional design limits causal inferences based on

the data. A longitudinal or experimental design is needed in future studies in order to differentiate such causal relationships.

Second, the study is based on self-reporting measures. This raises the possibilities of having common method bias. Although our research design and analysis process did impose different measures to control for this, it is recommended that future studies to use multiple sources for each data point in order to address this issue. For example, the data could be collected from the manager him or herself, and from people who know the manager well (e.g., coworkers).

Third, our study focused on the construction industry, and so it is unclear whether our findings can be generalized to other context. Even though we expect that the construction industry does share some similarities with other safety critical industries such as the oil and gas industry, future research can investigate whether our model can be applied to other industries.

Finally, the study used existing measures to evaluate all the latent variables of the model, while all those measures are subjective measurements which refer to how people actually experience. The fundamental problem of using subjective measures is that they depend on how individuals interpret the measurement questions. As a result, individuals' biases and measurement errors could distort the final results. To handle this problem, future studies may consider using objective measures in addition to subjective measures. For example, for measuring risk perception, we can use the historical records of accidents to evaluate it.

3.7 Conclusion

The majority of safety leadership studies have focused on how safety leadership affects safety performance and safety climate. The current study adopted a different focus and concentrated on studying what factors affect safety-specific transformational leadership by using the JD-R model as the framework. This was carried out by conducting an online survey of the leaders who work in a large privately owned construction company in the United States, then analyzing the data using EFA and SEM. We found that work engagement plays an important role in safety leadership. Additionally, we found PsyCap, social support, work autonomy, and risk perception contribute significantly to work engagement.

Chapter 4: Antecedents of safety leadership: are organizational or personal factors more important?

4.1 Introduction

In recent decades, there has been a great deal of interest in studying safety leadership. Many studies have found that safety leadership predicts safety climate, safety participation, and safety outcomes (e.g., Clarke, 2013; Wu, Chen, et al., 2008; Zohar & Luria, 2003). In a review of two decades of safety literature, Flin et al. (2000) concluded that 72% of the studies suggested that leadership plays a critical role in promoting and developing a safe work environment. While the effectiveness of safety leadership is well established, little is known about what factors influence the practice of safety leadership. Not knowing what drives safety leadership significantly hinders us from developing effective interventions that can target resources toward enhancing the contributing factors of safety leadership. Indeed, Conchie, Moon and Duncan (2013) tried to fill in this knowledge gap. Using focus groups, they interviewed 69 construction supervisors to explore the contextual factors that could help or prevent supervisors from engaging in safety leadership behaviors.

Similar to Conchie and her colleagues, our aim is to examine factors that affect the practice of safety leadership. However, there are four key differences in our approach. First, given the limitations in Conchie, Moon and Duncans' study solely focusing on construction supervisors, our study investigated construction leaders in different management levels. Second, we investigated the effect of personal factors in addition to contextual factors. Third, instead of studying safety leadership in general,

our study focuses on investigating safety-specific transformation leadership (SSTL) because SSTL has been empirically proven to have a strong and positive association with various safety outcomes (e.g., (Barling et al., 2002; Conchie, Taylor, & Donald, 2012; Mullen & Kelloway, 2009a). Finally, our study used quantitative approach through using questionnaires and statistical analysis.

Specifically, in this paper, we examine how organizational factors (social support, work autonomy, and risk perception) and personal factors (psychological capital) could affect SSTL.

4.11 Safety-specific transformational leadership (SSTL)

Transformational leadership refers to employing influence and enthusiasm to motivate followers to work for the benefit of an organization (Bernard M. Bass, 1990). SSTL refers to transformational leadership behaviors that specifically promote and develop a safe work environment (Barling et al., 2002). Numerous studies found a strong and positive association between SSTL and safety outcomes. For example, (de Koster et al., 2011) found that SSTL is negatively associated with warehouse accidents. (Conchie & Donald, 2009a) suggested that SSTL had a significant effect on subordinates' safety citizenship behavior.

According to Barling et al. (2002), SSTL consists of five components: idealized influence, inspirational motivation, intellectual stimulation, individualized consideration and contingent reward. Leaders with high 'idealized influence' demonstrate their own personal commitment to safety, thus facilitating higher levels

of follower trust that management considers safety important. Leaders demonstrate 'inspirational motivation' when they challenge followers to go beyond their personal needs for the collective well-being. For instance, leaders convince their followers to achieve high levels of safety standards, using stories to clarify their mission. By using 'intellectual stimulation', leaders challenge their followers to question long-held assumptions and motivate them to think about creative ways that could improve occupational safety. In addition, leaders manifesting 'individualized consideration' express an active interest in their followers' well-being, including their work safety. Lastly, leaders make use of 'contingent reward' to encourage and reinforce followers' safety behaviors.

4.2 Hypotheses

4.21 Relationship of work autonomy and SSTL

Work autonomy refers to the extent that an individual feels in control of the ways to get his or her job done (Breaugh, 1999). People with high levels of work autonomy have strong ownership of their behavior, strong relatedness to their organizations, and strong belief in their competence in performing the work (Edward & Ryan, 1985). This positivity enables them to dedicate their energy and abilities to their work tasks. Grote (2007) found that autonomy has the strongest impact on safety when desired safety behavior is not rule-based and when there is a high level of uncertainty. Because effective safety leadership in the construction industry is often defined as behavior performed beyond formal role obligations under the dynamic

nature of construction work (Conchie et al., 2013), we therefore believe that work autonomy can boost one's engagement in safety leadership. Indeed, our belief was also supported by (Conchie et al., 2013). They found work autonomy is one of the main resources to support safety leadership. Therefore, we hypothesized that:

Hypothesis 1: Work autonomy is positively associated with SSTL.

$$H_0: \beta_{WA} = 0$$

$$H_1: \beta_{WA} > 0$$

4.22 Relationship of social support and SSTL

Social support can come from co-workers, supervisors and top management (Turner et al., 2010; Zohar & Luria, 2003). Indeed, social support was found to promote safety. For instance, Zohar & Luria, (2003) showed that supervisor support helps to improve workers' safety behaviors and safety climate. Turner et al. (2010) found that co-worker support is important for the maintenance of employee safety performance. In the same vein, we believe that social support could promote construction leaders' engagement in safety leadership. In the construction industry, production and safety could be valued unequally in practice. When the pressure for production is on, there is the potential for safety to be compromised. Yet social support, especially from management, to expedite the production without sacrificing work safety could help construction leaders to engage in safety leadership even under significant production pressure. Conchie et al. (2013) found that social support is

critical for construction supervisors to practice safety leadership. To validate this relationship, we hypothesized that:

Hypothesis 2: Social Support is positively associated with SSTL.

$$H_0: \beta_{SS} = 0$$

$$H_1: \beta_{SS} > 0$$

4.23 Relationship of risk perception and SSTL

In addition to work autonomy and social support, risk perception is another organizational factor we examined. Risk perception is generally regarded as a significant work stressor in the construction industry (Hallowell, 2010; Perlman et al., 2014), because its work environment can involve significant risk factors such as fire, explosions, structural collapse, and accidents associated with slips, trips, and falls. There has been limited research on how an individual's risk perception could affect one's leadership behaviors in the context of safety; however, the impact of risk perception on worker behaviors has been widely studied. Numerous empirical studies (DeJoy et al., 2004; Frone, 1998; M. Goldenhar et al., 2003) reported that risk perception is negatively related to employees' engagement in safety activities, compliance, and job satisfaction because high levels of risk perception leads to burnout (González-Romá et al., 2006).

Yet we argue that risk perception may have a different impact on construction leaders because they have more resources and authorities to handle risks than

construction workers. When leaders have high levels of risk perception on their work, he or she may have a stronger sense of urgency to mitigate the risk. One of the possible ways to mitigate risk is to demonstrate safety leadership to guide subordinates to work safely. As such, we hypothesized that:

Hypothesis 3: Risk perception is positively associated with SSTL.

$$H_0: \beta_{Risk} = 0$$

$$H_1: \beta_{Risk} > 0$$

4.24 Relationship of psychological capital and SSTL

Psychological Capital (PsyCap) has emerged as the most important personal resource studied in positive organizational behavior due to its significant impact on desirable work behaviors, such as job satisfaction, organizational commitment, and organizational citizenship (Larson & Luthans, 2006; Lifeng, 2007; Luthans & Jensen, 2005). In addition, PsyCap is found to affect safety in general. For instance, (Bergheim et al., 2013; Hystad et al., 2013) concluded that PsyCap is positively related to safety climate in safety critical organizations.

Specifically, psychological capital (PsyCap) is a high-order construct that consists of four psychological resources, namely hope, optimism, resilience, and self-efficacy. A person high in PsyCap is characterized as: (1) having the confidence (self-efficacy) to put in necessary effort to complete challenging tasks; (2) making positive

attributions (optimism) about succeeding now and in the future; (3) persevering toward goals, and redirecting paths to goals (hope) in order to succeed whenever necessary; and (4) bouncing back and even beyond original states (resilience) to achieve success when encountering adversity (Fred. Luthans et al., 2007).

We consider that PsyCap may be a potential antecedent of SSTLBs. Fox example, leaders who are more hopeful tend to set higher standards on safety performance and become role models of safety behaviors. They are highly motivated to make their followers comply with the safety standards through various actions such as establishing a safety responsibility system, acting on safety policies, and recognizing followers' safety behaviors. Furthermore, their efficacious and optimistic beliefs about succeeding with their objectives on safety improvement lead them to put in the effort and persistence required to succeed. Finally, highly resilient leaders are more able to bounce back from adversity and stay focused on handling safety issues. As a result, they can find ways around difficulties to achieve better safety performance. Based on our review, we hypothesized that:

Hypothesis 4: PsyCap is positively associated with SSTL.

$$H_0: \beta_{PsyCap} = 0$$

$$H_1: \beta_{PsyCap} > 0$$

4.25 Relationship of organizational and personal factors on SSTL

According to the Person-Environment (P-E) fit literature, an employee's personal factors could alter the influence of job characteristics. In particular, Lorente et al., (2014) found that people who have higher levels of personal resources such as self-efficacy, mental competencies, and emotional competencies tend to believe that they can control the environment effectively. As a result, they are more likely to perceive job resources as abundant regardless of the objective situation, and get highly involved in their work to drive positive performance. In other words, personal factors or resources could be more important than organizational factors in terms of leading to positive work behaviors. With these consideration in mind, we hypothesized that:

Hypothesis 5: PsyCap has the greatest influence on SSTL relative to work autonomy, social support and risk perception.

$$H_0: \beta_{PsyCap} = \beta_{WA} = \beta_{SS} = \beta_{Risk}$$

$$H_1: \beta_{PsyCap} > \beta_{WA}, \beta_{SS}, \beta_{Risk}$$

Figure 16 summarizes all the above hypotheses.

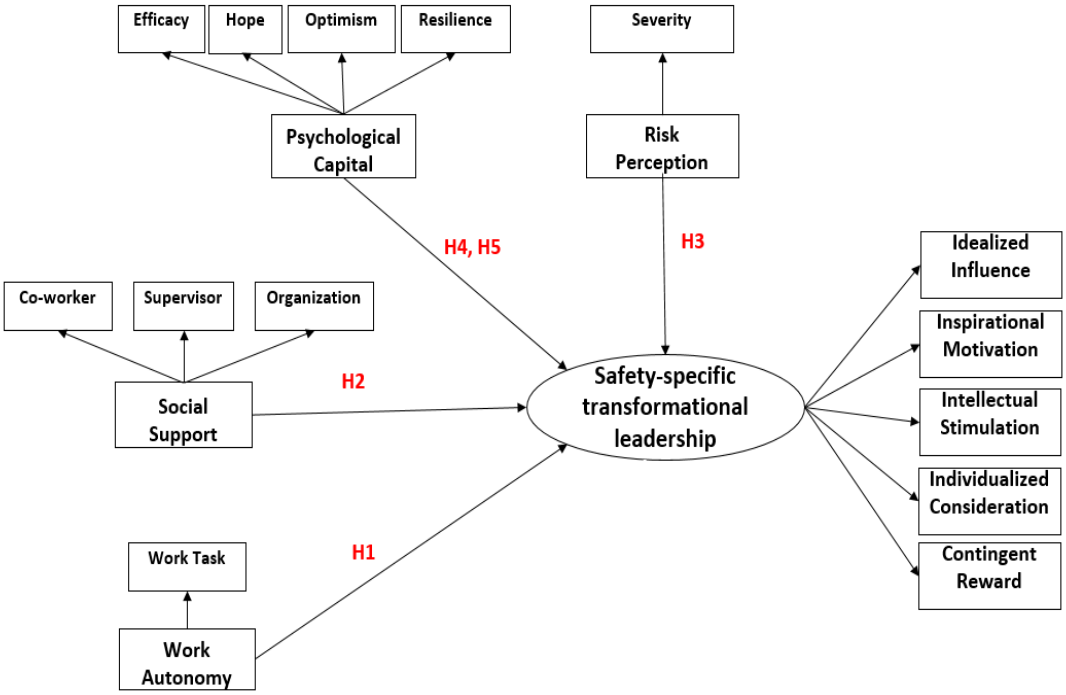


Figure 16 Direct effects of work autonomy, social support, PsyCap and risk perception on SSTL

4.3 Method

4.31 Sample and Procedure

The study was conducted in a large privately owned construction company in the United States. In October 2016, an online survey was sent to all of the company's 639 in management positions. A total of 386 questionnaires were returned, thus producing a response rate of 60%. Deletion of missing values and unengaged responses resulted in a usable sample of 383 employees (60%), of which 90% (N=345) were male. With respect to race, this sample was predominantly white (89%, N=340), with a few Asian (1%, N=4), Black (2%, N=7), Hispanic (5%, N=21), and unknown (3%, N=11) respondents. The workforce was relatively experienced with

72% (N=274) having worked in the construction industry for over ten years. Regarding job status, all participants are in managerial level positions with job titles distributed as follows: construction executive (4%, N=14), director (1%, N=2), executive (2%, N=7), manager (2%, N=6), project executive (10%, N=40), project manager (20%, N=77), safety director (1%, N=4), safety manager (4%, N=17), senior project manager (15%, N=59), senior safety manager (3%, N=13), senior superintendent (7%, N=25), senior vice president (3%, N=11), superintendent (18%, N=69), and vice president (10%, N=39).

4.32 Measures

1. Social Support

We measured social support according to three different sources: perceived organization support, perceived supervisory support and perceived coworker support.

a. Perceived organizational support

This scale consisted of the three highest-loading items adapted from the Management Attitude Toward Safety Scale built by Mueller et al. (1999). A sample item was: "Top management seems to care about my safety." Respondents answered items on a 5-point scale (strongly disagree to strongly agree), with a higher score indicating stronger perceived management support. The Cronbach alpha of the scale was 0.82.

b. Perceived supervisory support

This scale consisted of the three highest-loading items adapted from Management Attitude Toward Safety Scale built by Mueller et al. (1999). A sample item was: "My supervisor seems to care about safety." Respondents

answered items on a 5-point scale (strongly disagree to strongly agree), with a higher score indicating stronger perceived supervisory support. The Cronbach alpha of the scale was 0.93.

c. Perceived co-worker support

This scale consisted of the three highest-loading items adapted from Management Attitude Toward Safety Scale built by Mueller et al. (1999). A sample item was: "People in my work group emphasize working safely and make sure others do the same." Respondents answered items on a 5-point scale (strongly disagree to strongly agree), with a higher score indicating stronger perceived co-worker support. The Cronbach alpha of the scale was 0.87.

2. Work Autonomy

We used the three-item work autonomy scales developed by Breaugh (1999) to measure work autonomy. A sample item was: "I am allowed to decide how to go about getting my job done." Respondents answered items on a 5-point scale (never to always), with a higher scale score indicating high level of work autonomy. The Cronbach alpha of the scale was 0.93.

3. Psychological Capital (PsyCap)

PsyCap is a higher order construct made up of four related and mostly state-like dimensions: Hope, Efficacy, Resilience and Optimism. To measure these dimensions, we used the Luthans and his colleagues' (2007) 24-item Psychological Capital Questionnaire (PCQ). Each dimension was measured by 6

items. A sample item of hope was “At the present time, I am energetically pursuing my work goals”, efficacy was “I feel confident presenting information to a group of colleague”, resilience was “I can get through difficult times at work”, and Optimism was “when things are uncertain for me at work I expect the best”. Respondents answered items on a 6-point scale (strongly disagree to strongly agree), with a higher scale score indicating higher level of PsyCap. The Cronbach alpha was 0.83 for hope, 0.84 for efficacy, 0.86 for resilience, and 0.84 for optimism.

4. Risk Perception

Risk Perception was measured using a 2-item scale adapted from Rimal and Real's (2003) A sample item of severity was “work-related injury is a serious matter that can be fatal”. Respondents answered items on a 5-point scale (strongly disagree to strongly agree). A higher scale score indicates higher level of risk perception. The Cronbach alpha was 0.71.

5. Safety-Specific Transformational Leadership (SSTL)

We used the 10-item safety-specific transformational leadership scale developed by (Barling et al., 2002) to measure SSTL. Although the scale covered five dimensions (idealized influence, inspirational motivation, intellectual simulation, individualized consideration, and contingent reward), it was used as an unidimensional measurement because those dimensions are highly correlated ((Barling et al., 2002). A sample item of idealized influence was “I show

determination to maintain a safe work environment, inspiration motivation was “I talk about my values and beliefs regarding the importance of safety”, intellectual simulation was “I suggest new ways of doing jobs more safely”, individualized consideration was “I spend time showing my subordinates the safest way to do things at work”, and contingent reward was “I make sure that my subordinates receive appropriate rewards for achieving safety targets on the job”. Respondents answered items on a 5-point scale (not at all to always). A higher score indicates a higher level of SSTL. The Cronbach alpha of the one-factor scale was 0.86.

4.33 Common method variance

Because all the variables in our study were collected from a single source, we are concerned about having common method variance (CMV) in our data. Harman’s single-factor was used to investigate potential common method variance. To perform the test, we conducted an exploratory factor analysis (EFA) in which all items were constrained to load on one single factor with no rotation. The total variance explained by this one factor model is 25% which is below the threshold of 50%. Thus, the Harman test did not indicate common method variance.

4.34 Statistical analysis

1. Selection and application of statistical techniques

To test our hypothesis, we employed a three-step approach. The first step involves validating the reflective measurement model using an exploratory factor analysis in SPSS and then a confirmatory factory analysis in AMOS. The second step involved creating factor scores from latent variables in AMOS. This step reduces the fully latent model into one score per factor. In fact, the factor score account for the factor weights of the latent variables, just as in the latent model. The third step was using the factor scores to run multiple regression in SPSS.

2. Data Screening

Before running an exploratory factor analysis, we evaluated missing values, outliners, normality. All usable responses were complete. There was one response that had missing values and two responses that had unengaged answers. They were removed prior to subsequent analyses. The useable sample is 383. As all our variables are in ordinal (5-point, 6-point and 7-point Likert-scale), extreme value outliers do not exist. Because of employing short interval ordinal scales, skewness is not a major issue, but kurtosis could affect our results due to insufficient variance. Our kurtosis test showed that one item for social support (SS), one item for organizational support (OS), three items for self-efficacy and three items for resilience (RS) had kurtosis values that are slightly greater than 2.2. However, we opted to retain these items because their communalities during the EFA was sufficiently large (>0.400), which means they were likely to load significantly on certain factors. Moreover, as the

kurtosis items are all from previous validated measurements, eliminating them at this stage without further validation in EFA and CFA would have affected reliability and validity of those factors.

4.4 Results

4.41 Measurement model

We conducted exploratory (EFA) and confirmatory (CFA) factor analysis (using Maximum Likelihood) in order to establish the reliability and validity of our construct measurements. The pattern matrix of item loading is shown in Figure 4.2. All loadings were above the 0.300 threshold recommended by Hair et al. (2013) from with sizes greater than 350. Cronbach's alphas values are also reported for each factor in Figure 17. All Cronbach's alphas are above the recommended threshold of 0.700 for factor reliability (Fornell & Larcker, 1981). The total variance explained was 58.69% for the 10-factor model. During EFA, two items of hope and two items of resilience were deleted due to poor loading or failing to load with the expected factor. Indeed, the four deleted items were reported as kurtosis items in the data screening section.

The CFA confirmed the factor structure established during the EFA and provided additional measures for validity and reliability. The construction correlation matrix in Table 8 presents the correlations between factors, the AVE (average variance extracted) and CR (composite reliability).

(square root of the AVE on the diagonal)							
	CR	**AVE**	**Risk**	**SSTL**	**WA**	**PsyCap**	**Support**
Risk	0.739	0.586	**0.766**				
SSTL	0.869	0.406	0.172	**0.637**			
WA	0.933	0.823	0.099	0.419	**0.907**		
PsyCap	0.856	0.599	0.222	0.468	0.542	**0.774**	
Support	0.837	0.632	0.239	0.392	0.423	0.511	**0.795**

Table 8 Construct correlation matrix

To establish convergent validity, the AVEs should be greater than 0.500 (Kline et al., 2012). We meet this threshold for all factors except SSTL, which is right on the border at 0.406. Although this is below the recommended threshold, we decided to retain it because it met criteria for discriminant validity and reliability. To establish discriminant validity, the square root of the AVE should be less than any correlation with another factor. All of our factors achieve this criterion.

The goodness of fit statistics for the final measurement model are shown in Table 9. All thresholds from Hu & Bentler (1999) are met, indicating that we have sufficient model fit. No adjustments to the model (such as addressing issues indicated by the modification indices) were required in order to obtain adequate model fit.

Model fit for measurement model		
Metric	**Observed value**	**Ideal Threshold**
CMIN/df	1.826	between 1 and 3
CFI	0.920	>0.900
RMSEA	0.047	<0.060
PCLOSE	0.946	>0.050
SRMR	0.051	<0.090

Table 9 Model fit for measurement model

Pattern Matrix[a]

Cronbach's Alpha-->	Factor									
	0.863	0.837	0.841	0.931	0.933	0.886	0.819	0.835	0.798	0.712
SSTL_1	0.612									
SSTL_2	0.532									
SSTL_3	0.758									
SSTL_4	0.725									
SSTL_5	0.696									
SSTL_6	0.657									
SSTL_7	0.744									
SSTL_8	0.423									
SSTL_9	0.646									
SSTL_10	0.363									
WA_1					0.885					
WA_2					0.927					
WA_3					0.901					
OS_1							0.614			
OS_2							0.761			
OS_3							0.820			
SS_1				0.759						
SS_2				0.902						
SS_3				0.954						
CS_1						0.633				
CS_2						1.000				
CS_3						0.831				
Severity_1										0.704
Severity_2										0.831
SE_1			0.707							
SE_2			0.847							
SE_3			0.609							
SE_4			0.616							
SE_5			0.568							
SE_6			0.706							
HP_3									0.391	
HP_4									0.555	
HP_5									0.865	
HP_6									0.548	
RS_3								0.499		
RS_4								0.634		
RS_5								0.967		
RS_6								0.703		
OP_1		0.671								
OP_2		0.524								
OP_3		0.903								
OP_4		0.649								
OP_5		0.433								
OP_6		0.746								

Extraction Method: Maximum Likelihood.

a. Rotation converged in 8 iterations.

Figure 17 Pattern matrix of EFA

4.42 Multiple Regression

Table 10 presents the results from the multiple regression. In support of Hypothesis 1, work autonomy was positively related to SSTL (β = 0.184, $p < 0.05$). In support of Hypothesis 2, social support was positively related to SSTL (β = 0.164, $p < 0.05$). Although we found a positive Pearson's correlation coefficient between risk perception and SSTL in Table 8 to support Hypothesis 3, this relationship is not statistically significant (β = 0.053, $p = 0.230$). Thus, Hypothesis 3 was rejected. In support of Hypothesis 4, PsyCap was positively related to SSTL (β = 0.310, $p < 0.001$). Finally, in support of Hypothesis 5, PsyCap has the strongest influence on SSTL relative to social support, risk perception and work autonomy (PsyCap's β = 0.310 > work autonomy's β = 0.184 > social support's β = 0.164 > risk perception's β = 0.053 [statistically insignificant].)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.551	0.253		2.180	0.030
	Support	0.079	0.026	0.164	3.017	0.003
	PsyCap	0.148	0.028	0.310	5.218	0.000
	Risk	0.088	0.073	0.053	1.202	0.230
	WA	0.150	0.044	0.184	3.417	0.001

a. Dependent Variable: SSTL

Table 10 Summary of multiple regression for variables predicting SSTL

Table 11 presents all variables (social support, PsyCap, risk perception, and work autonomy) in the model, explaining 33.5% of variance in SSTL, which is within an acceptable range in behavioral science.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.579[a]	0.335	0.328	0.357

a. Predictors: (Constant), WA, Risk, Support, PsyCap

Table 11 Model summary of multiple regression for variables predicting SSTL

4.5 Discussion

This present study examined the relationship between organizational resources (work autonomy, social support and risk perception), personal resources (PsyCap) and SSTL. The results show that work autonomy, social support and PsyCap are positively related to SSTL. Furthermore, PsyCap has the greatest influence on SSTL compared to work autonomy, social support and risk perception. Unexpectedly, risk perception has an insignificant relationship to SSTL. One possible explanation is that this study focuses on one source of risk perception (severity) instead of the full range of sources of risk perception. As a result, we may not have captured the whole picture of risk perception to draw a clear conclusion.

The findings of the study help to disentangle what organizational and personal factors relate to SSTL, and highlight that personal resources could impose greater influence on SSTL than organizational resources. Additionally, this study is the first to our knowledge to examine the direct effects of both organizational and personal factors on SSTL.

Furthermore, as we found PsyCap has greater influence on SSTL than other organizational resources including work autonomy, social support and risk perception, companies can put their focus on improving leaders' PsyCap with the

purpose of enhancing SSTL. In addition, companies can also consider using PsyCap as an evaluation criterion when they hire for safety-related positions.

4.6 Limitations and future research

Although the research provides a number of important insights, it has some limitations. First, the use of a cross-sectional design limits causal inferences based on the data. A longitudinal or experimental design is needed in future studies in order to differentiate such causal relationships.

Second, the study is based on self-reporting measures. This raises the possibilities of having common method bias. Although our research design and analysis process did impose different measures to control it, for future studies, it is recommended to use multiple sources for each data point in order to prevent such an issue. For example, the data could be collected from the manager him or herself, and from people who know the manager well (e.g., coworkers).

Finally, our study focused on the construction industry, and so it is unclear whether our findings can generalize to our context. Even though we expect that the construction industry does share some similarities with other safety critical industries such as oil and gas industry in the safety context, future research can investigate whether our model can be applied to other industries.

4.7 Conclusion

In contribution to the otherwise limited research on the antecedents of safety, this study focused on examining what factors affect safety-specific transformational leadership. Through conducting an online survey with the leaders who work in a large privately owned construction company in the United States, we then analyzed the data using EFA, CFA and multiple regression. We found that work autonomy, social support, and PsyCap were positively related to SSTL. Furthermore, PsyCap has the greatest influence on SSTL relative to work autonomy, social support and risk perception.

Chapter 6: Summaries and Conclusion

This dissertation proposes to study what factors affect safety-specific transformational leadership by using the JD-R model as the framework. After an introduction to research background and early literatures in the first chapter, chapter two developed the a conceptual model based on the JD-R model to study what and how contextual and personal factors could affect construction leaders' engagement in safety leadership, and thus it provides us with insights into how safety leadership could be better supported and promoted. Chapter 3 validated the conceptual model proposed in Chapter 2 through conducting an online survey of the leaders who work in a large privately owned construction company in the United States, then analyzing the data using EFA and SEM. We found that work engagement plays an important role in safety leadership. Additionally, we found PsyCap, social support, work autonomy, and risk perception contribute significantly to work engagement. Chapter 4 tested the direct effects between PsyCap, social support, work autonomy and risk perception on SSTL using EFA, CFA and multiple regression. We found that all factors except risk perception were positively related to SSTL. Furthermore, PsyCap has the greatest influence on SSTL relative to work autonomy, social support and risk perception.

6.1 Summaries of proposed methodologies and results

	Chapter 2	Chapter 3	Chapter 4
Data Source	Literature Review	Online Survey (N=383)	Online Survey (N=383)
Analysis method	Content Analysis	EFA + SEM	EFA + CFA+ multiple regression
Results	Established four hypotheses for testing in Chapter 3.	Both measurement and structural models obtained sufficient model fit. (refer to table 6.1)	Measurement model obtained sufficient model fit.

Table 12 Summary of methodologies

Factors/constructs	Standardized Beta	p-value	Hypotheses Testing Results
Engagement <--- Social_Support	0.118	0.001	H1a: positive relationship (accepted)
Engagement <--- Work_Autonomy	-0.081	0.021	H1b: positive relationship (rejected)
Engagement <--- PsyCap_x_SocialSupport	-0.156	***	H2a : interaction effect (accepted)
Engagement <--- PsyCap_x_WorkAutonomy	0.070	0.078	H2b: interaction effect (rejected)
Engagement <--- Risk_Perception	-0.136	***	H3: negative relationship (accepted)
SSTL <--- Engagement	0.454	***	H4: positive relationship (accepted)
Structural model between upper and lower management (Chi-square difference test)		0.155	H5:dffierent structural model (rejected)

Table 13 Summary of the structural model of chapter 3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Hypotheses Testing Results
		B	Std. Error	Beta			
1	(Constant)	0.551	0.253		2.180	0.030	
	Support	0.079	0.026	0.164	3.017	0.003	H2: positive relationship (accepted)
	PsyCap	0.148	0.028	0.310	5.218	0.000	H4 & H5: positive relationship (accepted)
	Risk	0.088	0.073	0.053	1.202	0.230	H3:{statistically insignificant) (rejected)
	WA	0.150	0.044	0.184	3.417	0.001	H1: positive relationship (accepted)

a. Dependent Variable: SSTL

Table 14 Summary of multiple regression of chapter 4

6.2 Summary of contribution

Theoretical Implications

The findings of our research have theoretical implications for both the JD-R model and occupational safety research. First, our findings provide empirical support for the applicability of the JD-R model to safety leadership. Furthermore, while personal resources was added to the JD-R model in recent years (Bakker and Demerouti, 2008), researchers are still not clear on how to integrate this factor into the model (Bauer & Hämmig, 2013). In particular, there is relatively little research on the moderation effects of personal resources in JD-R research (Bakker & Sanz-Vergel, 2013). PsyCap has emerged as the most important measure of personal resources studied in the positive organizational behavior literature. Researchers have called for studying it in the JD-R model, but no empirical study has been done on the topic so far. The current study contributes to the JD-R literature by investigating how personal resources moderate the relationship between job resources and work engagement, as well as by exploring the effects of PsyCap in the JD-R model.

Furthermore, our finding is that work engagement plays an important role in safety leadership. We also found that PsyCap, social support, work autonomy, and risk perception contribute significantly to work engagement. These are valuable discoveries because most of the safety research focuses on studying how safety leadership affects safety performance but not on the factors affecting safety leadership. Therefore, this study helps to enhance our understanding of safety leadership in with a more extended perspective.

Last but not least, we found that PsyCap and social support had a substitute interaction effect on work engagement. This finding is important because very few studies have examined this mechanism although social support has long been discussed as a key job resources in the JD-R model (Grote & Künzler, 2000; Leplat, 1984; Turner et al., 2010). In addition, we also found that when the level of social support increases, individuals who are high in PsyCap become less engaged in work. This finding may be better explained by the social support research conducted in social psychology (e.g., Bolger, Zuckerman, & Kessler, 2000; Howland & Simpson, 2010). Studies base in that discipline have found that receiving social support entails emotional costs like inefficacy and indebtedness. Thus, social psychology research suggests that the benefits of support may be maximized when it is given invisibly. Likewise, the emotional costs imposed by social support might be the reason why people become less engaged at work when they receive a higher level of social support. Thus, future research can further investigate how invisible support affects work engagement.

Practical Implications

The results of our study have several practical implications. First, the work engagement cube shown in figure 15 provides managers with a tool to analyze what organizational or personal could be used or improved in order to achieve a higher level of work engagement.

Second, the study found that there is a substitute interaction effect between PsyCap and social support on work engagement. It means that mangers can improve

work engagement by allocating resources to either enhancing job resources or PsyCap, but not both.

Third, the study revealed that the marginal growth of work engagement is much higher when we improve PsyCap instead of social support. As such, it could be more effective for managers to focus their resources on providing training programs for PsyCap in order to obtain optimal levels of work engagement. In addition, individuals' level of PsyCap may also be used to make hiring decision on positions that relate to safety leadership.

Fourth, we also found that when the level of social support increases, individuals who are high in PsyCap become less engaged in work. Under this circumstances, to maximize work engagement, managers may consider assigning sub-ordinates who are high in PsyCap to work in projects or teams with less social support, and vice versa.

Finally, similar to other previous research findings (Nahrgang, Morgeson, & Hofmann, 2011; Turner et al., 2010), our results confirmed that there is a negative relationship between risk perception and work engagement, while work engagement is positively related to safety leadership. These results could imply that when leaders encounter an increasing level of risk perception, his or her work engagement in safety leadership diminish, and thus lead to more occupational accidents and fatalities. Although we expected risk perception may have a positive direct effect on safety leadership, we could not find the relationship statistically significant. Under the circumstance, it is important to control the level of risk perception for better work engagement and safety outcomes. One solution is to train and prepare employees

through various safety programs and thereby improve their overall impression of safety and their skills in handling safety issues.

6.3 Summary of limitations and future research

Although the research provides a number of important insights, it has some limitations. First, the use of a cross-sectional design limits causal inferences based on the data. A longitudinal or experimental design is needed in future studies in order to differentiate such causal relationships.

Second, the study is based on self-reporting measures. This raises the possibilities of having common method bias. Although our research design and analysis process did impose different measures to control it, for future studies, it is recommended to use multiple sources for each data point in order to prevent such an issue. For example, the data could be collected from the manager him or herself, and from people who know the manager well (e.g., coworkers).

Finally, our study focused on the construction industry, and so it is unclear whether our findings can generalize to our context. Even though we expect that the construction industry does share some similarities with other safety critical industries such as oil and gas industry in the safety context, future research can investigate whether our model can be applied to other industries.

Safety Leadership Survey

Q1 1. Total work experience in the construction industry
- ❍ < 1 year
- ❍ 1-2 years
- ❍ 3-5 years
- ❍ 6-10 years
- ❍ 11-20 years
- ❍ >20 years

Q2 2. What is the highest degree or level of education you have completed?
- ❍ Less than high school
- ❍ High school graduate
- ❍ Associate's degree
- ❍ Bachelor's degree
- ❍ Master's degree
- ❍ Ph.D.

Safety Leadership

Below are about your safety leadership behaviors. Please indicate the extent to which the following statements describe you in the last 12 months.

	Not at all	Once in a while	Sometimes	Fairly Often	Frequently or Always
1. I express satisfaction when my subordinates perform the job safely.	❍	❍	❍	❍	❍
2. I make sure that my subordinates receive appropriate rewards for achieving safety targets on the job.	❍	❍	❍	❍	❍
3. I provide continuous encouragement to my subordinates to do their jobs safely.	❍	❍	❍	❍	❍
4. I show determination to maintain a safe work environment.	❍	❍	❍	❍	❍
5. I suggest new ways of doing jobs more safely.	❍	❍	❍	❍	❍
6. I encourage my subordinates to express their ideas and opinions about safety at work.	❍	❍	❍	❍	❍
7. I talk about my values and	❍	❍	❍	❍	❍

beliefs regarding the importance of safety.					
8. I behave in a way that displays a commitment to a safe workplace.	❍	❍	❍	❍	❍
9. I spend time showing my subordinates the safest way to do things at work.	❍	❍	❍	❍	❍
10. I listen to my subordinates' concerns about safety on the job.	❍	❍	❍	❍	❍

about my job. (5)							
8. My job inspires me. (4)	❍	❍	❍	❍	❍	❍	❍
9. I am proud of the work that I do. (6)	❍	❍	❍	❍	❍	❍	❍
10. To me, my job is challenging. (14)	❍	❍	❍	❍	❍	❍	❍
11. Time flies when I am working. (15)	❍	❍	❍	❍	❍	❍	❍
12. I am happy when I am working intensely. (7)	❍	❍	❍	❍	❍	❍	❍
13. I am immersed in my job. (8)	❍	❍	❍	❍	❍	❍	❍
14. At work, I feel focused. (9)	❍	❍	❍	❍	❍	❍	❍

PsyCap

Below statements describe how you may think about your work performance right now. Use the following scales to indicate your level of agreement or disagreement with each statement. (Due to copyright restriction, only example questions can be shown in the following)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I feel confident analyzing a long-term problem to find a solution.	❍	❍	❍	❍	❍
2. I feel confident representing my work area in meetings with management.	❍	❍	❍	❍	❍
3. If I should find myself in a jam at work. I could think of many ways to get out of it.	❍	❍	❍	❍	❍
4. At the present time, I am energetically pursuing my work goals.	❍	❍	❍	❍	❍
5. When I have a setback at work, I can recover from it and move on.	❍	❍	❍	❍	❍
6. I usually manage difficulties one way or another at work.	❍	❍	❍	❍	❍
7. When things are uncertain for me at work, I usually expect the best.	❍	❍	❍	❍	❍
8. If something can go wrong for me work-wise, it will be better later on.	❍	❍	❍	❍	❍

Supervisor Support Below statements describe how you think about the level of support you have gotten from your day-to-day supervisor on safety issues in the last 12 months. Your day-to-day supervisor is whom you work most closely with. He or she may not be the person who completes your performance appraisal. Your answers are strictly confidential. All responses will be compiled together and analyzed as a group. Your responses are not shown to anyone.

	Strongly Disagree 1 (1)	Disagree 2 (2)	Neutral 3 (3)	Agree 4 (4)	Strongly Agree 5 (5)
1. Worker safety practices are important to my day-to-day supervisor. (1)	❍	❍	❍	❍	❍
2. My day-to-day supervisor seems to care about safety. (2)	❍	❍	❍	❍	❍
3. My day-to-day supervisor emphasizes safe practices on the job. (3)	❍	❍	❍	❍	❍

Organizational Support Below statements describe how you think about the level of support you have gotten from Clark's leadership on safety issues in the last 12 months. Your answers are strictly confidential. All responses will be compiled together and analyzed as a group. Your responses are not shown to anyone.

	Strongly Disagree 1 (1)	Disagree 2 (2)	Neutral 3 (3)	Agree 4 (4)	Strongly Agree 5 (5)
1. Clark's management gets personally involved in safety activities. (1)	❍	❍	❍	❍	❍
2. Clark's management is willing to invest money and effort to improve safety. (2)	❍	❍	❍	❍	❍
3. Clark's management seems to care about my safety. (3)	❍	❍	❍	❍	❍

Co-workers Support Below statements describe how you think about the level of support you have gotten from your co-workers on safety issues in the last 12 months. Your answers are strictly confidential. All responses will be compiled together and analyzed as a group. Your responses are not shown to anyone.

	Strongly Disagree 1 (1)	Disagree 2 (2)	Neutral 3 (3)	Agree 4 (4)	Strongly Agree 5 (5)
1. People in my work group expect each other to behave safely. (1)	❍	❍	❍	❍	❍
2. People in my work group emphasize working safely and make sure others do the same. (2)	❍	❍	❍	❍	❍
3. People in my work group remind each other to follow safety regulations. (3)	❍	❍	❍	❍	❍

Safety and Health at Work The following questions are about safety and health at your workplace. Your answers are strictly confidential. All responses will be compiled together and analyzed as a group. Your responses are not shown to anyone.

Q1 1. Below statements describe how likely you think that you may get injured at work. Use the following scales to indicate the likelihood of the following statements.

	Not at all likely 1 (1)	Slightly likely 2 (2)	Moderately likely 3 (3)	Very likely 4 (4)	Completely likely 5 (5)
1. I understand that my risk of getting injured at work is... (4)	❍	❍	❍	❍	❍
2. The likelihood of my getting injured at work is... (5)	❍	❍	❍	❍	❍

Q2 2. Below statements describe the severity of getting injured at work. Use the following scales to indicate your level of agreement or disagreement with each statement.

	Strongly Disagree 1 (2)	Disagree 2 (3)	Neutral 3 (4)	Agree 4 (5)	Strongly Agree 5 (6)
1. Work-related injury is a serious matter that can be fatal. (1)	❍	❍	❍	❍	❍
2. Work-related injury is more deadly than most people realize. (2)	❍	❍	❍	❍	❍

Personal Preferences Below statements are about your personal preferences. Use the following scales to indicate your level of agreement or disagreement with each statement. Please read each statement carefully and decide whether the statement truly describes your preference or not. Your answers are strictly confidential. All responses will be compiled together and analyzed as a group. Your responses are not shown to anyone.

	Strongly Disagree 1 (1)	Disagree 2 (2)	Neutral 3 (3)	Agree 4 (4)	Strongly Agree 5 (5)
1. I am always willing to admit it when I make a mistake. (1)	❍	❍	❍	❍	❍
2. I always try to practice what I preach. (2)	❍	❍	❍	❍	❍
3. I never resent being asked to return a favor. (3)	❍	❍	❍	❍	❍
4. I have never been irked when people expressed ideas very different from my own. (4)	❍	❍	❍	❍	❍
5. I have never deliberately said something that hurt someone's feelings. (5)	❍	❍	❍	❍	❍
6. I sometimes try to get even rather than forgive and forget. (8)	❍	❍	❍	❍	❍
7. At times I have really	❍	❍	❍	❍	❍

insisted on having things done on my own way. (9)					
8. There have been occasions when I felt very frustrated. (10)	❍	❍	❍	❍	❍
9. I read and answer the questions carefully when I complete this survey. (11)	❍	❍	❍	❍	❍

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