# CONSTRUCTION WORKERS' ABSENCE BEHAVIOR UNDER SOCIAL INFLUENCE

**by**

**Seungjun Ahn**

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Doctoral Committee:

Associate Professor SangHyun Lee, Chair
Associate Professor Vineet R. Kamat
Professor Scott E. Page
Professor J. Frank Yates

## DEDICATION

For my wife Sera and little baby Jane, with love and hope

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# ABSTRACT


## CONSTRUCTION WORKERS' ABSENCE BEHAVIOR UNDER SOCIAL INFLUNECE

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Due to the labor intensive nature of construction, workers' timely attendance and operation at the site is crucial to the success of a construction project. Recently, researchers have found that worker absenteeism is subject to social influences. However, it is not clear how strongly the social control in workgroups affects worker absence behavior in construction, and nor is it known how social controls regarding absence are exerted over workers. With this background in mind, the overarching goal of this research is threefold: (1) to enhance our understanding of the dynamic processes of the emergence and exertion of social controls for worker absence behavior in construction, (2) to extend our understanding of the group-level absence phenomenon in construction, and (3) to identify effective policies and interventions to reduce absenteeism by creating favorable social norms in construction projects. To achieve these goals, five interrelated, interdisciplinary studies using survey analysis, the agent-based modeling and simulation of human behavior, and a behavioral economic experiment were conducted. These studies

revealed that (1) team cohesion affects workers' behavior in construction; (2) construction workers who perceive salient social norms in their team are less likely to be absent from a job site; (3) workers are under the influence of social norms more likely by self-categorization than by interpersonal exertion of social controls; (4) attachment and commitment to the current project are important variables for workers' self-regulation, and therefore play a significant role in creating favorable social norms over time in workgroups; (5) workgroup's mean level of social adaptation and mean level of formal rule adaptation can explain variance in the group-level absence rate; (6) there is a general pattern of alignment, but also a measurable difference between workers' social norms and managers' desired norms; and (7) workers who have emotional and/or evaluative identification with their project tend to have personal standards regarding absence that are similar to what their managers desire. These findings enhance our knowledge about the social mechanism for worker absence behavior in construction, and provide insights into how to prevent/reduce excessive absenteeism in construction projects by creating desirable social norms regarding absence.

# CHAPTER 1

# INTRODUCTION

## 1.1 BACKGROUND

Labor is an essential resource in construction. Even today, many tasks in construction have to be manually performed by construction workers on job sites, which is indicated by that labor costs typically range from 33% to 50% of the total construction cost (Hanna 2001). Therefore, workers' timely attendance and operation at the site is crucial to the success of a construction project.

As defined by Johns (2008), "absenteeism is the failure to report for work as scheduled." In construction, paid vacation leave for construction workers is rare, and missed work usually means that the absentee is not paid for the day. However, construction workers take absence due to a number of reasons, and these reasons include personal circumstances and better work options. Although absence rates vary with projects' different environments, especially by the region and economic condition, finding construction projects that face the problem of worker absenteeism is not very difficult. Absence rates were as high as 6%–15% on most large projects in the 1980s (Hinze et al. 1985). More recently, it was reported that absence rates hovering between 6% and 10% are still not uncommon in electrical construction projects in the US (Hanna et al. 2005). Also, the worker absence rate in Canada's construction sector was reported to be 8.6%, 9.3%, and 8.5% in 2006, 2007, and 2008, respectively (Sichani et al. 2011). It was reported, in particular, that large industrial projects in Alberta, Canada recently experienced a productivity loss associated with absenteeism (Sichani et al. 2011).

While job site productivity is the result of many factors—such as the skill and experience of the workforce, and the leadership and motivation of the workforce—absenteeism has been

identified as an important factor of productivity loss (Hendrickson 2000). If a worker is absent, his/her primary workgroup is immediately affected in a detrimental way. Because each member of the group has a role to perform and there is interdependency among the work roles, the absence of a single member forces the workgroup to expend energy compensating for that individual's missing contribution. When the absence level in a workgroup is excessive, managers may have to consider inputting substitutes to cover the absentee's roles. However, this might lead to the use of less skilled or inexperienced workers. If the missing roles are not effectively covered by other members of the workgroup or substitutes, all operations dependent on that work role will be affected in the chain of work processes, the utilization of resources such as tools and equipment will decrease, and task accomplishment may be delayed. Then, in turn, the productivity associated with that process may decrease, and revenue loss can occur when the schedule is not met (Hinze et al. 1985; Business Roundtable 1982). Moreover, workers may be exposed to an increased likelihood of accidents if they are under schedule pressure and/or they are working with inexperienced peers due to others' missed work (Firns et al. 2006). In addition to all of these direct impacts of absence, indirect detrimental impacts, such as reduced morale, may ensue (Rhodes and Steers 1981).

Researchers have attempted to estimate the cost impact of missed work in construction. Nicholson et al. (2006) have used economic models to estimate that when a carpenter in construction is absent, the cost of the absence is 50% greater than his/her daily wage, and when a laborer in construction is absent, the cost is 9% greater than his/her daily wage. Researchers have also investigated the impact of absenteeism on overall productivity in construction. Hanna et al. (2005) looked at electrical construction projects and revealed that productivity decreased by 24.4% when the absence rate on a job site was between 6% and 10%, whereas productivity increased by 3.8% when the absence rate was between 0% and 5%. They also reported that 9.13% of productivity loss on average was measured in electrical construction projects. These analyses imply that the costs of absenteeism increase nonlinearly in the level of absenteeism. For example, 10% absenteeism is not just a 10% decrease in productivity, and if absenteeism increases from 5% to 10%, the decreased in productivity caused by absenteeism might more than double. The decrease in productivity is one of the main causes of cost overruns in construction projects. Therefore, maintaining a low absence rate is critical to cost-effective construction.

Researchers have surveyed the causes of construction workers' absence behavior by interviewing construction managers and workers. Hanna et al. (2005) found a disjuncture between construction managers and workers in how they viewed the main causes of absenteeism. In their survey, managers reported the main causes of absence, in descending order of strength, as personal and family illness, reluctance to work, doctor or dental appointments, drug or alcohol use, and lack of responsibility. In contrast, workers identified the chief causes of absence to be personal and family illness, injury, doctor or dental appointments, bad weather, and unsafe working conditions (Hanna et al. 2005). This survey clearly shows that managers tend to attribute a sizeable portion of worker absences to discretionary mechanisms, whereas workers attribute their own absence primarily to a variety of uncontrollable life circumstances. In another study, Sichani et al. (2011) found that the self-reported causes of absence were (in descending order of frequency) personal illness or injury, personal appointment, bad weather, and other family responsibilities, which is very similar to Hanna et al. (2005)'s result.

These studies on absenteeism in construction provided valuable findings regarding the causes, factors, and consequences of absenteeism in construction. However, most of these studies relied on self-reported absence causes. In other words, the causes of absenteeism identified in the studies are mostly based on the perception of the individuals who took absences. This approach may identify the documentable causes of absence in the view of respondents. However, this approach may be poorly equipped to reveal the underlying mechanisms that produced their absence behavior.

## 1.2 SOCIAL INFLUENCE ON WORKER ABSENCE BEHAVIOR

When suffering from a high absence rate of workers, construction managers have mainly used individual-oriented formal controls (i.e., penalties and incentives for individuals). For example, in large industrial projects in Canada where absenteeism posed a major problem, different absence reduction programs that focused on individuals were implemented. These programs included providing attendance incentives, providing opportunities to offer overtime hours to those who did not miss work, and taking gradually increasing disciplinary action (e.g., warnings, suspension, and dismissal) against those who presented excessive unapproved

absenteeism. However, these individual-oriented programs failed to sufficiently mitigate the absenteeism problem (Sichani et al. 2011).

A possible reason for the insufficiency of the impact of such absence-reduction programs is that the social controls for worker absence were overlooked. In other words, worker attendance control policies overlooking social factors may not produce the effect as much as intended. Traditionally, construction managers have seen absenteeism as a problem of individuals, and so have not paid much attention to absenteeism as a phenomenon of the group. However, a prominent finding of the last 25 years in absence research is the susceptibility of employees to social controls and the attendance dynamics associated with informal social controls in organizational settings (Johns 2008). While the characteristics and situations of individuals are a factor of their absence behavior, more recent absence literature has highlighted the importance of social and organizational mechanisms (i.e., absence culture) in shaping employee absence behavior. While many individual (e.g., age), job-related (e.g., trade), and contextual (e.g., supervisory actions) characteristics affect an employee's absence behavior, a key predictor of absence behavior may be the absence culture (Johns 2008; Bamberger and Biron 2007; Rentsch and Steel 2003; Xie and Johns 2000; Gellatly and Luchak 1998; Martocchio 1994; Mathieu and Kohler 1990; Nicholson and Johns 1985).

Johns and Nicholson (1982) defined absence culture as "the set of shared understandings about absence legitimacy in a given organization and the established 'custom and practice' of employee absence behavior and its control…." Since Johns and Nicholson (1982) introduced the concept of absence culture as the set of shared understandings about absence legitimacy in an organization—which implies that employees perceive social norms and control their absence behavior accordingly (i.e., social control of absence)—many researchers have investigated social influence variables in their study of absence behavior (Rentsch and Steel 2003). Under the influence of absence culture, absence behavior is not only determined by an individual's disposition or his or her personal situation, it is also controlled by absence-related beliefs and values shared at the group level (Gellatly and Luchak 1998). Evidence demonstrating the existence of an absence culture comes from studies showing that absence behavior is consistent within a unit but variable across units (Rentsch and Steel 2003).

## 1.3 PROBLEM STATEMENT

Although many researchers have worked on the social influences on absenteeism, most of the absenteeism studies focus on the social influences affecting absence behavior for the cases of employees of permanent organizations. Rarely have studies focused on the case of temporary employees working for short-term projects. Employer–worker relationships and between-worker relationships within construction projects may be unique in several respects. Usually construction workers are temporarily employed for a specific construction process and get paid based on their exact labor hours, and therefore have limited loyalty to a project. Workers are not always directly employed by the general contractor who manages the overall projects but are often employed by subcontractors. Therefore, although working for the same project and sharing goals, workers often have differing company memberships and may be under different social influences. Also, a unionized construction worker is not only a member of a current project/company but at the same time is a member of the union representing his/her trade, which could complicate the study of social influence on worker behavior. Therefore, one may question the applicability of research findings dealing with the effects of absence culture on absence behavior to the case of employment transients, like construction workers. However, efforts to study construction workers' social control of absence behavior are scarce.

Although decades have passed since researchers began to consider the effect of social controls on worker absence behavior, few research efforts have been made to theorize the social mechanism of worker absence, partly because of a methodological weakness. Especially, there have been few investigations of how to develop social norms that support higher attendance. If how such social norms emerge, and if how they play a role in controlling workers' behavior becomes clear, construction managers can invest time in promoting favorable absence norms rather than focusing on regulations targeting individuals, but it has not been the case. Due to the lack of understanding of the social mechanism for worker absence behavior, strategies to control absenteeism have been concentrated on the aspect of formal control targeting poorly behaved workers (e.g., penalty imposed on absentees), leaving the evidence of the social control on absenteeism unassociated with the policy development (Johns 2008). Therefore, there is a considerable need for research efforts to better understand the control mechanisms of construction workers' absence behavior, and in particular, the social control of absence.

Actually, the lack of knowledge about the social mechanism for worker behavior is not just a problem regarding attendance. Regarding other types of worker behavior that also have great impacts on construction performance—such as safety behavior and engagement behavior, the social mechanism has been substantially overlooked in the construction industry. A better understanding about the social mechanism for worker behavior is expected to greatly contribute to the advancement of workforce management in general and to benefit the entire industry.

## 1.4 RESEARCH OBJECTIVES AND APPROACHES

With this background in mind, the overarching goal of this research is threefold: (1) to enhance our understanding of the dynamic processes of the emergence and exertion of social controls for worker absence behavior in construction, (2) to extend our understanding of the group-level absence phenomenon in construction, and (3) to identify effective policies and interventions to reduce absenteeism by creating positive social norms in construction projects. What follows are the more specific objectives in this research.

1. **To identify workgroup cohesion characteristics that influence individual construction workers' absence**: Although social scientists have found that group characteristics significantly affect people's absence in organizations, it is not known how strong this mechanism is in construction, nor is it known which workgroup characteristics contribute to this mechanism. Therefore, workgroup cohesion characteristics that will influence the social mechanism for worker absence behavior in construction need to be identified.

2. **To identify the relationship between workers' perceptions and attitudes toward social rules and their absence behavior**: It is not clear how strongly the social control in workgroups affects worker absence behavior in construction. Nor is it known how—and in what process—social controls regarding absence are exerted over workers. To enhance our understanding of the emergence and exertion of social controls for worker absence behavior, the relationship between workers' perceptions and attitudes toward social rules in workgroups and their absence behavior need to be identified.

3. **To create a formal behavior model for construction workers' absence influenced by both formal rules and social rules**: A formal model to represent the processes involved in worker absence behavior will help improve our understanding of the dynamic processes of the emergence and exertion of social controls for worker absence behavior in construction. Once validated, the model can be used for "thought experiments" to explore worker absence behavior, which can contribute to the development of policies and interventions to effectively reduce absenteeism.

4. **To explore group-level absence phenomena in workgroups in construction under the influence of social norms on worker absence behavior**: The exploration of group-level absence behavior will provide answers to "What if" questions regarding worker absence in construction. These answers, in turn, can provide insights into what managers will need to do to prevent or reduce excessive absenteeism on the site, and when and how to do these things.

5. **To measure construction workers' actual social norms regarding absence**: An essential but elusive question when studying construction workers' absence behavior influenced by social rules would be what the definition of a social norm regarding absence is and what the social norms regarding absence in a construction project are. If these questions are answered, our understanding of social norms affecting worker absence can be greatly improved.

To achieve these diverse research objectives, an interdisciplinary approach is used in this research. The first approach taken in this research is survey data collection and analysis using statistical techniques. This approach has been widely used in many social sciences. Using this approach allows researchers to empirically estimate the causal influence of the various variables representing the individual and environmental determinants of human behavior (Hedstrom and Swedberg 1998). In this research, survey data analysis is used to investigate the relationship between workgroup characteristics and individual construction workers' absence (Research Objective 1) and the relationship between workers' perception/attitudes toward formal/social rules in workgroups and their absence behavior (Research Objective 2).

Another approach used in this research is formal behavior modeling. This research proposes a formal model of a construction worker's absence behavior that is under the influence of both the formal and social rules in projects (Research Objective 3). This approach is pursued with an awareness of the importance of directly looking at the social mechanisms regarding worker absence behavior. This mechanism-oriented approach is sometimes called an analytical approach to social theory, and seeks to explain the mechanisms that generate observed phenomena (Hedstrom and Swedberg 1998). "A major advantage of the mechanism-based approach is that it provides (or encourages) deeper, more direct, and more fine-grained explanations. The search for generative mechanisms consequently helps us distinguish between genuine causality and coincidental association, and it increases the understanding of why we observe what we observe" (Hedstrom and Swedberg 1998, p.9). Therefore, the mechanism-based approach can compensate for the variable-based survey analysis approach, and vice versa. Regarding the relationship between the variable-based approach and the mechanism-based approach, Boudon (1979) argued that "Causal analysis does not explain the chart. It simply summarizes it. Understanding a statistical structure means in many cases building a generating theory or model … that includes the observed empirical structure as one of its consequences" (pp.51–52).

Another approach taken in this research is the computational modeling and simulation of human behavior in organizations: agent-based modeling and simulation (ABMS). Using this approach, construction workers' group-level absence behavior is explored (Research Objective 4). This approach is in line with the mechanism-based approach to generative social theory, and goes a step further. In this approach, an individual-level behavior model is transformed into computational agent behavior rules, and group-level phenomena—often called emergent behavior—are generated by computer simulations. As will be introduced in Chapters 4 and 5, computational modeling is expected to better address the "What if" questions in the study of organizational behavior by unfolding the process that produced an observed phenomenon.

The last approach taken in this research is a behavioral economic experiment. This approach is used to elicit construction workers' social norms and managers' desired norms regarding absence (Research Objective 5). More specifically, an incentive-compatible survey facilitated by the coordination game structure is used to investigate construction workers' and

managers' social norms regarding absence. As will be introduced in Chapter 6, this technique has recently been developed by Krupka and Weber (2013), and it has been argued that this technique has advantages over more traditional real-world data collection methods such as surveys and observations in eliciting social norms data.

## 1.5 THE STRUCTURE OF THE DISSERTATION

This dissertation is a compilation of the studies undertaken to achieve the research objectives. This dissertation is composed of seven Chapters, and Chapters 2 through 6 each introduces the study that corresponds to a research objective. What follows is a list of the chapters.

***Chapter 1: Introduction***. This chapter covers the background, problem statements, objectives, and approaches of the entire research effort.

***Chapter 2: Influence of Workgroup Cohesion Characteristics on Construction Workers' Absence.*** This chapter presents a study to investigate the extent to which perceived team characteristics predict variance in attendance and overall performance, focusing on three contextual determinants that would vary by construction crew, namely: cohesion, communication/cooperation, and support.

***Chapter 3: Influence of Social Norms on Construction Workers' Absence.*** This chapter presents a study that more directly investigates the influence of social norms on worker absence behavior. In this study, construction workers' perceptions and attitudes toward formal/social rules, and their self-reported absence, are surveyed. Additionally, the relationship among the variables is analyzed using statistical techniques.

***Chapter 4: An Agent-Based Model and Thought Experiments to Explore Construction Workers' Absence Behavior Under the Influence of Social Norms.*** This chapter presents a study to create a formal behavior model for worker absence behavior that is influenced by both the formal rules and social rules in construction projects, and to explore the group-level absence behavior using agent-based simulations.

***Chapter 5: Comparison Between the Agent-Based Model Behavior and Real Workers' Absence Behavior.*** This chapter provides an overview to the proposed methodology developed to test an agent-based model for workers' social behavior using empirical data collected by surveys. This chapter also presents the result of a comparison between the agent-based model of worker absence behavior and the empirical data collected from real workers using surveys.

***Chapter 6: Construction Workers' Social Identification, and Their Social Norms and Personal Standards Regarding Absence.*** This chapter presents a culminating work in this research. This study involves eliciting workers' actual social norms as well as managers' desired norms regarding worker absence by using a method called the "norm elicitation technique." Also, this study reveals the relationship between workers' social identification and their personal standards regarding absence.

***Chapter 7: Conclusions and Recommendations***. This chapter provides a summary of the conclusions that can be drawn from the research as well as recommendations for management practice. Several recommendations for future work stemming from this research are also provided.

# CHAPTER 2

# INFLUENCE OF WORKGROUP COHESION CHARACTERISTICS ON CONSTRUCTION WORKERS' ABSENCE[1]

## 2.1 INTRODUCTION

Historically, absence researchers have tended to focus on predictors such as job satisfaction, attendance motivation, physical ability to attend and a host of personal characteristics (Steers and Rhodes 1978). More recently, researchers have focused attention on the social context in which the daily decisions to attend or be absent are made (Johns, 2008). Much attention has been directed towards understanding the effects of a group's absence culture on individual behavior. Absence culture has been understood to reflect the set of shared understandings about absence legitimacy in a given organization and the established 'custom and practice' of employee absence behavior and its control (Johns and Nicholson, 1982). However, it is not clear what the factors that contribute to a team's absence culture are, or what the factors that determine whether individuals align their behavior with other team members are in construction (for a discussion of group effects on individual absence, see Gellatly and Allen, 2012). Xie and Johns (2000) identified group cohesion as a team characteristic that determined whether or not individuals tracked the absence behavior of other members in organizations. It follows that other team characteristics, especially those that strengthen or fortify bonds within individual members might also play a role (i.e., team cohesion characteristics). With this background in mind, the objective of this study was to investigate the extent to which perceived team characteristics predicted variance in attendance behavior. This study focused on three

[1] This chapter is adapted from Ahn, S., Gellatly, I. R., Lee, S., and Robinson-Fayek, A. (2013). "Survey of social factors of construction workers' absence behavior." *Proceedings of the Canadian Society for Civil Engineering 2013 Annual Conference*, Canadian Society for Civil Engineering, Montreal.

contextual determinants that would vary within construction crews, namely, cohesion, communication/cooperation, and support, and examined the extent to which these accounted for variance in attendance (and performance).

## 2.2 METHOD

### 2.2.1 Sample and Procedure

This study surveyed tunnelling crews who were working at various sewer tunnelling sites located in Edmonton, Alberta, Canada. The survey items were administered via one-on-one interviews (each survey question was presented orally; interviewees were then shown the response scale and asked to use it to express their opinion; then interviewers recorded the response) [see Appendix A: Survey Questionnaire 1 – 1 (Construction Workers' Perceived Team Cohesion Characteristics)]. In total, 70 laborers who worked in 10 tunneling crews were interviewed. Next, absenteeism and performance ratings were collected from the general supervisor. This individual was selected because s/he knew everyone very well, had ample opportunity to observe over the target period, and was aware of their personnel statistics.

### 2.2.2 Variables

Team cohesion was measured using three items that were adapted from a scale developed by Carron, Widmeyer, and Brawley (1985). The three items were as follows: "In general, my team members get along well with each other."; "My team members like each other."; and "The members of my crew really stick together, especially when things get tough." For each item, respondents indicated their agreement or disagreement by selecting a score on a 7-point scale (1 = strongly disagree; 2 = disagree; 3 = slightly disagree; 4 = neither disagree nor agree; 5 = slightly agree; 6 = agree; 7 = strongly agree). Item responses were averaged to produce an average cohesion score for each individual. Across the entire sample, the average cohesion score was 6.21 (indicating a high level of cohesion within the teams). The reliability of the team cohesion scale was .77 (coefficient alpha).

Communication and cooperation was measured by adapting a 3-item scale developed by Campion, Medsker, and Higgs (1993). The three items were as follows: "Team members are

very willing to share information with each other about our work."; "When it comes to getting the work done, members of my crew communicate well."; and "Members of my crew cooperate with each other to get the work done." Respondents indicated their agreement or disagreement by selecting a score on a 7-point scale (1 = strongly disagree;…, 7 = strongly agree). Item responses were averaged to produce an average communication and cooperation score for each individual. Across the entire sample, the average score on this characteristic was 6.21. The reliability of the communication and cooperation scale was .65 (coefficient alpha).

Team support was measured by adapting a 3-item scale developed by Campion, Medsker, and Higgs (1993). The three items were as follows: "Working in a team allows me to provide support to other members."; "Working in a team increases my opportunities for positive social interactions."; and "Members of my team help each other out at work when needed." Respondents indicated their agreement or disagreement by selecting a score on a 7-point scale (1 = strongly disagree;…, 7 = strongly agree). Item responses were averaged to produce an average team support score for each individual. Across the entire sample, the average score was 6.25. The reliability of the team support scale was .69 (coefficient alpha).

Additionally, workers' perception of the relative impact of social rules—as compared to the impact of formal rules—on their day-to-day decisions was measured using a 100-point scale (0 = 100% influenced by formal rules/policies; and 100 = 100% influenced by social rules). The question was as follows: When it comes to day-to-day decisions how to act on the job, are you more influenced by the formal work rules/policies or by what you see your team mates doing? Across the entire sample, the average scores was 53.87 and the standard deviation was 22.6.

This study used the Relative Percentile Method (RPM) to structure the attendance and performance ratings [see a sample form in Appendix B: Survey Questionnaire 1 – 2 (Behavior Rating Sheet)]. The accuracy and validity of the RPM has been demonstrated in previous research (e.g., Goffin, Gellatly, Paunonen, Jackson, and Meyer, 1996; Goffin, Jelley, Powell, and Johnston, 2009). This approach resulted in a rating within the 0-100 range for attendance and overall effectiveness. Using this scale, the supervisor rated each individual with their respective crew. Two RPM ratings were made for each crew member, one for attendance relative to other members of the tunneling team, and one for overall effectiveness relative to other members of

the tunneling team. The average ratings for the attendance and overall effectiveness measures were 73.10 and 72.03, respectively.

## 2.3 RESULTS

Means, standard deviations and correlations among the study measures are displayed in Table 2.1. As expected, modest positive correlations among the three team characteristic measures were observed. Both outcome measures (attendance and overall effectiveness) were positively correlated with the team characteristics, except the correlation between team cohesion and attendance did not reach statistical significance.

Table 2.1: Descriptive statistics—means, standard deviations, and correlations

| Measures | *M* | *SD* | Measures | | | | |
|---|---|---|---|---|---|---|---|
| | | | *1* | *2* | *3* | *4* | *5* |
| 1. Perceived Team Cohesion | 6.21 | 0.65 | 1.00 | | | | |
| 2. Perceived Communication and Cooperation | 6.21 | 0.68 | **0.46** | 1.00 | | | |
| 3. Perceived Team Support | 6.25 | 0.65 | **0.39** | **0.43** | 1.00 | | |
| 4. Attendance | 73.10 | 15.44 | 0.12 | **0.37** | **0.29** | 1.00 | |
| 5. Overall Effectiveness | 72.03 | 15.36 | **0.21** | **0.37** | **0.37** | **0.68** | 1.00 |

*Note. N=70; M=Mean, SD=Standard Deviation. Correlation in bold type are significant (p< .05;1-tail test).*

To assess the extent to which variance in the two outcome measures was explained by perceived team characteristics, two regression analyses were conducted with attendance and overall effectiveness, respectively, being the criterion. The results of the regression analyses are presented in Tables 2.2 and 2.3. Table 2.2 shows that the set of context variables explained a significant amount of variance in attendance behavior ($R^2$ = .16, $F(3, 66) = 4.33$, $p<.01$). However, an inspection of the regression coefficients revealed that only communication and cooperation exerted a significant effect on attendance behavior.

Table 2.2: Variables in the regression model predicting attendance

| Predictor Variables | *beta* | *t* | *p* < |
|---|---|---|---|
| Perceived Team Cohesion | -0.10 | -0.78 | ns |
| Perceived Communication and Cooperation | 0.33 | 2.50 | 0.02 |
| Perceived Team Support | 0.19 | 1.46 | ns |
| R = .41<br>$R^2$ = .16<br>F(3,66) = 4.33, p < .01 | | | |

*Note. ns= not significantly different from zero*

Likewise, Table 2.3 shows that the set of context variables explained a significant amount of variance in overall effectiveness ($R^2$ = .19, $F$(3, 66) = 5.18, $p$<.01). An inspection of the regression coefficients revealed that both communication/cooperation and team support exerted significant effects on overall effectiveness.

Table 2.3: Variables in the regression model predicting overall effectiveness

| Predictor Variables | *beta* | *t* | *p* < |
|---|---|---|---|
| Perceived Team Cohesion | -0.10 | -0.05 | ns |
| Perceived Communication and Cooperation | 0.26 | 2.02 | 0.05 |
| Perceived Team Support | 0.25 | 2.02 | 0.05 |
| R = .44<br>$R^2$ = .19<br>F(3,66) = 5.18, p < .01 | | | |

*Note. ns= not significantly different from zero*

## 2.4 DISCUSSION AND CONCLUSION

The two supervisor-ratings—attendance and overall effectiveness—were strongly and positively correlated. This is the evidence that the workers who timely attend the job site also tend to perform well in their operation. Interestingly, both outcomes were predicted by the nature of experiences within the team, namely the degree to which members effectively communicate and demonstrate cooperation and support. Although 16% and 19% of variance in attendance and overall effectiveness, respectively, may seem modest, it is argued that aggregated across

hundreds of workers on a typical construction site, the cost of poorly functioning teams (or the benefits of effective teams) can be quite large. Additionally, it was found that the average of the workers' perceived impact of social rules was comparable to that of formal rules, which implies that the influence of social rules is as strong as the influence of formal rules to the workers on average.

These findings suggest a new way of thinking about attendance management. Rather than focusing on formal attendance control policies – they do have their place – these findings suggest that construction managers need to pay attention to the workplace culture at their project, and, in particular, the social dynamics within work crews. It would seem that even a modest investment in team work training may pay off in terms of increased attendance and performance. This is especially true for crews who perform highly interdependent work like construction crews. Further research efforts should extend this work and examine a broader range of social context factors that either shape an absence culture or affect the extent to which individuals willingly track the behavior of their crew members.

# CHAPTER 3

# INFLUENCE OF SOCIAL NORMS ON CONSTRUCTION WORKERS' ABSENCE [2]

## 3.1 INTRODUCTION

The approach to workers' absenteeism in this study has its theoretical foundation in Bandura's (1991) social cognitive theory of self-regulation, which explains the mechanism by which a person acquires information about how to behave and regulates own behavior to make it aligned with the personal standards. This theory serves as a framework for worker absence behavior. Bandura (1991) argues that the functioning of a self-regulatory system can explain the causal process of many human behaviors. According to this theory, the negative feedback loop—in which when a measure of a system's status deviates from a reference value, the system functions to bring it back—is the basic unit of behavioral control. In this negative feedback loop of one's behavioral control system, its own behavior is constantly compared to the internal standard (i.e., reference value of behavior), and if there is a discrepancy, behavior is produced to reduce the discrepancy (Carver and Scheier 1982). The initiator of such behavioral control is the affective component. People do not consciously and deliberately try to reduce the gap between their behavior and their internal standards, but the control takes place spontaneously (i.e., "feeling what is right to do") (Carver and Sheier 1981). Therefore, from this perspective, one's behavior is determined by which behavior is regarded as legitimate and by how well the control system functions.

An interesting topic of discussion is how people's internal standard is created and adjusted. According to the social cognitive theory of self-regulation, internal standards are created by

[2] This chapter is adapted from Ahn, S., Lee, S. and Steel, R. (2014). "Construction workers' perceptions and attitudes toward social norms as predictors of their absence behavior." *Journal of Construction Engineering and Management*, ASCE, 140(5): 04013069.

associating one's behavior with its determinants and the effects, and by judging the behavior in relation to the situation (Bandura 1991). Also, this theory emphasizes the role of people's social cognition in the process of forming internal standards (Bandura 1991), which can help explain why people are aware of and comply with social norms to obtain group and organizational approval.

From the perspective of the social cognitive theory, absence culture, which is defined as "the set of absence-related beliefs, values, and behavioral patterns that are shared among members of a work group" (Gellatly and Luchak 1998, p.1086), can be seen as a widely accepted group-level consequence of individuals' social cognition involved in processes of understanding and producing absence behavior within a group. Absence culture implies that there is a social nature to attendance dynamics, and that absence behavior is susceptible to this social control (Johns 2008).

The existence of absence culture is supported by empirical evidence indicating that variance in absence within groups is smaller than it is between groups (Xie and Johns 2000). Once an absence culture emerges in a group, it influences the absence behavior within the group (Johns and Nicholson 1982). The strength of absence culture is often measured by salience, which refers to "the extent to which there is homogeneity or mutual agreement among the group members about absence pattern and legitimacy" (Xie and Johns 2000, p.32). When absence culture is salient, the social standard of absence is clear and consistent, but when absence culture is less salient, social expectations on absence behavior are less explicit (Xie and Johns 2000). Therefore, the salience of social norms can be a good indicator of how strongly the social control on absence behavior takes place within groups.

While paying appropriate attention to the social control of absence behavior, the role of formal rules in controlling workers' absence behavior should not be ignored. Work organizations, including construction projects, function by a set of rules to which members of the organization are expected to comply. Several researchers have investigated the effect of interventions and formal/informal managerial actions on employee absence behavior. Increasing supervisory communication that reminds workers of formal absence standards can influence absence frequency (Majchrzak 1987). Given that internal standards can be seen as a result of seeking to maximize the long-term best interest of the individual (Muraven and Baumeister 2000), if

construction workers are clearly aware of the risks associated with not conforming to the formal absence standard, their absence behavior should be under a stronger influence of formal rules.

Although speculation is possible, it is not clear how—i.e., in what process—social controls regarding absence are exerted over workers. It is also unclear as to what degree their perceptions and attitudes toward formal/social rules affect their absence behavior. Based on the theoretical propositions and empirical findings of previous literature and observations in the construction industry, the main objective of this study is to investigate the relationship between construction workers' perceptions and attitudes toward formal/social rules for absence in the construction project and their absence behavior. Therefore, the hypotheses to test in this study are:

Hypothesis 1: Construction workers' perceptual and attitudinal variables toward formal controls will be significant predictors of their absence behavior.

Hypothesis 2: Construction workers' perceptual and attitudinal variables toward social controls will be significant predictors of their absence behavior.

## 3.2 METHOD

### 3.2.1 Participants

For data collection, two building construction sites in Ann Arbor, Michigan, were approached. Site A was a new high-rise building construction site located in the downtown of Ann Arbor. The survey was conducted during October 2012. The number of workers operating at this site at the time of survey was approximately 80, and valid responses were received from a total of 67 workers at this site.

Site B was a large-sized university dormitory building retrofit project. The survey was conducted during December 2012. The number of workers operating at this site at the time of survey was approximately 110, and valid responses were received from a total of 94 workers at this site.

### 3.2.2 Procedure

At each site, survey questionnaire copies [see Survey Questionnaire 2 (Construction Workers' Perceptions/Attitudes Toward Formal Rules and Social Norms, and Their Absence Behavior)] and pens were distributed to workers on the survey date. Workers filled out the survey at the site during breaks or safety meetings, and completed questionnaires were collected at the site using either a lockbox or envelopes. With much encouragement from the management team, most of the workers who attended on the survey date participated in the survey. Instructions on the questionnaire clearly stated that participating in this survey was voluntary, participants' responses were confidential, and the data would be used for research purposes only.

### 3.2.3 Variables

The variables and the instruments for measuring the variables used in the survey are listed in Table 3.1. The variables are categorized into four groups: satisfaction, perceptions and attitudes toward formal rules, perceptions and attitudes toward social rules, and absence behavior. Except for the absence behavior variable for which respondents gave a numerical answer, respondents indicated their agreement or disagreement with a given statement by selecting a score on a 5-point scale (1 = disagree; 2 = somewhat disagree; 3 = neutral; 4 = somewhat agree; 5 = agree).

Table 3.1: Variables

| Group | # | Variables | Statement |
|---|---|---|---|
| Satisfaction | 1 | Job satisfaction | Overall, I am satisfied with my job in this project. |
| | 2 | Policy satisfaction | Overall, I am satisfied with labor control policies (for example, sick-day policy or lateness policy) in this project. |
| | 3 | Communication-with-managers satisfaction | I can communicate with project management team (for example, superintendent) for talking about my needs. |
| Perceptions and attitudes toward formal rules | 4 | Perceived strictness of formal rules | I think the rules and regulations for this project are inflexible (for example, about absence or lateness). |
| | 5 | Anxiety about breaking formal rules | I worry about breaking project rules. |
| | 6 | Conformity to formal rules | I always try to adapt my behavior to comply with project policies. |
| Perceptions and attitudes toward social rules | 7 | Perceived uniformity of behavior | I think our crew members' behavior (for example, absence rate or lateness rate) are similar to one another. |
| | 8 | Perceived explicit social control | If somebody in my team is doing something wrong, my team members will tell them that it is wrong. |
| | 9 | Perceived salience of social norms | My team members have a high degree of agreement about which behavior is wrong. |
| | 10 | Anxiety about breaking social rules | I am worried about upsetting my team members by breaking "our rules" in the team. |
| | 11 | Learning from others | I learn how-to-behave in the jobsite by watching others. |
| | 12 | Conformity to social rules | I always try to match my behavior to my team's behavior. |
| | 13 | Desire to outperform | I would like to perform a better job than the average worker in the team. |
| Absence behavior | 14 | Self-reported absence | How many days in this project have you been absent from work? |

In addition to the variables of main interest in this study, the satisfaction variables were included on the survey based on the empirical finding that attitudinal variables related to job satisfaction can predict absence level (Steel et al. 2002). Particularly three job- or context-related variables were selected for the test: job satisfaction, policy satisfaction, and communication-with-managers satisfaction.

Three perceptual and attitudinal variables related to awareness of formal rules were included on the survey: perceived strictness of formal rules, anxiety about breaking formal rules, and conformity to formal rules. The first variable refers to the perceived strength of formal rules to control workers' behavior. The second and the third variables refer to the attitude toward formal rules.

Seven perceptual and attitudinal variables related to awareness of social rules were included on the survey: perceived uniformity of behavior, perceived explicit social control, perceived salience of social norms, anxiety about breaking social rules, learning from others, and conformity to social rules. The first three variables refer to the perceived strength of culture (i.e., strength of social rules), and the other four refer to the attitudes toward social rules. The absence culture can be measured by group members' prior absence behavior or perceptions of absence standards (Rentsch and Steel 2003). The more consistent the perceptions and behaviors are, the more salient the absence culture is. The existence of salient culture in a group implies that the group is cohesive (Xie and Johns 2000). Studies of social cohesion in groups provide explanations for the attitudinal consensus and behavioral uniformity appearing in groups. Some researchers emphasize the role of direct interpersonal interactions through social networks (i.e., interpersonal relationships) in the process of producing such attitudinal consensus and behavioral uniformity (Friedkin 2004), whereas others argue that social cohesion arises when individuals identify themselves as a member of a particular group and reference their attitude and behavior to the prototypical norms, which are implicit in the distribution of attitudes and behaviors of persons in the group (Hogg 1992). The variables—perceived explicit social control and perceived salience of social norms—were included to bring both viewpoints on social cohesion into the test.

Lastly, absence behavior was measured by self-reported absent days at the current job site. Researchers have found that self-reported absence shows high test-retest reliability and may

produce accurate data although a caution has to be exercised for the circumstances under which the self-reported data are collected (Harrison and Shaffer 1994). There can be valid excuses for absences defined by rules and project policies, such as illness or family emergency (i.e., excused absence). The absent days self-reported in the survey included both the excused and unexcused absences. It has been suggested that this omnibus measure of total absenteeism can be as effective as "pure" absence measures focusing on unexcused absenteeism if the variance in absence is of interest (Steel 2003).

In addition, the name of the company from which the respondent gets paid, the trade, and the work duration at the current site were also collected.

### 3.2.4 Data Coding

After the data collection, self-reported absence data were transformed into categorical data, namely absence level ("0" means no absenteeism and "1" means some absenteeism). This practice was exercised because self-reported absence rates were highly skewed—which is common in absence studies (Steel 2003)—thus incompatible for most parametric statistical analysis methods requiring a normality assumption. By this binary coding of absence levels, the workers who present no absenteeism are separated from the workers who are sometimes absent from work, and factors that would differentiate these two groups can be investigated using statistical methods.

The criterion applied to transform the raw data into categorical data is that if the number of reported total absences is equal to or less than 1, or if the absence rate (day/12months) is equal to or less than 3, the absence level is 0; otherwise the absence level is 1. The absence rate was calculated by associating self-reported absence with work duration at the current site. Figure 3.1 shows the frequency levels of the absence rate and the absence level for the entire data, Figure 3.2 shows these levels for the data from Site A, and Figure 3.3 shows these levels for the data from Site B.

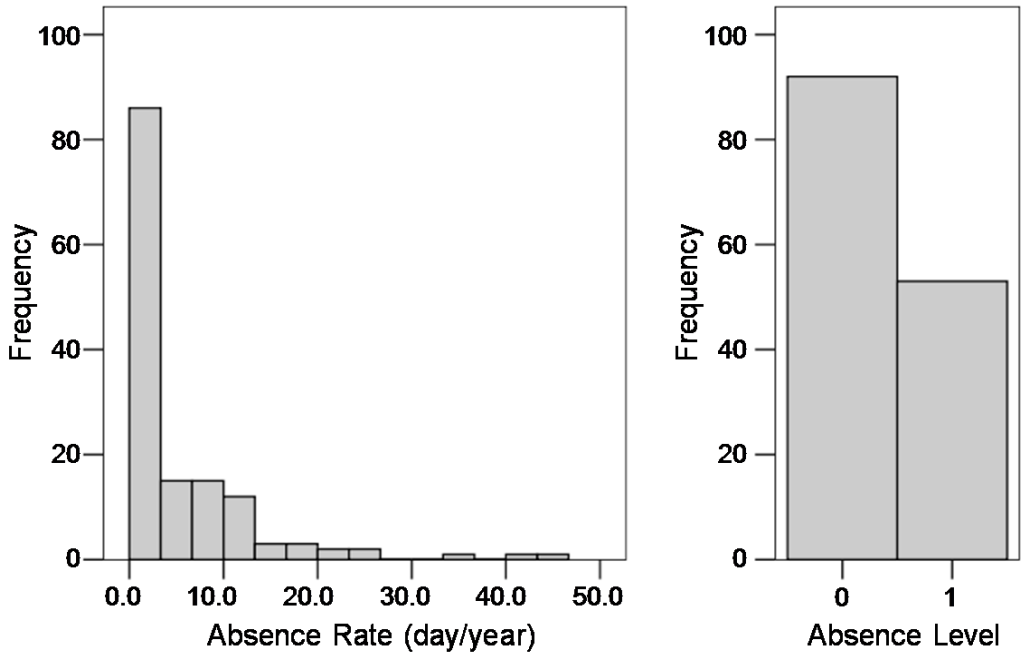



Figure 3.1: Frequency of absence rate and absence level for the entire data set

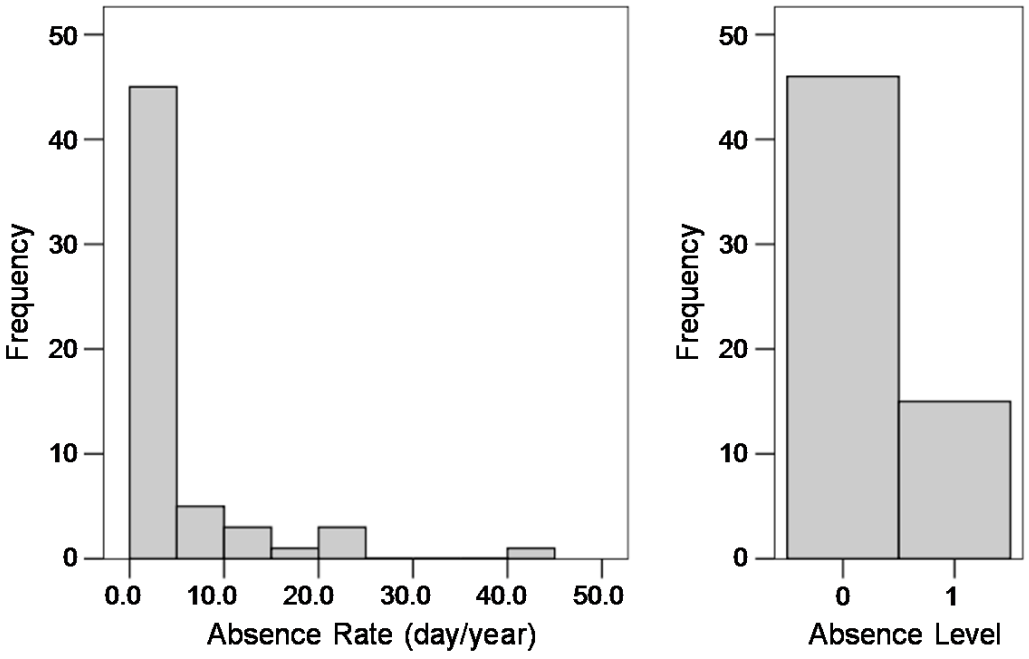



Figure 3.2: Frequency of absence rate and absence level for the data from Site A

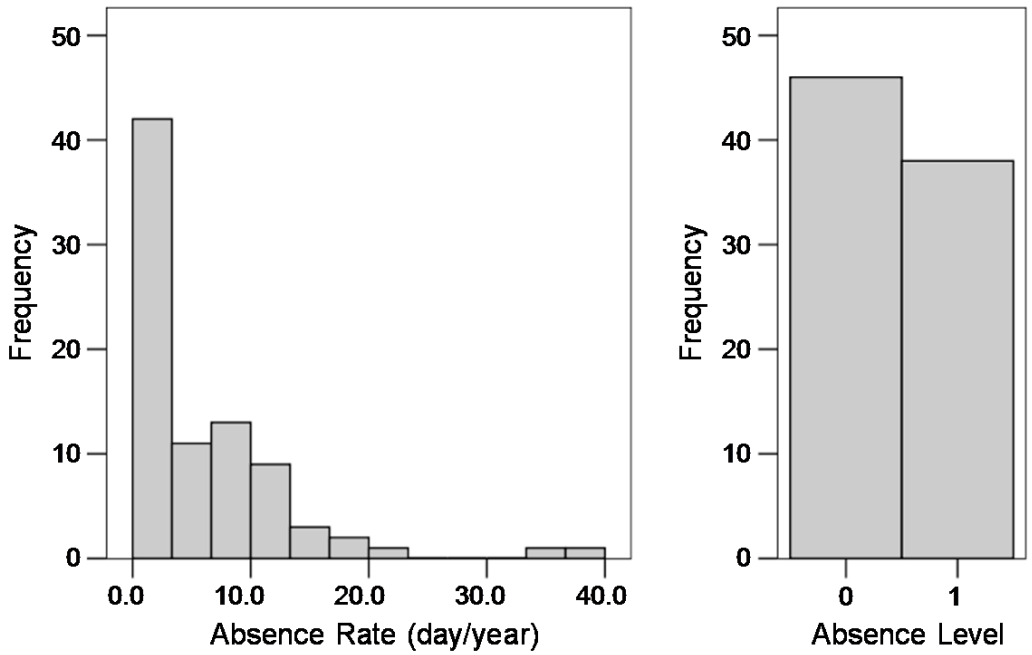



Figure 3.3: Frequency of absence rate and absence level for the data from Site B

## 3.3 RESULTS

### 3.3.1 Analysis on Overall Data

Table 3.2 provides an inter-correlation matrix. Many variables were significantly inter-correlated within each group. Only the perceived salience of social norms was significantly correlated with the criterion variable, absence level. The relationship between perceptual and attitudinal variables and the criterion variable was more thoroughly investigated with logistic regression models, which will be introduced later in this chapter.

Table 3.2: Intercorrelations matrix

| Variable | *M* | *SD* | Variables 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Measures of satisfaction | | | | | | | | | | | | | | | | |
| 1. Job satisfaction | 4.7 | .67 | – | **.52** | **.35** | .03 | .03 | .14 | .13 | **.31** | **.28** | -.03 | .07 | .11 | .14 | -.02 |
| 2. Policy satisfaction | 4.5 | .92 | | – | **.35** | .07 | .07 | **.18** | **.20** | .15 | **.34** | -.19 | .06 | .12 | **.17** | -.01 |
| 3. Communication satisfaction | 4.5 | .79 | | | – | .09 | .10 | **.27** | **.21** | **.36** | **.42** | .02 | -.05 | .08 | **.17** | -.09 |
| Measures of perceptions and attitude toward formal rules | | | | | | | | | | | | | | | | |
| 4. Perceived strictness of formal rules | 3.1 | 1.36 | | | | – | **.29** | **.20** | .14 | .02 | .02 | **.40** | **.28** | **.27** | .04 | -.05 |
| 5. Anxiety about breaking formal rules | 3.2 | 1.45 | | | | | – | **.26** | **.19** | .03 | -.01 | **.58** | **.16** | **.17** | **.20** | .00 |
| 6. Conformity to formal rules | 4.4 | .92 | | | | | | – | **.18** | **.36** | **.25** | **.22** | .11 | .11 | **.18** | .03 |
| Measures of perceptions and attitude toward social rules | | | | | | | | | | | | | | | | |
| 7. Perceived uniformity of behavior | 4.0 | 1.06 | | | | | | | – | **.36** | **.33** | **.19** | .03 | **.23** | **.24** | -.05 |
| 8. Perceived explicit social control | 4.6 | .70 | | | | | | | | – | **.56** | .06 | -.00 | .05 | **.36** | .08 |
| 9. Perceived salience of social norms | 4.4 | .87 | | | | | | | | | – | .07 | .03 | **.17** | **.25** | **-.24** |
| 10. Anxiety about breaking social rules | 3.3 | 1.38 | | | | | | | | | | – | **.26** | **.18** | **.18** | .00 |
| 11. Learning from others | 2.9 | 1.40 | | | | | | | | | | | – | **.50** | .04 | -.10 |
| 12. Conformity to social rules | 3.3 | 1.33 | | | | | | | | | | | | – | .02 | -.08 |
| 13. Desire to outperform | 4.6 | .82 | | | | | | | | | | | | | – | -.02 |
| Measure of absence behavior | | | | | | | | | | | | | | | | |
| 14. Absence level | .37 | .48 | | | | | | | | | | | | | | – |

*Note. N = 161; M = Mean; SD = Standard Deviation; Correlations in bold type are significant (p < .05; 2-tail test)*

An interesting observation is that many of the measures of perceptions and attitudes toward social rules are correlated with the measures of satisfaction (e.g., correlations between variables 1, 2, and 3 and variables 7, 8, and 9, as shown in Table 3.1). The correlation between the measures of satisfaction and the measures of perceptions and attitudes toward social rules agrees with Friedkin's (2004) proposition that individuals who experience positive rewards in a group have high levels of attachment to the group, have positive membership attitudes and behavior, and are likely to be in favor of the norms of the group.

Another interesting correlation is observed between the measures of perceptions and attitudes toward social rules and the measures of perceptions and attitudes toward formal rules. In particular, anxiety about breaking social rules had a significant correlation with all of the formal rule-related variables. The correlation between anxiety about breaking social rules and anxiety about breaking formal rules, for example, was 0.58 ($p < .05$). This result implies that individual characteristics (e.g., personality) influence the perception of and attitude toward rules in organizations. It is inferred from this that those who are aware of formal rules are also likely to be aware of social rules and to strictly control their absence accordingly.

Analytical methods that are based on maximum likelihood, such as logistic regression, have been advocated by statisticians for applications involving the analysis of categorical data (Steel 1996). Hence, logistic regression was used in this study as the basis for identifying significant predictors of absence level. Particularly, a forward stepwise procedure was employed to select the best predictor variables. In this procedure, the model starts with no variables, then in each step a variable is entered into the model if adding the variable is going to significantly improve the model (i.e., a variable is entered if the significance level is less than 0.05). As a result of this procedure, a set of significant predictors was isolated.

Table 3.3. Variables in the final logistic regression model predicting absence level (for entire data)

| Predictors | B | S.E. | Sig. |
|---|---|---|---|
| Perceived salience of social norms | -1.065 | .314 | .001 |
| Perceived explicit social control | 1.037 | .384 | .007 |

*Note. N = 128 (33 cases among the total of 161 were not included in the analysis due to missing data); -2Log Likelihood = 147.253; Nagelkerke $R^2$=.164; B = maximum likelihood regression statistic; S.E. = standard error; Sig. = significance level.*

Table 3.3 shows the results of the logistic regressions. Two predictors entered significantly into the final regression model: perceived salience of social norms and perceived explicit social control. These two variables combined to significantly predict worker absence level ($p < 0.01$). Nagelkerke $R^2$ is a pseudo R-squared that can have a value between 0 and 1, and is indicative of the degree to which the fitted model improves the prediction of the null model. The value of pseudo R-squared was .164.

While the pseudo R-squared is useful in seeing the fit of the regression model to the data, it should not be directly interpreted as the amount of variance accounted for by the predictors as opposed to the ordinary R-squared. Thereby, it could be helpful to obtain the ordinary R-squared value, if possible, and compare it with the pseudo R-squared for interpreting the result. The results of maximum likelihood and least squares techniques may diverge when the dichotomous categorical data are highly skewed, but the results are comparable when the base rate in the categorical data is between .30 and .70 (Steel 1996). Based on this claim, a least squares regression analysis was conducted to supplement the logistic regression because the percentages of the absence level "1" in the population (i.e., the base rate of the absence level "1") was .37 (i.e., mean of absence level as shown in Table 3.2). The results from the least squares model were identical to that of logistic regressions shown in Table 3.3 (i.e., perceived salience of social norms and perceived explicit social control were isolated as significant predictors of absence level), and the regression model yielded an R2 value of .12. Therefore, roughly speaking, the 12% variance in worker absence level was explained by the two variables—perceived salience of social norms and perceived explicit social control—combined.

### 3.3.2 Analysis for Each Job Site

As a next step, it was attempted to fit logistic regression models to subsets of data collected from each job site separately. The assumption underlying this analysis is that different construction job sites may have different job- and context-related characteristics—such as different requirements on the site, management styles, and absence policies—which can result in workers' different perceptions and attitudes toward formal/social rules, and absence behavioral patterns. In fact, the base rate of the absence level "1" at Sites A and B were quite different. The base rate of the absence level "1" was 25% at Site A whereas it was 45% at Site B; Site A has a lower absence level than Site B. This implies that workers at Sites A and B may have different perceptions and attitudes toward rules that affect their absence behavior.

Table 3.4 shows the results of the logistic regressions for Site A. In the logistic regression model for Site A, four predictors entered significantly into the final regression model: perceived salience of social norms, perceived explicit social control, anxiety about breaking formal rules, and communication satisfaction. The four variables combined significantly to predict the worker absence level at Site A ($p < 0.01$). The value of pseudo R-squared was .729, which implies that the four variables combined to explain a very large portion of variance in absence level at Site A.

Table 3.4. Variables in the final logistic regression model predicting absence level (for Site A)

| Predictors | B | S.E. | Sig. |
|---|---|---|---|
| Perceived salience of social norms | -5.873 | 2.752 | .033 |
| Perceived explicit social control | 6.626 | 3.102 | .033 |
| Anxiety about breaking formal rules | 4.260 | 2.260 | .059 |
| Communication satisfaction | -2.154 | 1.081 | .046 |

*Note. N = 53 (14 cases among the total of 67 were not included in the analysis due to missing data); -2Log Likelihood = 20.842; Nagelkerke $R^2$=.729; B = maximum likelihood regression statistic; S.E. = standard error; Sig. = significance level.*

Table 3.5 shows the results of the logistic regressions for Site B. In the logistic regression model for Site B, three predictors entered significantly into the final regression model: desire to outperform, perceived explicit social control, and perceived salience of social norms. The three variables combined significantly to predict the worker absence level at Site B ($p < 0.01$). The value of pseudo R-squared was .209.

Table 3.5. Variables in the final logistic regression model predicting absence level (for Site B)

| Predictors | B | S.E. | Sig. |
|---|---|---|---|
| Desire to outperform | -1.380 | 0.631 | .029 |
| Perceived explicit social control | 1.383 | 0.606 | .023 |
| Perceived salience of social norms | -.795 | 0.424 | .061 |

*Note. N = 75 (19 cases among the total of 94 were not included in the analysis due to missing data); -2Log Likelihood = 89.688; Nagelkerke $R^2$=.209; B = maximum likelihood regression statistic; S.E. = standard error; Sig. = significance level.*

## 3.4 DISCUSSION

It is commonly believed that the "usefulness" of predictor variables in regression models can be measured by the explanatory power for the variance in the criterion variable. From this perspective, having 10%–20% of the variance in the absence level explained by the predictor set may appear modest. However, it should not be ignored that the regression models used in this study were not intended to include all of the major factors that may influence worker absence behavior. Factors like ill health, sick family members, stress, tiredness, and personal problems—all of which have been identified as absenteeism predictor variables (Hackett et al. 1989)—were not included in this research. This study focused on workers' perceptions and attitudes toward formal/social rules that may influence workers' self-control of absence behavior, and the results show that those few variables can explain 10%–20% of the variance in absence level. Also, aggregated across hundreds of workers on a typical job site, the cost of productivity loss related to high levels of absenteeism (or the benefit of productivity gain due to committed workers) can be large, and therefore, a reduction of absence on the site, even at a modest level, can bring benefits to a project.

Both of the two significant predictors isolated by the stepwise procedure in the logistic regression model for the entire data set—perceived salience of social norms and perceived explicit social control—were the perceptual and attitudinal variables toward social rules. This result provides clear evidence that construction workers' absence behavior is under the influence of social norms, which agrees with many empirical findings provided in the absenteeism literature. However, extra caution has to be given for interpreting the regression model, because

the signs of beta coefficients for the two predictors are opposite. As shown in Table 3.3, the beta coefficient for the perceived salience of social norms is negative whereas it is positive for perceived explicit social control. This seems to be confounding, because the two variables are thematically similar, and as shown in Table 3.2, are strongly and positively correlated. This is called a "suppressor effect." According to the traditional definition of a suppressor effect, the suppressor variable is a predictor that has zero correlation with the criterion variable but still contributes to the predictive power of a regression model by virtue of correlation with another predictor (Lancaster 1999). Suppressor variables are advantageous because they improve the prediction of the criterion variable by "suppressing" irrelevant variance in the other predictor variable(s) (Thompson 1999).

Perceived explicit social control had a near-zero correlation with the absence level, but had fairly high correlation with the other predictor—the perceived salience of social norms. Experiences of explicit social control in the group should be a way to increase the perceived salience of social norms. However, one could perceive salient social norms also through self-categorization and referencing their attitude and behaviors to the prototypical norms in the group, as proposed by Hogg's (1992) self-categorization theory. When perceived explicit social control was entered into the regression model, the prediction of the overall model increased (the Nagelkerke R2 value increased from .075 to .164) by removing the variance in the perceived salience of social norms that can be explained by the perception of explicit social controls. This implies that the main mechanism by which workers' absence behavior is under social influences—thereby producing attitudinal consensus and behavioral uniformity (i.e., salience) in projects—is more likely to be workers' self-categorization than explicit exertions of interpersonal social controls in projects. Therefore, an interpretation of the regression model is that workers who perceive salient social norms in their teams, mainly by identifying themselves as members of their team and perceiving prototypical norms, but not by experiencing explicit interpersonal social controls, are less likely to present absenteeism.

In the logistic regression models for each site, both the variables isolated as significant predictors in the previous model were included. Therefore, the validity of predictive capacity in those variables was reaffirmed. Also, the results of logistic regression models for each site showed a higher R2 value than did the model for the entire data set, which implies that the site-

specific models have a larger explanatory power on the variance in absence level. In particular, the regression model for Site A showed a very high level of model fitting to the data. It is inferred from this that workers' absence behavior may be better explained with site-specific predictors. However, a caution has to be paid to the appropriate sample size for the analysis.

From the absence level data, it was found that workers at Site B presented higher absenteeism than did workers at Site A. Then, the regression results revealed that the additional predictors included in the model for Site A were anxiety about breaking formal rules and communication satisfaction, whereas the additional predictor included in the model for Site B was the desire to outperform. Given that the variable communication satisfaction measures how satisfying the communication with the project management team is, both the additional predictors in the model for Site A are related to formal policies and labor control in the project, while the additional predictor in the model for Site B is related to one's attitudes toward social approval. With caution, it is arguable that the formal absence control at Site A is more clearly present than at Site B, and therefore workers at Site A are more aware of the formal absence rules and this higher awareness can cause a lower level of absenteeism at this site. The speculation of less strict formal absence rules at Site B was supported by the managers at Site B saying, "Workers are told that they can be absent as many times as they could afford." Although such an anecdote supports the validity of the speculation, more comparative studies are warranted to reveal the meaningful differences in labor control policies at different sites.

## 3.5 CONCLUSIONS

Due to the labor-intensive nature of construction projects, workers' absenteeism can pose serious threats to construction projects. Workers' attendance can be seen as a resulting behavior of self-controlling efforts to conform to formal or social rules in an organization; these rules play an important role in maximizing their interest within organizations. To better manage workers' attendance on job sites, therefore, construction managers need to understand the processes of workers' behavioral control, such as how workers perceive formal/social rules for absence, build attitudes toward the rules, and control their absence behavior accordingly. However, the knowledge of the processes is limited. In an effort to address these issues, the objective of this

study was to investigate the relationship between workers' perceptions/attitudes toward formal/social rules and their absence behavior using real-world data. To fulfill the objective, a survey questionnaire was developed and data were collected from three different job sites, and then statistical analyses using logistic regression models were performed.

From the results of the study, it is concluded that construction workers who perceive salient social norms in their team are less likely to be absent from a job site, which implies that worker absence behavior is under the influence of social controls. Also, it was found that the main mechanism by which social controls on construction workers' behavior take place is the self-categorization, which means a worker is influenced by social norms by identifying themself as a member of a particular group and adapting their behavior to the prototypical behavior in the group. It was found that explicit interpersonal social control was not the main mechanism of social influence on behavior. Additionally, from observations of different absence levels at different sites, it was confirmed that while social control of absence behavior is effective, when high formal rule awareness is combined absenteeism can be maintained at an even lower level.

The fact that the perceived salience of social norm was a significant predictor of absence level suggests a new way of thinking about attendance management. Rather than focusing on formal attendance control policies—which, granted, do have their place—these findings suggest that construction managers need to pay attention to the absence culture in their project, and, in particular, the social dynamics within work crews. Even a modest investment in promoting social cohesion and creating a positive prototype in teams can be an effective means of maintaining low absenteeism on a job site.

It is expected that the result of this study will help construction organizations better understand the control mechanism of construction workers' absence behavior. This extended understanding will help reduce costs involved in labor control in projects because individual-focused, formal controls using strict regulations are not only costly but also may inadvertently fortify a culture that works against the organization's interests. Therefore, attempting to foster a positive social norm in construction sites can benefit both owners and contractors of construction projects in the long term.

This study has limitations. It is disputable that the results of this study are generalizable due to this site-specific validity of certain predictors in the model, even though multiple sites were involved. Further, the surveys were conducted at a point in time, thus lacking the perspective of possible longitudinal changes in perceptions and attitudes toward formal/social rules and the relationship between these perceptual/attitudinal variables and absence behavior. To obtain a greater external validity of the results, more surveys are required at multiple time points, preferably under different economic conditions.

In addition, the data collection and statistical analysis presented in this study were only at the individual-level. Some researchers emphasized the importance of unit-level absence research (i.e., collecting group-level data and investigating the relationship between group-level variables), because absence culture is a unit-level phenomena based on members' collective experiences (Rentsch and Steel 2003). Therefore, in order to have an in-depth understanding of the effect of absence culture and the informal control of absence behavior, unit-level data research on construction workers' absence is warranted.

# CHAPTER 4

# AN AGENT-BASED MODEL AND THOUGHT EXPERIMENTS TO EXPLORE CONSTRUCTION WORKERS' ABSENCE BEHAVIOR UNDER THE INFLUENCE OF SOCIAL NORMS [3]

## 4.1 INTRODUCTION

This chapter introduces a study to create a formal behavior model for worker absence behavior that is influenced by both the formal rules and social rules in an organization and to explore the group-level absence behavior using agent-based simulations. Aiming to understand the social mechanism of worker absence behavior, the essential elements to consider are how workers acquire the how-to-behave information (i.e., learning) and how they regulate their behavior with that information (i.e., self-regulation). Therefore, these elements constitute the proposed behavior model. To explore the system-level (i.e., organizational-level) effects of these processes from diverse viewpoints, computer simulations are used in this study. For this, the proposed behavior model is transformed into agent behavior rules, and an experimental analysis is conducted by running simulations with the agent-based model. In other words, workers' absence-taking behavior is modeled as a computational behavior rule and the effect of workers' different characteristics on their absence behavior is investigated in the simulated organization. The questions that are addressed through the exploration are as follows: (1) What is the mechanism and effect of social learning in worker absence behavior? (2) When and how can the workers' social learning of their behavior be used to constructively reduce absenteeism?

[3] This chapter is adapted from Ahn, S., Lee, S. and Steel, R. (2013). "Effects of workers' social learning: Focusing on absence behavior." *Journal of Construction Engineering and Management*, ASCE, 139(8), 1015–1025.

## 4.2 AGENT-BASED MODEL DEVELOPMENT

### 4.2.1. Theoretical Foundation

Bandura (1991) asserts that the functioning of a self-regulatory system (also known as a self-control system) is the causal process of human behavior, and that it provides the very basis for purposeful action. Various efforts have been made to use control theory to explain human behavior in organizations (McMahan and Wright 1993; Carver and Scheier 1982). Using the assumption that individuals are goal-oriented, self-regulating systems, the process of voluntarily taking an absence can also be modeled from the control theory perspective. In this theory, the negative feedback loop (i.e., balancing feedback loop) is the basic unit of control. In the loop, the perceived current situation is compared to the reference value and if a discrepancy exists between them, behavior is produced to reduce the discrepancy (Carver and Scheier 1982). Carver and Scheier (1981) explain that the affective component (i.e., the desire to reduce the discrepancy) is the initiator of this behavior and that people do not deliberately try to reduce the gap between their standard and their behavior, but they control themselves by "feeling what is right to do." Here, the standard means a reference value that gives a sense of "what is right." The reference value is created by associating one's behavior with its determinants and the effects and by judging the behavior in relation to the situation (Bandura 1991). Therefore, the reference value can be regarded as a result of learning with seeking to maximize the long-term best interests of the individual (Muraven and Baumeister 2000). Then this how-to-behave information is stored in memory along with other perceptual and conceptual information so that this information can be used to guide behavior in the future (Carver and Scheier 1982).

Social modeling is a powerful mechanism of transmitting standards (Bandura 1986). Bandura's social cognitive theory (1986, 1991) does a solid job of explaining this sociological aspect of one's learning and behavior regulation. The agent behavior rules in the ABM in this study are developed based on Bandura's (1991) social cognitive theory of self-regulation.

### 4.2.2. Conceptual Model

The social cognitive theory of self-regulation gives us a chance to model a worker's absence-taking process as a set of causal, traceable self-regulatory processes. In fact, the absenteeism literature provides abundant empirical observations that testify to the socially

cognitive self-regulatory system involved in a worker's voluntary absence taking. Hence, a set of agent behavior rules, which is constructed by customizing functions in the self-regulatory system into the absence behavior case, is summarized in Figure 4.1.

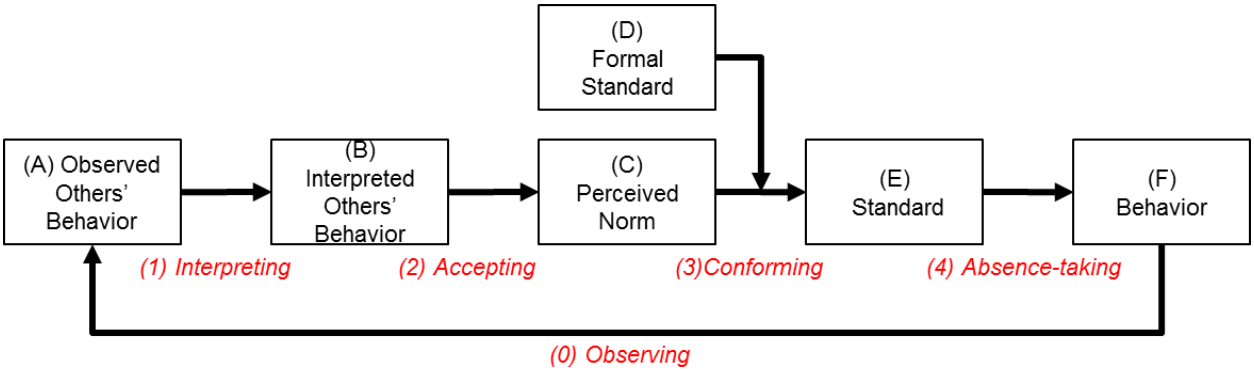



Figure 4.1: Agent-behavior rule

A worker observes others' absence in the workgroup via a social network (Bamberger and Biron 2007; Friedkin and Johnsen 2003; Iverson et al. 2003; Friedkin 2001; Nicholson and Johns 1985). The information of others' observed—and remembered—absence behavior [(A) in Figure 4.1] is interpreted, and the interpretation is influenced by the influence weight of each of the observed workers (Johns 2008; Kristensen et al. 2006; Friedkin 2001). This interpreted others' absence behavior [(B) in Figure 4.1] is the source for perceiving a social absence norm [(C) in Figure 4.1] (Rentsch and Steel 2003; Gellatly and Luchak 1998). This procedure, termed accepting, is influenced by the worker's social adaptation, which refers to the degree of the worker's tendency to learn others' absence behaviors and follow them (Johns 2008; Bamberger and Biron 2007; Friedkin 2001; Hackman 1992). Accepting is also influenced by salience, which refers to the degree of the distinctiveness of an absence norm in the group (i.e., the degree of uniformity of the behavior of observed workers) (Rentsch and Steel 2003; Xie and Johns 2000; Nicholson and Johns 1985). Hence, the greater the social adaptation or salience, the more quickly the worker adapts his or her perceived norm according to the interpreted others' behavior. Then the worker forms an internal standard of absence behavior [(E) in Figure 4.1] based on the perceived absence norm [(C) in Figure 4.1] and the formal absence standard [(D) in Figure 4.1]

(Das and Teng 2001; Bandura 1991; Steers and Rhodes 1978). The two perceived standards are often incongruent. In the conforming step, formal rule adaptation determines the weight that is attached to the formal absence standard relative to the perceived absence norm. Therefore, the greater the formal rule adaptation, the closer the worker's internal standard is to the formal standard. Once an internal standard is formed in the worker's mind, he or she takes absences in a way that reduces the discrepancy between the internal absence standard and behavior (McMahan and Wright 1993; Bandura 1991; Carver and Scheier 1982). When he or she behaves, the absence behavior [(F) in Figure 4.1] becomes available and is observed by the other workers who are linked to him or her through their social network (e.g., belonging to a same workgroup). This process that determines one's absence-taking behavior applies for every worker at every time step (e.g., a day).

### 4.2.3. Computational Model

These agent behavior rules are formalized as mathematical equations for use in computer simulations as follows:

$$I_i^{(t)} = w_{i1}X_1^{(t)} + w_{i2}X_2^{(t)} + \cdots + w_{iN}X_N^{(t)} \quad (1)$$

$$N_i^{(t+1)} = (s_i S_i)I_i^{(t)} + (1 - s_i S_i)N_i^{(t)} \quad (2)$$

$$R_i^{(t+1)} = (a_i)F^{(t+1)} + (1 - a_i)N_i^{(t+1)} \quad (3)$$

Equations (1), (2), and (3) are translations of each step in Figure 4.1—*interpreting*, *accepting*, and *conforming*—into computational rules. The step *observing* in Figure 4.1 is embedded in Equation (1). The explanation of the variables in the equations is as follows. *t* is time (e.g., day). $I_i^{(t)}$ is the interpreted others' absence rate in worker *i*'s mind at time *t* (days/month). $w_{ij}$ is the influence weight of worker *j* on worker *i* [0-1]. $X_i^{(t)}$is worker *i*'s absence rate at time *t* (days/month). $N_i^{(t)}$ is the perceived absence norm in worker *i*'s mind at time *t* (days/month). $s_i$ is worker *i*'s *social adaptation*. The lower the value of *social adaptation*, the more stubborn the worker is in the perceiving of social rules. The inverse of *social adaptation* implies the days the worker would take to fully accept the interpreted others' behavior and perceive it as a social norm. $S_i$ is the *salience* of a social absence norm in worker *i*'s mind. The

salience of a social absence norm can be measured by how uniform the observed data are in one's observation sample. Hence, the greater the value of *salience*, the greater impact the observed others' behavior has on the perception of it as a social norm. Operationally, $S_i$ is defined as an inverse of the standard deviation of *X* in one's observation sample. The value of $S_i$ is limited so that $s_i S_i$ does not exceed 1. $R_i^{(t)}$ is worker *i*'s internal absence standard at time *t* (days/month), and $a_i$ is *formal rule adaptation* [0-1]. The greater the *formal rule adaptation*, the more weight the worker gives to the formal standard than to the perceived social absence norms. Finally, $F^{(t)}$ is the formal absence standard at time *t* (days/month) (i.e., excusable absence rate).

One of the cherished notions of absenteeism research is the distinction between voluntary and involuntary absence (Steers and Rhodes 1978), which means the two different forms of absence may be instigated by different mechanisms. This study assumes that voluntary absence is controlled by an individual's self-regulation mechanism, but involuntary absence occurs due to uncontrollable conditions, such as illness or an accident. When such uncontrollable conditions appear, even a worker with very strict self-regulation might not be able to attend work. To include both forms of absence in the model, the absence-taking step is formulated by a dyad of functions. First, when a worker is under a condition of involuntary absence, the worker is absent. Second, when a worker is not under such a condition, the worker's absence is determined by a probability function [Eq. (4)]. This equation reflects the self-reaction to reduce the discrepancy between one's internal standard and behavior. Hence, the function $f_R$ is not identical for every worker, but may be different according to the strength of one's self-regulatory system.

$$Probability\left(x_i^{(t+1)} = 1\right) = f_R(R_i^{(t+1)} - X_i^{(t)}) \tag{4}$$

In Equation 4, $x_i^{(t)}$ is whether or not the worker *i* is absent at time *t*. Hence the probability of a worker's absence ($x_i^{(t+1)}$) is determined by a comparison of one's absence rate (i.e., $X_i^{(t)}$) with the internal standard ($R_i^{(t+1)}$). $f_R$ is a function that produces a greater probability when one's recent absence rate is lower (i.e., when $R_i^{(t+1)} - X_i^{(t)}$ is larger).

## 4.3 EXPERIMENT DESIGN

In order to address the research questions that were raised, the impact of the principal parameters—social adaptation, formal rule adaptation, and strictness of self-regulation—on the dynamics of organizational absence rate were explored. Those three parameters determine how quickly workers adapt their perceived absence norm according to observed others' behavior (i.e., power of social learning), how much more workers consider formal standards over perceived absence norms (i.e., power of formal learning), and how strictly workers regulate their absence behavior. The impact of these parameters was tested by applying different values for them and comparing the results. For this purpose, the mean of the internal standards and the mean of the monthly absence rate (days/month) of all agents for each of the 300 simulated days were measured.

Specifically, eight models constituting different combinations of those three parameters were made by applying either a low or high value for each of the three parameters [e.g., low and high social adaption (LS and HS, respectively), low and high formal rule adaptation (LF and HF, respectively), and low and high strictness of self-regulation (LR and HR, respectively)].

The values and functions that were used to represent the low and the high case for each parameter are described in Table 1. What is represented by those parameters is implicit and thereby difficult to directly measure from realities. Therefore, hypothetical settings that are assumed to be the boundary cases of normal construction workers' different characteristics that affect the absence-taking process were used. First, it was assumed that the amount of time workers take to accept a social norm ranges from a few days to several months. The process of workers' internalization of norms (Deci et al. 1994) and the degree (i.e., speed) of social learning (i.e., social adaptation) (Stone and Zafar 2010) can widely differ according to the social context. In these experiments, 10 days and 6 months (approximately 200 days) were selected as the boundary examples of duration for social norm internalization; thereby the values 0.1 (i.e., 1/10) and 0.005 (i.e., 1/200) were used for the high and the low case, respectively, of social adaptation in simulations (because the inverse of social adaptation implies how many days a worker would take to perceive the observed others' behavior as a norm). Second, it was assumed that the weight that construction workers attach to formal rules over social rules in the daily formation of their internal standards ranges from 0.1 (i.e., the relative importance between the formal standard

and social standard is 1:9) to 0.7 (i.e., the relative importance between the formal standard and social standard is 7:3). Because the formal rule adaptation offsets the effect of social adaption in this model, setting too high of a value for the formal rule adaptation eliminates all social influences among workers in the simulations. Because many absenteeism papers clearly demonstrate the evidence of the existence of workers' social behavior, too high of a value of formal rule adaptation was not tested. Last, it was assumed that a worker with a strict self-regulation would not take an absence when he or she finds out that he or she has been violating his or her internal absence standard, whereas one with a less strict self-regulation would still have some probability of taking an absence in the same situation. Therefore, the high and low cases of strictness of self-regulation are differentiated by setting different step functions, as shown in Table 1. These step functions realize the principle of self-regulation: when the discrepancy between the standard and the behavior is wider, the internal force to reduce the discrepancy is stronger. Hence, in the high case of strictness of self-regulation the probability of taking an absence begins at 0% and increases stepwise as the internal standard minus the personal absence rate increases. In the low case, the probability begins at 20% and increases likewise. After conducting the experimental analysis, a sensitivity analysis was also conducted to compensate for the uncertainty of these assumptions, which will be introduced subsequently.

Table 4.1: Values and functions representing the low and high case of each parameter

| **Parameter** | **Low(L)** | **High(H)** |
|---|---|---|
| *Social Adaption(S)* | 0.005 | 0.1 |
| *Formal rule adaptation(F)* | 0.1 | 0.7 |
| *Strictness of Self-Regulation(R) (Absence-taking probability function $f_R$ in Equation 4)* | $f_R(x) = 20\%\ if\ 0 \geq x,$<br>$30\%\ if\ 0 \leq x < 1,$<br>$40\%\ if\ 1 \leq x < 2,$<br>$50\%\ if\ 2 \leq x$ | $f_R(x) = 0\%\ if\ 0 \geq x,$<br>$10\%\ if\ 0 \leq x < 1,$<br>$20\%\ if\ 1 \leq x < 2,$<br>$30\%\ if\ 2 \leq x$ |

Beyond the three principal parameters, common settings of other parameters for simulations are described in Table 2. A 100-worker organization, which consists of 10 crews,

each of which has 10 workers, is simulated. Within each crew, every worker can observe other workers, whereas workers' social reach is limited across crews. The formal absence standard is set as 1 day/month for all of the simulation runs. Workers in the simulation remember 150 cases of peers' attendance or absence and use the stored information in the process of perceiving social absence norms. In the beginning of each simulation run, workers are initialized with a standard that is randomly assigned based on a uniform distribution from 1 to 5. This simulates a problematic initial situation. The probability of involuntary absence is determined based on the duration of the absence, implying that short-absence-inducing causes are more common than long-absence-inducing ones.

Table 4.2: Common settings for simulations

| Parameter | Setting | Description |
|---|---|---|
| *Number of Workers* | 10 workers × 10 crews | 100 workers in the simulated organization |
| *Probability of Network Connection Between Workers* | Within crew: 100% (i.e., a clique (Newman 2010)) | Everyone in one crew knows, and can observe, each of the others |
| | Across crews: 3% (i.e., a sparse network (Newman 2010)) | Workers have a small chance of exchanging social influences across crews |
| *Formal Standard* | 1 day | 1 day of absence is excusable |
| *Memory Capacity* | 150 cases | A worker remembers 150 attendance/absence cases of others |
| *Initial Internal Standard* | Uniform distribution [1.0-5.0] | Initial internal absence standard distributed from 1 to 5 days (i.e., simulating a problematic situation) |
| *Probability of involuntary absence* | - Uniform distribution of duration [1-5]<br>- Occurrence Probability: (1 / duration) / 50 | Frequency (probability of occurrence) of involuntary absence is inversely proportional to the severity (duration of absence) of the inevitable absence cause |

## 4. 4 RESULTS

Figures 4.2 and 4.3 illustrate the results of the simulations. Figure 4.2 shows the single-run simulation results of each of the eight cases. A single-run simulation data set is generated by running a simulation and storing measures at each time, and therefore can be seen as "data as history" (Axelrod 1997b). Therefore, analyzing the single-run simulation data enables explanation of possible reasons for the behavior observed in the real world. Because each run of the simulation is under the effect of randomness (i.e., stochasticity of events) and path dependence (i.e., the current decision situation is dependent on the past decisions) (Brown et al. 2005), each graph in Figure 4.2 should be seen as an example of the simulation results. In the simulations, the involuntary absence rate, the voluntary absence rate, and the mean internal standard from the $30^{th}$ to the $300^{th}$ simulated day were recorded. From the results, it is shown that when the strictness of workers' self-regulation is low [e.g., the four cases in Figure 4.2(a, c, e, and g)], the voluntary absence rate stays high or even increases. On the other hand, when the strictness of workers' self-regulation is high, the voluntary absence rate is controlled at a low level or even decreases. From this comparison, it can be seen that the strictness of workers' self-regulation plays a critical role in workers' absence behavior in this model.

As could be expected, when workers' formal rule adaptation is high [e.g., the four cases in Figure 4.2(a–d)], the overall voluntary absence rate tends to be relatively small compared to when formal rule adaptation is low. This is due to the low value of internal absence standard that is resulting from workers' attaching a large weight to the formal absence standard rather than to perceived norms. In other words, workers' internal standards do not fluctuate much but stay at a low level when workers' formal rule adaptation is high, and this steady low internal absence standard leads to low absenteeism.

The impact of social adaption is seen clearly only when the formal rule adaptation is not high because formal rule adaptation can offset the effect of social adaption in the model. Therefore, when workers' formal rule adaptation is high or when workers' social adaption is low, social adaption plays a small role and so workers' internal absence standards do not change frequently over time. On the other hand, when workers' social adaptation is high, if there is a presence of strict self-regulation in workers, the social adaptation contributes to reducing the overall voluntary absence rate by reinforcing the low absenteeism [Figure 4.2(h)]. Conversely, if

the strictness of self-regulation is low among workers while their social adaptation is high, social adaptation adversely affects the voluntary absence rate [Figure 4.2(g)] because workers with a high social adaptation learn high absenteeism from one another. This way, the positive impact of social adaption on worker absence behavior is conditional on the degree of formal rule adaptation and strictness of self-regulation.

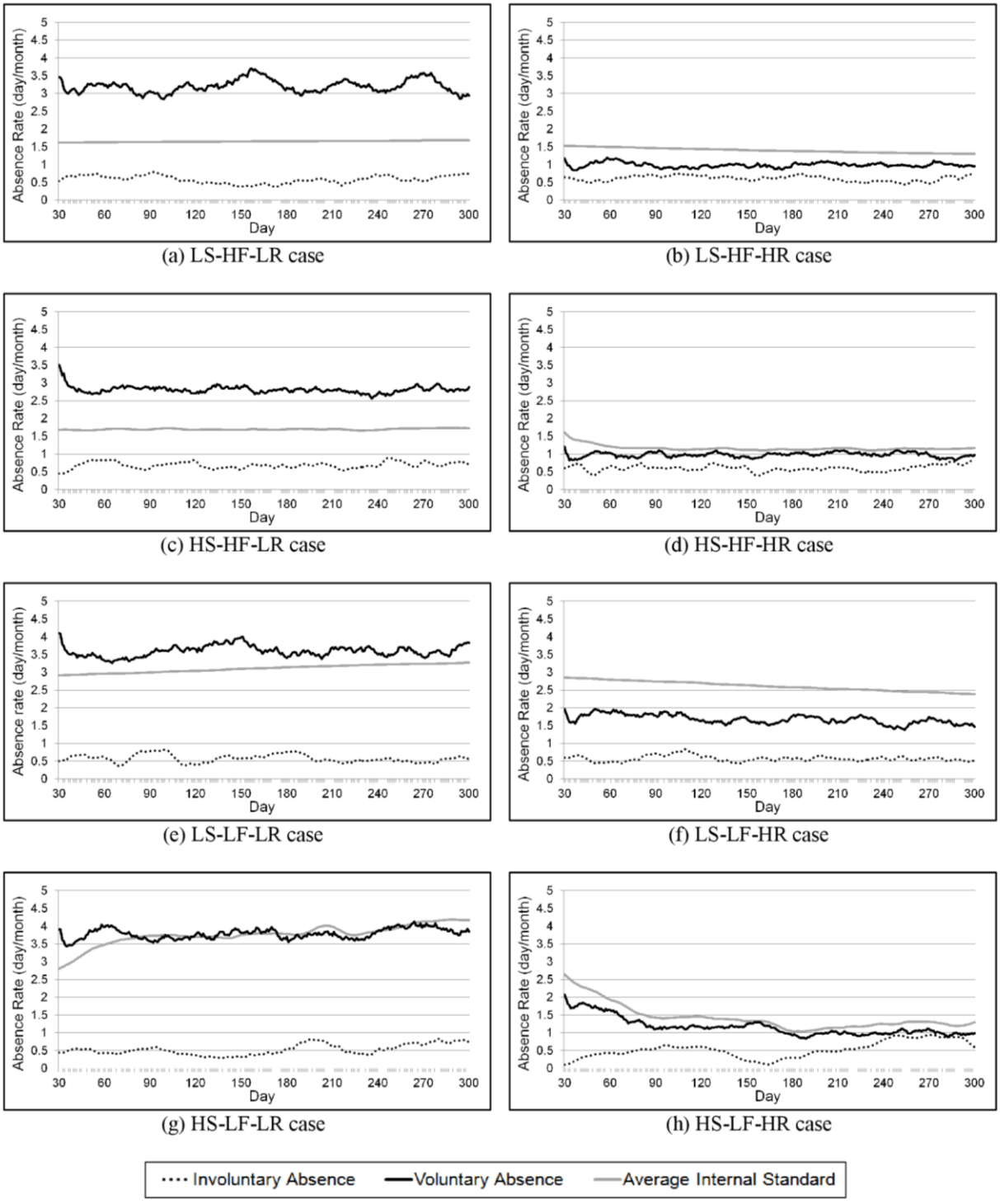



Figure 4.2: Result of single-run simulations

The role played by social adaption in the model with respect to the emergence of an absence norm can be clarified by tracing the distribution of workers' internal standards over time. Figure 4.3 shows a comparison of the tracing of three cases: LS-LF-HR, HS-LF-HR, and HS-LF-LR. The x-axes in Figure 4.3 are the personal internal absence standard, and the y-axes are the frequency for each bin. Because workers in the simulations are initialized with various internal standards ranging from 1 to 5 days, in the beginning of simulations the distribution of workers' internal standards is wide. As the simulation progresses, workers' internal standards converge only if there is a high presence of social adaptation in the organization [see Figure 4.3(b and c)]. In contrast to Figure 4.3(b and c), such convergence is not observed when the social adaptation is set low [Figure 4.3(a)]. The process of the convergence of workers' internal standards and the ensuing absence behavior can be seen as a simulation of the process of the emergence of absence norms. In other words, the simulations effectively demonstrate the emergence of absence norms in worker organizations, and it is reaffirmed from the simulation results that individuals' social cognition and adaptation in their self-regulatory system produce the emergence and exertion of norms in organizations.

However, the effect of absence norms can be either positive or negative for management, and it depends upon the direction of the norms' evolution. This direction is not predetermined by only the high presence of social adaptation, but is contingent. When the low-absenteeism behavior is initiated by workers' strict self-regulation or managerial actions, a positive culture (i.e., low absence norm) can begin to evolve and reinforce the low absenteeism behavior [Figure 4.3(b)]. On the other hand, when a high absence rate is observed, a negative culture (i.e., high-absence norm) can evolve and reinforce the misbehavior [Figure 4.3(c)].

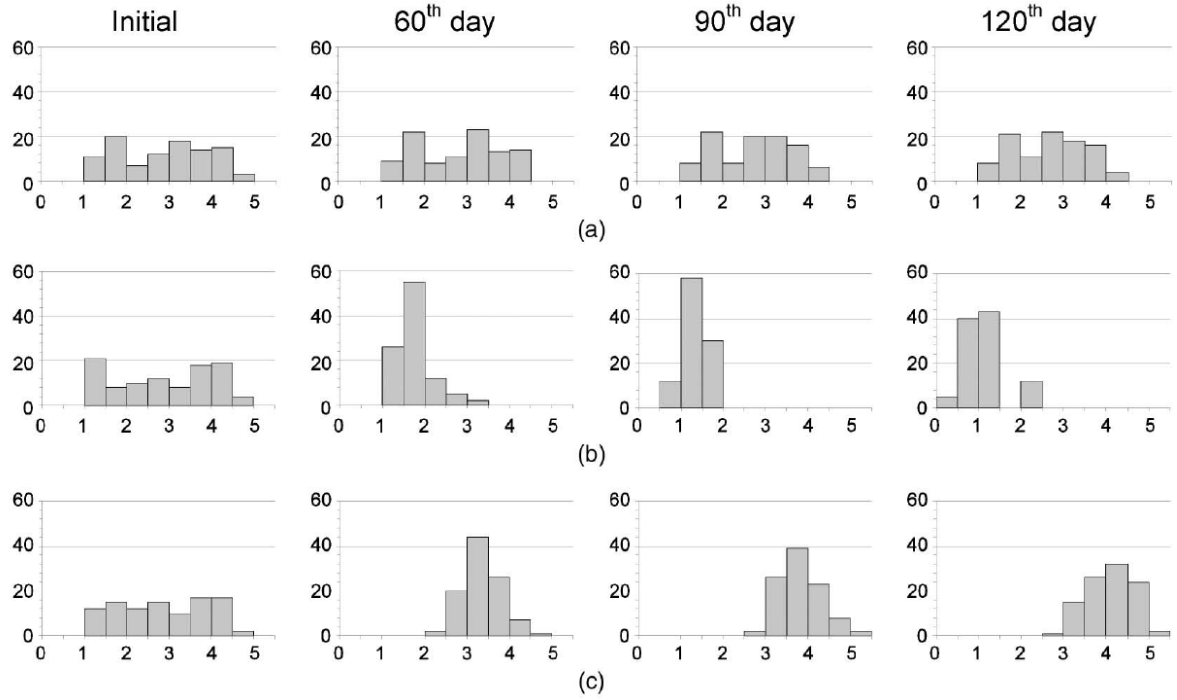



Figure 4.3: Distribution of workers' internal standard over time; the x-axis is the personal absence standard and the y-axis is the frequency: (a) LS-LF-HR (no culture); (b) HS-LF-HR (positive culture); (c) HS-LF-LC (negative culture)

While the analysis of single-run simulation results can provide an explanation for an observed phenomenon, statistical analyses of multiple simulation runs can highlight the variability of simulation results and enable clear comparison of the simulation results of each case. To see the variability of simulation results, 100 simulations were run for each of the eight combinations of parameter settings. Figure 4.4 shows a summary of all the simulation results. Each of the box plots in the figure represents the distribution of voluntary absence rate of the last 30 simulation days (i.e., 270th–300th day in the simulation) with each of the parameter setting combinations. The difference between these box plots clearly shows that voluntary absence rates in the simulation do not just follow a random walk. As can be seen, the most favorable consequence can be observed in the LS-HF-HR, HS-HF-HR, and HS-LF-HR cases. From this, it can be seen that the prerequisite of low absenteeism is the presence of strict self-regulation among workers. A common condition in the first two cases is workers' high attention to the formal standard. Being aware of this, construction managers may have been focusing mainly on

the development of reward or penalty systems that would stimulate individual workers' awareness of formal rules. However, the low absence rate of the HS-LF-HR case is the evidence demonstrating that workers' high sensitivity to social rules can stand in for the role of formal rule adaptation.

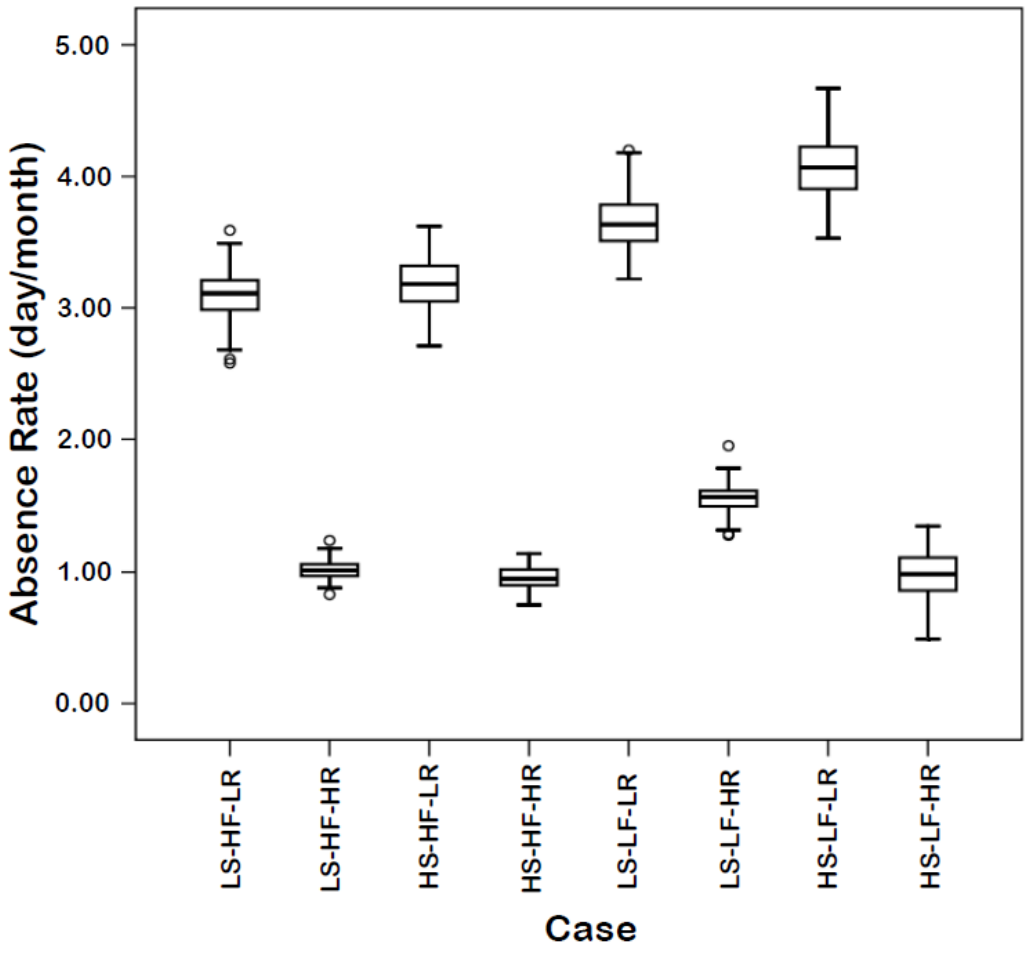
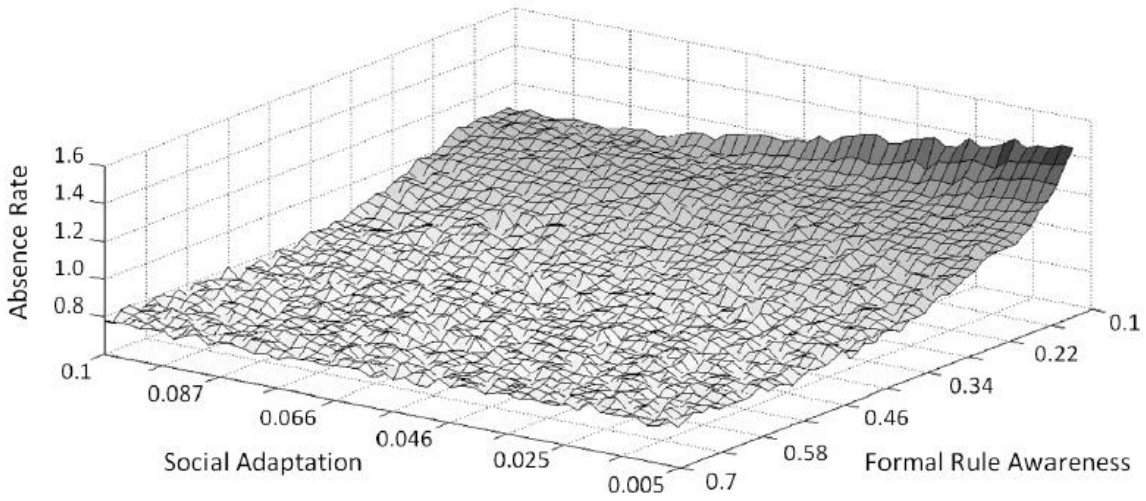


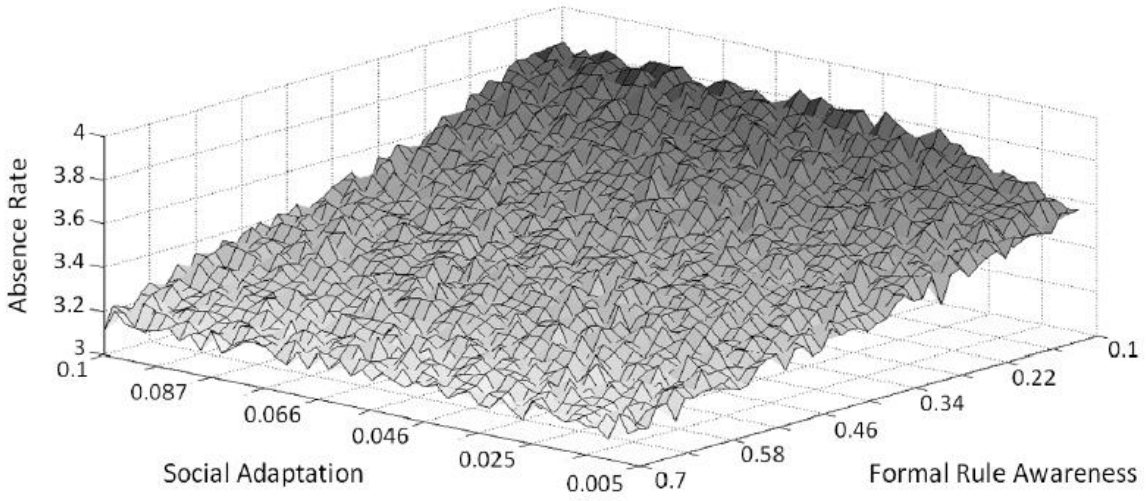

Figure 4.4: Box plots of simulation results

Last, a sensitivity analysis was conducted to see how the output value (mean absence rate) of the simulation model changes as the value of the input parameters changes. The values that were used to represent the low and high case for each parameter were selected with a set of

assumptions that are difficult to prove. Therefore, this sensitivity analysis can compensate for the input uncertainty by presenting numerous output values that are produced by various input values (Hekimoğlu and Barlas 2010). Particularly, a two-way sensitivity analysis of social adaptation and formal rule adaptation (i.e., varying the value of the two parameters simultaneously and observing the variation in output) was conducted because these two parameters have an interactive impact on workers' absence behavior. Figure 4.5 shows the result of the sensitivity analysis. The z-axis in each surface graph represents the mean voluntary absence rate of the last 30 simulation days (i.e., 270th–300th day in the simulation). Each absence rate in the graphs is obtained by averaging the mean absence rate of 100 simulations with the same input settings. As shown in Figure 4.5, the simulation output value changes gradually as the input values change. Also, no critical points were observed within the boundary. An intermediate value of input parameters—for example, 0.05 for social adaption and 0.5 for formal rule adaptation in the HR case—yields an intermediate output value 0.82 days=month, which makes sense with respect to the trends in the sensitivity analysis result. From this sensitivity analysis, more confidence can be placed in the behavior of the simulation model.




(a) HR case




(b) LR case

Figure 4.5: Two-way sensitivity analyses on social adaptation and formal rule adaptation: (a) HR case; (b) LR case

## 4.5 VALIDATION

The validity of a complete simulation model should be evaluated against the purpose of the modeling work (Gilbert 2008; Sterman 2000; Robinson 1999). Among Axtell and Epstein's

classification (1994) of agent-based modeling, the agent-based model in this study is categorized as Level 1. ("The model is in qualitative agreement with empirical macro-structure, as established by plotting, say, distributional properties of the agent population.") Therefore, to validate the simulation model the qualitative agreement with the empirical findings of the absenteeism literature was tested.

The simulation results presented previously reaffirm Bamberger and Biron's (2007) empirical finding that referent group norms can significantly shape excessive absence behavior via an association with formal organizational controls. The simulation model in this study effectively reproduces the process of social norms in shaping workers' absence behavior: workers learn by observing others, workers internalize the observed behavior rules (this takes time), finally the internalized absence standard is manifested as behavior (Nicholson and Johns 1985; Gellatly and Luchak 1998; Mason and Griffin 2003). The simulation results also reproduce the phenomenon that workers' perceptions and behaviors assimilate over time under the influence of social norms (Gellatly and Luchak 1998; Mason and Griffin 2003). Also, the simulation provides evidence of how a cohesive workgroup (i.e., high social adaptation and salient norms) can have lower absenteeism (Hanna et al. 2005; Sanders 2004; Xie and Johns 2000; Duffy et al. 2000; Edwards and Scullion 1982). The explanatory power for the observations that are reported in the absenteeism literature is an important function of the simulation (Eason et al. 2007).

Simulation is an approach to formally identify and model the underlying processes that are thought to play key roles in the behavior of interest; therefore, developing a simulation model is a way to build theory (Harrison et al. 2007). Because this research primarily aims to model the process of construction workers' absence behavior and study the impact of workers' social learning on their absence behavior, a limited effort to validate the insights and the suggestions for practices has been made. More empirical studies will need to be conducted to fully validate the applicability of the model when it is applied and customized to real-world projects.

## 4.6 DISCUSSION

Although the absence literature provides abundant information about which factors have a strong correlation with absence behavior, it gives limited insight into the causal process underlying this behavior and how it can be reduced. The approach in this study (i.e., using computational simulations with an ABM) can, therefore, complement conventional, survey-oriented organizational behavior research because the modeling of agent behavior rules forces researchers to pay more attention to the causal factors underlying observed behavior. Then the simulation generated from the model can be used to reaffirm the theories that have been presumed to be true but are not yet articulated enough to predict plausible consequences of the behavior rules.

It was posited that workers' formal rule adaptation, social adaptation, and strictness of self-regulation are three primary forces concerning the emergence and exertions of absence norms. That is why the impact of the three parameters was examined by applying various values for them. The result of the examinations clarifies that each of the three parameters plays a unique role in the dynamics of workers' absence behavior, and their interplay produces various results of organizational absenteeism. Figure 4.6 illustrates the interactive role of each parameter in the dynamics of workers' absence behavior. First, formal rule adaptation exerts a force to drag the line of internal standard down toward 1 day, which is set as the formal absence standard. And on the other hand, social adaptation exerts a force to gradually drag the same line, the line of internal standard, toward where the total absence rate is at the moment. Therefore, the location of the line of internal standard is determined to be where these two forces are in balance. Last, strictness of self-regulation determines a relative location of the line of voluntary absence rate to the line of internal standard. Therefore, the stricter the self-regulation, the lower the voluntary absence rate. The case that is used in Figure 4.6 is LS-HF-LR. In this case, where the social adaptation is low but the formal rule adaptation is high, it is shown that the dominant force exerted on the line of internal standard is the latter, and so the internal standard stays at a low level near the 1-day absence rate with little fluctuation over the simulated time period. Although the internal absence standard stays at a low level, the actual absence rate hovers at a high level distant from the line of internal standard because the force to drag the line of voluntary absence rate down (i.e., strictness of self-regulation) is weak.

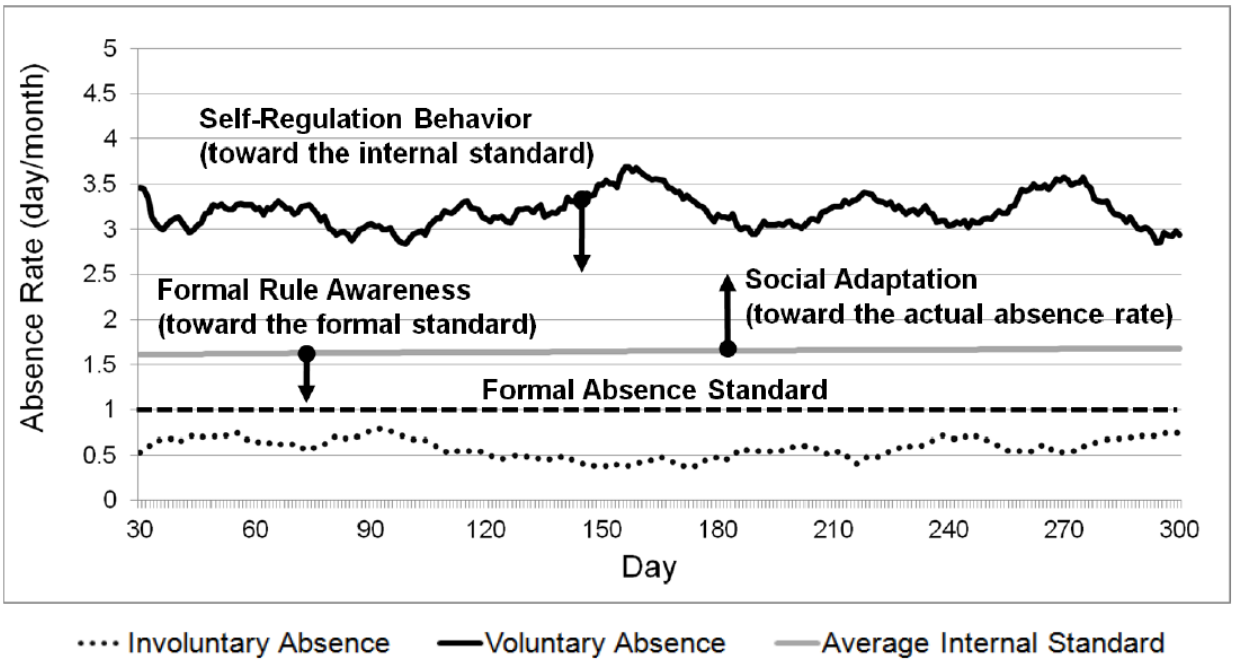



Figure 4.6: Role of each parameter in the dynamics of workers' absence behavior

In sum, the operation of the entire simulated organization is dictated by two qualitatively and hierarchically different feedback mechanisms. One is the individual-level balancing feedback mechanism that is the work of self-reaction in individuals' self-regulatory systems, and the other is the cross-level (between individual-level and group-level) reinforcing feedback between the workgroup's behavior and individuals' internal standard (i.e., the more workers' absences are observed, the more workers' internal absence standards increase, and the more workers take absence). The three forces in the dynamics of workers' absence behavior are then the controllers of those feedback mechanisms. Strictness of self-regulation is the gauge of the individual-level negative feedback system, social adaptation is that of the cross-level positive feedback system, and formal rule adaptation is a counterbalance of the positive feedback system such that it always attracts workers' internal standards toward the formal standard. Therefore, the dynamics of absence behavior can be seen as a result of those interactive feedback systems in the human organization system.

From the simulation results, it can be seen what construction managers might want to do to effectively control workers' absence behavior. First of all, construction managers need to track and monitor construction workers' attendance at their construction site on a daily basis, maybe by using a check-in system. This is because the longitudinal data of workers' attendance is useful for understanding the main cause of absenteeism in the organization. It is only when managers have an understanding of the dynamic changes that are taking place in workers' absence behavior that they can find out what path the organization's current situation is following. Particularly, construction managers should pay attention to the distribution of the workers' absence rate. Especially when absenteeism damages the project, to better understand the underlying reason of workers' absenteeism, managers might want to survey workers' behavioral and attitudinal characteristics by using a questionnaire; this kind of survey can help managers figure out the main cause of the high absence rate.

In general, absenteeism could be caused either by a prevalence of the perception that a somewhat high level of absence would benefit employees (i.e., high internal absence standards) or a prevalence of low morale that leads to misbehavior that does not necessarily originate from high internal absence standards (i.e., weak self-regulatory systems) among workers. If it turns out that workers at the site do not have strict self-regulation and this is a main cause of high absenteeism, managers may have to focus on developing policies that address workers' self-regulatory system. Factors influencing workers' strictness of self-regulation include commitment to the job (Nicholson 1977), physical energy (Muraven and Baumeister 2000), and perception of higher level goals (Carver and Scheier 1982). Therefore, if weak self-regulation among workers is observed, managers might want to develop a project policy that can improve one of these influence factors. Particularly, attachment (i.e., commitment to the work organization) is indicated as an important element that affects organizational misbehavior (Hollinger 1986; Wiatrowski et al. 1981), including withdrawal behavior (i.e., lateness, absence and turnover) (Abrams et al. 1998). Therefore, when absenteeism is a problem in the project, managers should primarily consider how to raise workers' feeling of attachment to their work.

On the other hand, if it turns out that workers have a high absence norm and this is a main cause of high absenteeism, managers would first need to attempt to stop the adverse norm from spreading any further (i.e., interrupting the effect of social adaptation). Then managers might

want to try to lower workers' internal absence standard by introducing strict formal reward or penalty policies for some duration. Once workers' absence behavior is under control with a self-regulatory system working properly within workers, then managers can promote cohesion in the workgroups so that the workgroup can socially and autonomously control workers' behavior through the development of positive social absence norms.

Though the simulation results and analyses gave insights into when and how social absence norms develop within workgroups and how worker absenteeism should be approached using the norms, there are several more things that have to be investigated in order to develop the insights into practical suggestions. How to definitely raise or lower in reality each of the parameters that were tested in the simulations needs to be further investigated. Also, the range of value of each of the parameters in reality needs to be further studied in order to simulate more realistic scenarios. When there is a further understanding of the values of the parameters and the process of their change in reality, more concrete guidelines on how to most effectively control workers' behavior through experimental analysis with simulations can be given.

## 4.7 CONCLUSIONS

An ABM that is a model of a worker's absence-taking process has been constructed by drawing on the theoretical and empirical findings from the literature. By running simulations on the model with different settings for focused parameters, it has been demonstrated that (1) high social adaptation can work as a force to either increase or decrease workers' absence rates; (2) when strict self-regulation is prevalent among workers, high social adaptation can lead to the development of a positive social norm at the jobsite; and (3) when high social adaptation reinforces formal rules, this occurrence reduces the need for additional formal control of worker behavior. The experimental analysis with the simulation model extends the knowledge of the dynamic relationship among workers' absence behavior, social absence norm within teams, and labor controls concerning absenteeism in construction management. Those findings lay the foundation for a new approach to worker attendance control: cultivating favorable social norms that facilitate workers' improved attendance, rather than imposing regulations that target individuals.

This study has limitations that can be addressed through follow-up research efforts. Future research progress should be bidirectional—further experimenting and analyzing the current ABM and extending the scope of the ABM by including more factors in the model. The experiment that is presented in this study was conducted with hypothetical conditions; therefore, the simulation results mainly contribute to understanding the principles behind workers' absence behavior. However, the ultimate goal is to use the simulation model for project policy suggestion. To do so, site-specific actual data are needed because those actual data can contribute to producing more realistic simulation results that can actually help with project policy development. Also, the effect of the heterogeneity of workers' characteristics can be tested in future simulations. Last, this approach can be applied to the issues regarding other types of workers' behavior in construction projects—such as productivity, unionization, and problem solving—by extending the scope of the ABM.

# CHAPTER 5

# COMPARISON BETWEEN THE AGENT-BASED MODEL BEHAVIOR AND REAL WORKERS' ABSENCE BEHAVIOR[4]

## 5.1 INTRODUCTION

Recently, agent-based modeling and simulation (ABMS) has emerged as an innovative approach to studying employees' behavior influenced by social norms in organizations and the group-level phenomena created by group members' interactions (Macy and Willer 2002). ABMS allows researchers to virtually observe group-level phenomena emerging from individuals' interactions, and to conduct "thought experiments" to generate plausible scenarios in organizations (Macy and Willer 2002).

Despite the advantages offered by ABMS, supporting an agent-based simulation with real data is the greatest challenge in using ABMS for organizational behavior research. The problem of validating an agent-based model is particularly important when one wants to use ABMS for a pragmatic purpose, such as providing assistance to decision makers in developing organizational policies and interventions to better manage human resources. If a researcher wants to argue which types of organizational policies will be effective for creating a positive safety culture on site over time using the results of ABMS, for example, the researcher would have to provide empirical evidence that the worker agents' safety behavior generated by the simulation are realistic. However, the methodology for creating an empirically supported agent-based model of human behavior has not been established (Axtell and Epstein 1994).

[4] This chapter is adapted from Ahn, S. and Lee, S. (2014). "Methodology for creating empirically supported agent-based simulation with survey data for studying group behavior of construction workers." *Journal of Construction Engineering and Management*, 10.1061/(ASCE)CO.1943-7862.0000918, 04014065.

With this background in mind, this chapter provides an overview to the proposed methodology developed to test an agent-based model for worker absence behavior using empirical data collected by surveys. The proposed methodology is applied to the agent-based model of worker absence behavior, which was presented in Chapter 4, and the results are provided in this chapter. In addition to this, theoretical and application implications of the proposed methodology are discussed later.

## 5.2 THEORETICAL BACKGROUNDS

### 5.2.1 Agent-based modeling for organizational behavior

Computational modeling has emerged as a new research tool for studying organizational behavior (Hulin and Ilgen 2000). Computational modeling is expected to better address the "What if…" questions in the study of organizational behavior, which were poorly addressed by traditional research approaches (Hulin and Ilgen 2000). Computational models incorporate temporal dynamics, and thus the models represent processes (Seitz 2000). Since a user can control the time steps in simulations, the unfolding process can be observed at any point in a computer simulation's time steps (Seitz 2000).

Among several types of computational modeling and simulation approaches, ABMS has drawn great attention from scholars who are interested in the system-level behavior of organizations emerging from the organizational members' interactions. This system behavior emerging from individual members' interactions is referred to as complex systems behavior (Flake 1998). The notion of complex systems implies that a system's behavior is not a product of inherently complicated individuals in the system, but is an emergent property that results from many adaptive individuals' actions and interactions within the system (Flake 1998). ABMS is a tool specialized in studying such emergent system behavior, and thus has been increasingly used in the studies of people's complex group behavior created by individuals' social interactions in organizations. In the construction research domain, there have also been increasing efforts to use ABMS for construction organizational research (Jin and Levitt 1996; Taylor et al. 2009; Son and Rojas 2011; Du and El-Gafy 2012).

### 5.2.2 Performance Levels of Agent-Based Model

The levels of an agent-based model's performance can be categorized by how accurately the model can replicate the reality (Axtell and Epstein 1994). Axtell and Epstein (1994) summarized the different levels of performance of an agent-based model in this regard, as follows. In this description of each level, macro-structure refers to the group-level behavior of organizations; micro-structure refers to the individual agent's behavior.

- Level 0: "The agent behavior rule is in qualitative agreement with the micro behavior"
- Level 1: "The model behavior is in qualitative agreement with empirical macro-structures"
- Level 2: "The model behavior is in quantitative agreement with empirical macro-structures"
- Level 3: "The model behavior is in quantitative agreement with empirical micro-structures"

Axtell and Epstein's (1994) taxonomy of agent-based models provides a means to classify an agent-based model by its performance level, provides conceptual criteria for each performance level, and also gives an idea of how one can develop an agent-based model in a progressive way to achieve a high performance level (Levels 0 – 3 can be achieved in a progressive way). However, they did not specify what kind of data is required and how the data can be used to actually achieve each level. Therefore, a concrete research methodology to create a high-performance agent-based model for workers' group behavior still needs to be developed, given that a methodology is a system of methods that can be used in a particular area of study.

Since the modeling objective may vary according to the field's state and standards as well as modeling resources, the target performance level of an agent-based model may also vary. To date, not many agent-based models of human behavior have aimed at high levels like Level 2 or Level 3 (Axtell and Epstein 1994). Researchers who used ABMS in sociology or anthropology, for example, often thought that their agent-based model did not need to show quantitative agreement with the empirical data, because many agent-based models were often used to "…perform highly abstract thought experiments that explore plausible mechanisms that may underlie observed patterns" (Macy and Willer 2002, p.147). Further, Axelrod argued that agent-based models in the social sciences do not necessarily "…aim to provide an accurate representation of a particular empirical application" (Axelrod 1997a, p.25).

However, the objective of using ABMS in management research, including the construction management domain, may be to provide pragmatic assistance in decision making to deal with a current phenomenon in an organization. In other words, the objective of using ABMS in management research is often application-oriented rather than theory-oriented. When the modeling objective is application-oriented, the model's behavior needs to exhibit quantitative agreement with real systems' behavior to some extent (i.e., Level 2 or above). However, methods of using empirical data for creating an empirically supported agent-based model have not yet been established (Axtell and Epstein 1994), but efforts are underway to develop such methods (de Marchi 2005).

### 5.2.3 Previous Efforts to Use Real Data for ABMS

There have been several efforts to use empirical data with an aim to enhance the performance of an agent-based model. The most common way of using real data in ABMS is to measure some of the variables used in the model from the real world, and to use the data to set model parameter values (Wolf et al. 2012; Valbuena et al. 2010; Villarmor et al. 2012). However, these efforts of setting model parameters with real data are often limited to the variables that allow direct measurement. Researchers have most often used hypothetical values with some assumptions for other model parameters that are difficult to measure, such as perceptual and attitudinal variables, and have performed a sensitivity analysis on these variables to compensate for their uncertainty.

## 5.3 METHODOLOGY

With the abovementioned background in mind, the goal of the proposed methodology is to create an agent-based model of construction workers' behavior that satisfies the criteria of Level 2 models. Level 2 is aimed for because achieving Level 3 (i.e., quantitative correspondence of an agent's behavior in the simulation with the micro-level, actual human behavior) would not be realistic in the human behavior simulation due to the inherent uncertainty in human behavior and the random events in the reality.

Figure 5.1 shows the flow chart of the proposed methodology. The proposed methodology suggests that the common processes of ABMS research (A. Modeling and Experiment in Figure 5.1) are integrated with survey data collection and analysis (B. Data Collection and Analysis in Figure 5.1), and empirical data is used for testing the performance of an agent-based model in three steps (C. Model Testing in Figure 5.1).

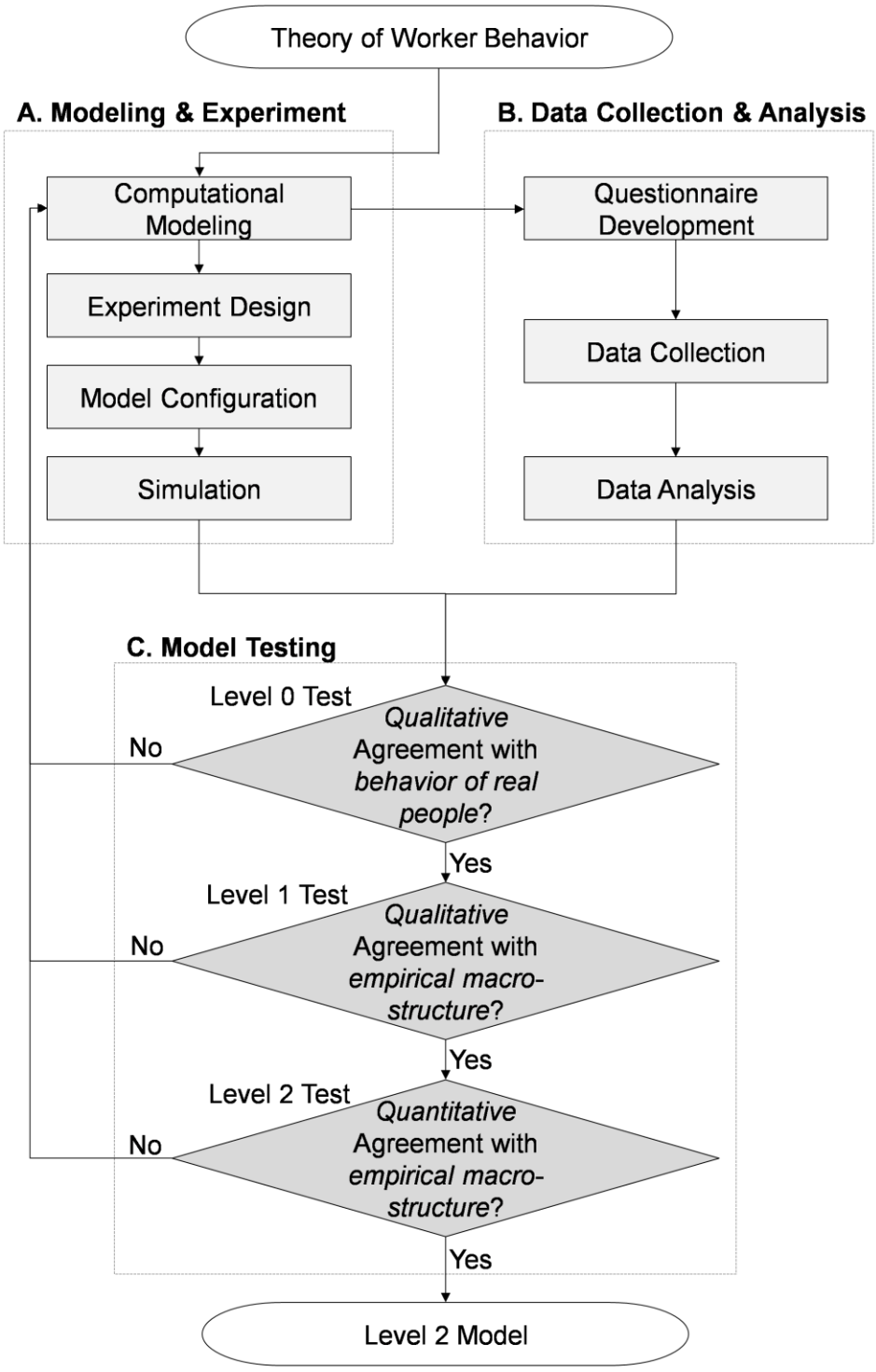



Figure 5.1: Flow chart of proposed methodology

### 5.3.1 Modeling and Experiment

The process of modeling and running an experiment (A in Figure 5.1) begins by creating a general agent-based model based on the existing theories of worker behavior. The goal of this process is to define a set of variables that represent the states of a worker (e.g., a worker's perception, attitude, and behavior) and a set of computational rules for the processes by which the variables change over time.

This process of translating existing theories of social behavior into computational agent behavior rules is not trivial. For example, if a conceptual behavior model simply states that a worker learns from his/her peers how to work safely at a jobsite, a modeler still needs to define the process of "learning from peers" as a mathematical equation or a computational algorithm to use the theory as an agent behavior rule for simulation. Also, more often than not, it is the case that previous research does not provide the entire set of formal specifications of the processes for the human behavior of interest. Then, the simulation researcher would have to develop a new theory to fill the gap. In this respect, Harrison et al. (2007) describe a computational model as an outcome of theoretical development.

After a theory-based, general agent-based model of worker behavior is created, a simulation experiment is designed. In the proposed methodology, designing a simulation experiment means that a set of model parameters that work as an independent variable are identified and the range of model parameter values that will be tested is decided. Applying varied values for model parameters means that many specific agent-based models are created from a general agent-based model by specifying the characteristics of an agent population. In this sense, Page (2005) said that these parameters are like "knobs"; by turning these knobs, a model is specified. In ABMS, model parameters define the characteristics of an agent population. In the studies of worker behavior, therefore, the model parameters of an agent-based model would define the perceptual/attitudinal/behavioral variables of the worker population in the simulation. Then, the simulation outputs generated with these varied settings can show the impact of the parameter on the model behavior (i.e., sensitivity analysis).

Although controversial, unlike traditional experiments hypotheses are not required in simulation experiments (Harrison et al. 2007). This is because the simulation results are determined by a series of computations, and the findings themselves can be seen as theoretical conclusions or predictions (Harrison et al. 2007). Simulation research thus should not be limited

by testing only a few different settings of parameters. As long as the computational capability allows, a researcher should take full advantage of a simulation model by testing various different combinations of settings of parameters (i.e., multidimensional sensitivity analysis). The feasibility of testing a huge range of parameters over a vast range of possible scenarios is one of the greatest advantages of computational models (Epstein 2008).

As a result of this simulation experiment with many different settings of model parameters, a "possibility space" is created (Hulin and Ilgen 2000). A possibility space is an abstract space that has as many dimensions as the number of parameters, and simulation fills out the space with simulation outputs. For example, the dimensions that constitute a possibility space of workers behavior would be the variables that specify a worker population, such as the average level of social adaptation or the average level of conformity to project policies, and the value assigned at each point in the space would be the group-level worker behavior of interest, such as incident rate, absence rate, and productivity.

In stochastic models, the simulation output is different every time even with the exact same setting of parameters. This stochasticity reflects the role of chance in reality. Therefore, a researcher should run a stochastic model multiple times to get a representative model behavior for each setting of parameters. The result of simulations with a stochastic model should be, therefore, a large number of sets of aggregate data representing the model behavior (each set is created by a specific setting of model parameters). For example, if one decides to run a stochastic model 100 times with a setting of parameters, and if there are 4 parameters to test and each parameter is set at 10 different levels, then the artificial organization will run 1 million times (100 x 104 = 106). In this example, the possibility space is conceived as a 4-dimensional space, each of 104 settings (the total number of combinations of parameters) corresponds to a point in the possibility space, and a representative simulation output over the 100 simulation runs is the value assigned at each point in the space.

### 5.3.2 Data Collection and Analysis

It is proposed that the data collection and analysis process (B in Figure 5.1) works in parallel with the modeling and experiment process. This process includes steps like survey questionnaire development, data collection, and data analysis.

In a broad sense, data collection methods can be divided into observations and interviews (including survey questionnaires) (Robson 2002). A major advantage of an observation is its directness, whereas major issues in an observation are that the observer affects the situation, and that it is very time consuming (Robson 2002). On the other hand, interviewing is a quick, flexible way of collecting data; however, it requires considerable skill and experience in developing the data collection tool and interviewing (Robson 2002).

The objective of data collection in the proposed methodology is to measure the perceptual/attitudinal/behavioral variables in the worker behavior simulation model. In this methodology, therefore, it is proposed that a survey questionnaire is used as the data collection tool. This is mainly because many human perceptual or attitudinal variables are not observable, thus a survey questionnaire is conceived as the most viable method of collecting data.

After a survey questionnaire tool is completed, the survey is administered. Then, the collected survey data is used to create an empirically supported agent-based model in three steps, as described in the next section.

### 5.3.3. Model Testing

Once the processes of the simulation experiment and the data collection are complete, the model itself and the model behavior are examined by a series of inquiries (C in Figure 5.1) to ensure the level of performance of an agent-based model.

#### 5.3.3.1 Testing against the "Level 0" Criterion

The question to ask at this step is, "Does the agent behavior rule in the model resemble real construction workers' behavior?" This question is about whether the general agent behavior rules used in the simulation model are a good representation of actual worker behavior. As mentioned earlier, computational modeling almost always involves some theoretical endeavors, thus the behavior rules used in the simulation model need to be supported by empirical evidence even if the model is built based on existing theories of human behavior.

The survey data can help answer the question, because the data can be used for testing the hypotheses that are the theoretical predictions from the behavior rules. If the agent behavior rule to test is "A construction worker's internal standard regarding tardiness is determined by the

perceived social norms about tardiness in his/her workgroup," for example, a hypothesis originating from the behavior rules can be "The level of susceptibility to the social norms is a significant predictor of the level of tardiness." Regression-based methods can be utilized to test this hypothesis. If the hypothesis is accepted by the result of such statistical methods, a modeler can have increased confidence in the behavior rule that is the origin of the hypothesis. The more that hypotheses created from a behavior rule are accepted, the more the confidence with the behavior rules increases.

#### 5.3.3.2 Testing against the "Level 1" Criterion

The question to ask at this next step is, "Does the system-level (i.e., group-level) model behavior resemble real systems' behavior?" In other words, the inquiry at this step is whether or the not the model behavior is in qualitative agreement with the actual data. This examination can be done by comparing the trend in the simulation result with empirical data of actual construction workers' behavior. An example of such a trend would be "Cohesive workgroups tend to have higher levels of productivity than non-cohesive groups."

Again, survey data can be useful for answering this question. To compare the group-level model behavior with survey data, the survey data that were collected from individual workers need to be aggregated and transformed into a group-level data set. This transformation can be achieved by creating group-level variables that represent the distribution of the individual-level variables in a group (e.g., mean or median). Then, these group-level variables are used to see whether the trends in the variables are similar to the simulation model behavior (i.e., group-level behavior in the simulation).

#### 5.3.3.3 Testing against the "Level 2" Criterion

The inquiry at this last step is whether or the not the model behavior is in quantitative agreement with the actual data. This quantitative agreement—i.e., "fitting"—involves matching both means and distributions between simulation data and empirical data. Actually, the task at this step is to select the model parameters that correspond to a specific reality rather than to test the simulation data against the actual data.

As mentioned earlier, the "possibility space" has already been filled out by simulation outputs when the simulation experiment is complete. This means that all possible workers' group-level behavior has been virtually created and recorded in the simulation data. In contrast, only a limited number of cases are included in the empirical data. We can reasonably assume that the possibility space includes all of the cases in the empirical data. Therefore, the task at this step is identifying a point among the numerous points in the possibility space that corresponds to an empirical case.

Once such a point is located in the possibility space, since the dimensions of the possibility space are the model parameters, the coordinate of the point tells us what model parameter values correspond to a specific reality (i.e., characteristics of workers and the workers' group-level behavior). Therefore, the process of identifying the points that correspond to a specific empirical case can be seen as a process of finding the model parameters for a specific agent-based model that can show quantitative agreement with a specific empirical case.

To define a particular empirical case that can be located in the possibility space, the group-level empirical data needs to be categorized and further aggregated. This is analogous to a modeler running a stochastic simulation multiple times to get a representative model behavior for each setting of parameters. Since randomness also exists in real events, to get a representative empirical behavior with a certain setting of perceptual/attitudinal/behavioral variables of worker population, the empirical cases that have a similar worker population should be aggregated. If a model parameter is, for example, the average level of social influence between workers, the actual crews characterized by high, medium, and low levels of social influence between workers based on their response to the survey questionnaire can be categorized, and a representative group-level behavior can be identified for each of the categories. Then, the location of these crews with high, medium, and low levels of social influence between workers in the possibility space can be identified based on the representative group-level behavior.

## 5.4 APPLICATION OF THE PROPOSED METHODOLOGY TO WORKER ABSENTEEISM STUDY

The proposed methodology has been developed based on Axtell and Epstein's (1994) theoretical framework of the different performance levels of agent-based models, and shows how to achieve each performance level using survey data ultimately to realize a high-performance agent-based model to study construction workers' group behavior. This work is, therefore, a theoretical endeavor to flesh out the existing theoretical framework; a more thorough validation of the proposed methodology would require many research cases using this methodology. In this section, a research case is presented as an example to show that the proposed methodology can effectively guide a researcher to create an empirically supported agent-based model to study workers' group behavior using surveys.

The proposed methodology has been used to study construction workers' absenteeism, focusing on the role of social norms in shaping workers' absence behavior. An objective of this study is to create an agent-based model of workers' absence behavior to use the model for conducting simulation experiments to answer "what if" questions and for developing policies/interventions to improve workers' group-level attendance on jobsites.

### 5.4.1 Modeling and Experiment

As a first step, an agent based model was created based on Bandura's (1991) social cognitive theory of self-regulation. This theory allowed us to model workers' absence behavior that would be determined by both formal and informal control in their workgroup. Figure 5.2 is an Agent UML class diagram (Huget 2003). This class diagram in UML represents the relationships between classes and defines the attributes and operations for the classes (Huget 2003), and shows the ontology used in the agent-based model (Livet et al. 2010). As shown in the figure, a workgroup (i.e., agent population) is an aggregate of individual workers. A worker can recognize the absence-related statistics in his/her workgroup, such as group average monthly absence rate and the variations in individuals' absence behavior. Therefore, a worker's variables (such as perceived social norm and personal absence standard) are dependent on the group-level observable phenomena.

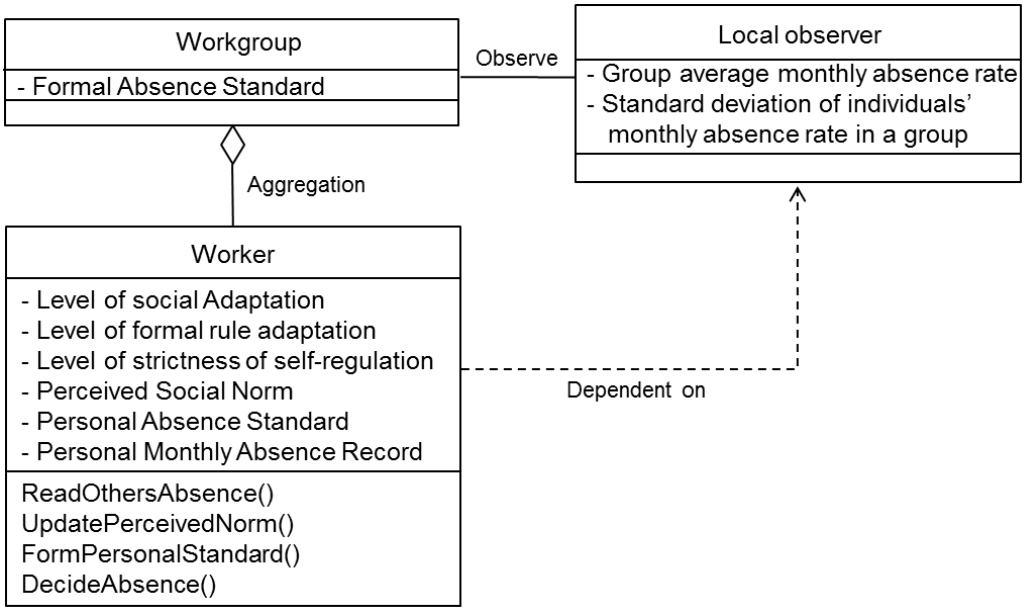



Figure 5.2: Agent UML class diagram of the agent-based model

Workers in the model (i.e., agents) observe others' absence behavior in their workgroup and perceive the average and variance of their peers' absence level. A worker's perceived social norm is updated by others' absence behavior. In this process, the level of social adaptation of a worker affects how quickly the worker accepts the observed others' behavior as a social norm. A worker in the model forms an internal absence standard based on the two sources of information: the perceived formal standard and the perceived norm. In this process, the degree to which a worker is more influenced by the formal rule than the social norm is determined by the level of formal rule adaptation. Lastly, a worker's absence-taking behavior is determined by the worker's internal absence standard and his/her level of strictness of self-regulation.

This agent behavior rule has been transformed into a set of computational rules (see Chapter 4), then the agent-based model has been implemented as a computer algorithm in JAVA using the Java Software Development Kit 7 (JDK 7). A class to represent the "worker" (i.e., worker agent) has been designed, and the agent behavior rules have been implemented as an algorithm to change the variables of an instance of this class (e.g., the attributes of a worker agent) using the JDK.

This study has focused on three attitudinal/behavioral variables: 1) the level of social adaptation, 2) the level of adaptation to formal rules, and 3) the level of strictness in self-regulation. Therefore, the model parameters in the simulation set: 1) the average level of social adaptation, 2) the average level of adaptation to formal rules, and 3) the average level of strictness in self-regulation for the agent population.

After the agent-based model was created, the model was specified with many different settings of the model parameters—the average level of social adaptation, the average level of awareness of formal absence standard, and the average level of strictness in self-regulation—and the model behavior with each setting was observed using simulations. The main research question at this point was whether or not the absence rate would increase/decrease over time if workers were characterized in general by different levels of social adaptation, formal rule adaptation, and strictness of self-regulation. Therefore, the sensitivity of the group absence rate to these three parameters was tested (i.e., multidimensional sensitivity analysis). To do this, the simulation with a setting for model parameters is repeated 100 times (At each run, a different "seed" is used for the random number generator, so the numbers generated for the random variables are all different for each run.), and a representative model behavior for each setting is obtained by averaging the 100 simulation results. This procedure is repeated for all of the possible sets of model parameters to get the model behavior for all of the possible settings. The result of this sensitivity analysis is group average absence rates for each setting for these parameters, and each simulation result corresponds to a point in the possibility space (Each dimension of the possibility space corresponds to a model parameter.).

Figure 5.3 is an illustration of simulation results. Figure 5.3 shows the ranges of the group average absence rate after a crew of 10 workers work together for a year as the social adaptation level and the formal rule adaptation level vary while the strictness level of self-regulation is fixed at a very high level. Therefore, Figure 5.3 can be seen as showing a "slice"—because the strictness level is fixed at a value—of the entire possibility space created by simulation results.

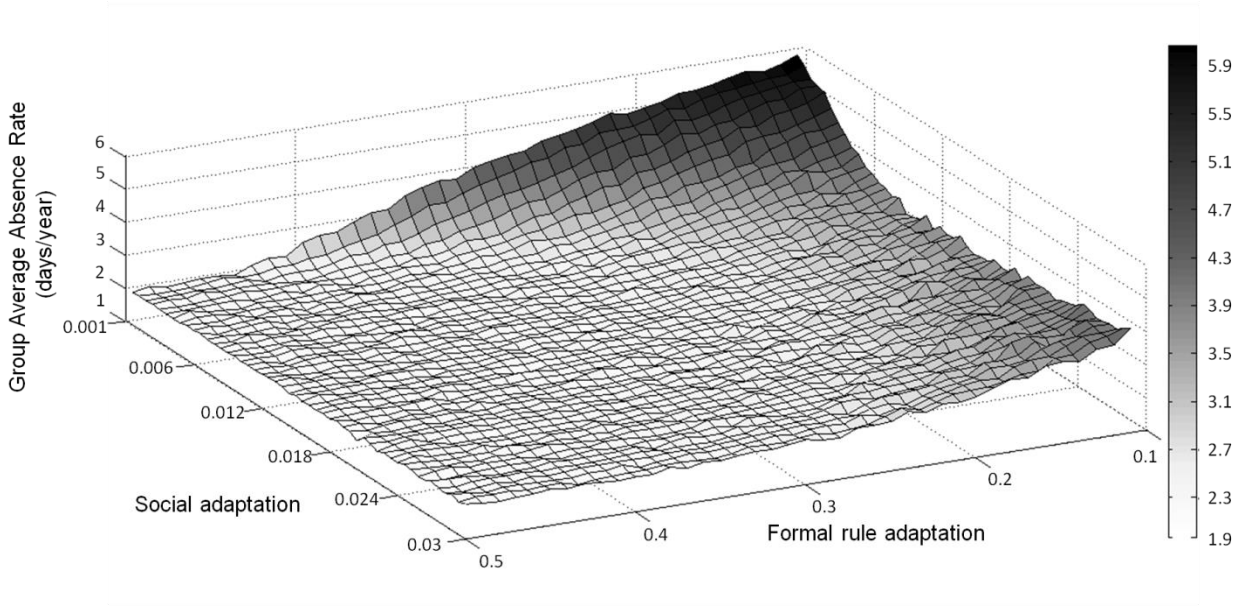



Figure 5.3: Crew average absence rates from the simulation with various settings of the social adaptation and the formal rule adaptation ("Very strict self-regulation" case)

### 5.4.2 Data Collection

In the meantime, a survey questionnaire has been developed and used to collect real world data. The questionnaire was developed to measure workers' perceptual/attitudinal/behavioral variables regarding absence behavior. The questionnaire measures, in particular, how much the respondent perceives the salience of formal rules and the salience of social rules in their workgroups; the questionnaire also asked how many days the respondent has missed work at the current jobsite. To measure the variables, questions that had been validated in the previous employee absence behavior research were used—modified to fit in the context of construction project. Aside from the self-reported absence record item, the other items asked about the respondent's general perception/attitudes toward formal or social rules in their workgroups, so these items would be reusable for other types of worker behavior. Three building construction sites in Ann Arbor, Michigan, were approached for data collection, and a total of 228 valid responses were collected from these sites. More details about the survey questionnaire (e.g., the variables and the questions used to address each variable) and the data collection process can be found in Chapter 3.

### 5.4.3 Model Testing

#### 5.4.3.1 Testing against the "Level 0" Criterion

As a first process in this step, a set of hypotheses was constructed: 1) construction workers' perceptual and attitudinal variables toward formal controls will be significant predictors of their absence behavior, and 2) construction workers' perceptual and attitudinal variables toward social controls will be significant predictors of their absence behavior (see Chapter 3). These hypotheses were the theoretical predictions that can be drawn from the agent behavior rule used in the model. Therefore, if the agent behavior rule was a valid representation of real people's behavior, these hypotheses should be accepted.

Statistical analyses using logistic regression models were performed to test the hypotheses. The results of these analyses supported the agent behavior rules in the model. One of the results was that construction workers who perceive salient social norms in their team would be less likely to be absent from work, which implies that worker absence behavior is indeed under the influence of social controls. Also, it was found that while the social control of absence behavior is effective, when high formal rule awareness is combined, absenteeism can be maintained at an even lower level, which also corresponded to the prediction from the agent behavior rule. Before this study, the impact of an informal, social control mechanism on construction workers' absence behavior could only be speculated, but to our knowledge the impact had never been shown with empirical data. Therefore, these findings significantly increased the confidence with the behavior rules in the simulation model.

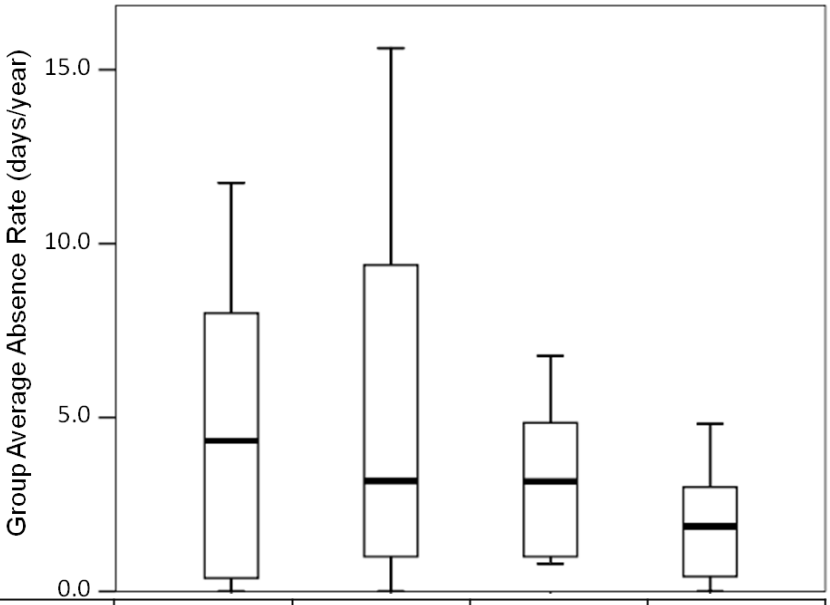
Additionally, the statistical analyses of the survey data revealed that workers' absence behavior is under social influence by observing others and perceiving the salience of social norms rather than the explicit exertion of interpersonal social controls in workgroups. In other words, the survey data supported the idea that those who strongly perceive the salient prototypical behavior in their workgroup tend not to voluntarily take absences. These findings supported the agent behavior rule that agents perceive the social norm by reading and interpreting the mean and standard deviation of absence rates in their primary workgroups (i.e., crews).

#### 5.4.3.2 Testing against the "Level 1" Criterion

At this step, the simulation results were qualitatively compared with the group-level empirical data. In other words, it was attempted to find the patterns that are commonly observed from the simulation results and the empirical data.

To do this, the 29 crews that participated in the survey were categorized into 4 groups according to the level of social adaptation (i.e., "low" and "high" groups) and the level of formal rule adaptation (i.e., "low" and "high" groups). Among the variables used in the survey, the variables that appeared to have the greatest predictive power on the group-level absence rate (i.e., crew average absence rate)—the perceived salience of social norms and anxiety about breaking formal rules—were selected as the categorizing variables. The variable indicating the level of strictness in self-regulation turned out to be unable to distinguish groups' average absence rate, so it was reasonably assumed that the overall level of the strictness in self-regulation is similar across the crews. As a result, all the crew data are categorized into 4 groups, and the distribution of crew average absence rates for each group obtained from the survey data are shown in Figure 5.4.

From the qualitative comparison between the simulation data (as shown in Figure 5.3) and the empirical data (as shown in Figure 5.4), it was found that the order of the groups in terms of the representative average absence rate is the same in the actual data and in the simulation output; the average absence rate of the "low social adaptation and low formal rule adaptation" (LS-LF) group is highest among the groups, the "low social adaptation and high formal rule adaptation" (LS-HF) group and the "high social adaptation and low formal rule adaptation" (HS-LF) group show a similar absence rate at a lower level than the LS-LF group, and the absence rate of the "high social adaptation and high formal rule adaptation" (HS-HF) group is the lowest among the groups. Another interesting observation was a relatively large variance in the average absence rate in the HS-LF group both in the actual data and in the simulation output. This implies that a cohesive crew may end up with a higher average absence than a less cohesive crew if the formal rule adaptation is not strong in the crew. With this comparison of empirical data with simulation outputs, it has been demonstrated that the model behavior exhibits qualitative agreement with the empirical group-level worker behavior.




| Group | LS-LF | HS-LF | LS-HF | HS-HF |
|---|---|---|---|---|
| Median | 4.33 | 3.18 | 3.16 | 1.87 |
| Mean | 4.8 | 5.24 | 3.29 | 1.93 |

Figure 5.4: Crew average absence rate for each group from the survey data

#### 5.4.3.3 Testing against the "Level 2" Criterion

At this step, the model parameters (i.e., the level of social adaptation at the group level, the level of awareness of formal absence standard at the group level, and the level of in self-regulation at the group level) that correspond to each of the four empirical cases (i.e., LS-LF, HS-LF, LS-HF, and HS-HF, as shown in Figure 5.4) were identified. Figure 5.5 shows the locations of each of the 4 empirical cases on the graph of the simulation result. Then, the agent-based models specified with the model parameters could be conceived as the models that show quantitative agreement with a specific empirical case. Therefore, the specific agent-based models can be used to generate the most plausible scenarios in a given situation.

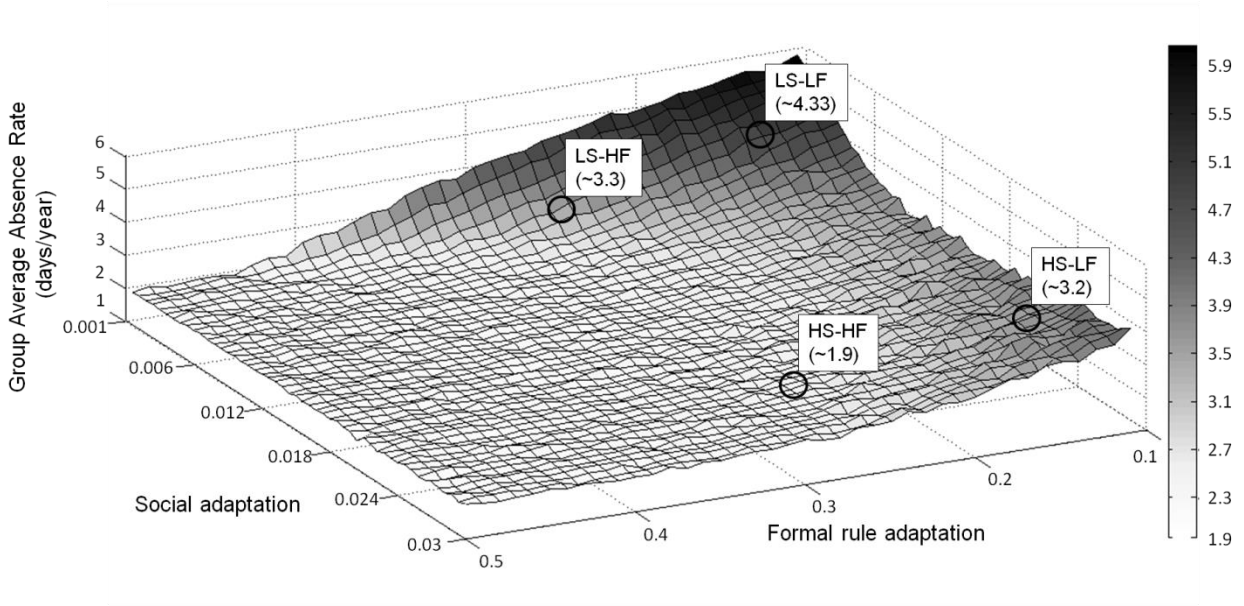



Figure 5.5: Location of each empirical case on the graph of crew average absence rate from the simulation

## 5.5 DISCUSSION

The variables used in the simulation and the variables measured by the survey questionnaire are often not directly convertible due to the difference in the types of variables used. In particular, attitudinal or behavioral variables are most commonly measured by a scale—like a 5-point or 7-point Likert scale—using a survey questionnaire; whereas the attitudinal or behavioral variables used in ABMS may have a specific, operationalized definition to be used in the computational rules. An example of this would be that the impact of others' social influences on one's decision making can be modeled as an abstract, computable level ranging from 0 to 1, while the most viable way to measure this in reality is taking people's responses to the statements like, "I am affected by my friends' opinions in my day-to-day decision making," using scales such as the Likert Scale (e.g., "strongly agree" [5 points] to "strongly disagree" [1 point]).

A benefit of trying to locate the empirical cases in the possibility space created by simulation is that it offers a means of converting responses on the survey questionnaire to model

parameters. In other words, by finding the points in the possibility space that correspond to specific empirical cases, a modeler can have a better idea of the quantitative relationship between an empirical variable and the simulation variable corresponding to the empirical variable, and then, a specific agent-based model supported by empirical data can produce more plausible scenarios and have a higher predictive power.

However, it is important to understand that the actual data may correspond to only a small space in the entire possibility space that is filled out by simulation outputs. Then, extra caution has to be exercised when interpreting the simulation results created with the model parameters that are away from the observed range. As noted earlier, the sweeping simulation (i.e., automatically repeating the simulation for all of the possible sets of model parameters) can produce data that forms a possibility space that represents an exhaustive set of all of the possible consequences that can result from different conditions in the simulation model. However, an empirical case collected by a survey questionnaire represents a specific reality, corresponding to a specific setting of the simulation model. Therefore, it can be said that using the actual data can help increase the confidence with the model behavior, at least, for the part of the entire possibility space that is indicated by the actual data.

It is also important to remember that the testing methods included in the proposed methodology do not directly prove the simulation model or results, but they help increase the confidence in the simulation model. This is because, as Hulin and Ilgen (2000) argued, dynamic processes cannot be confirmed by static data. Instead, static empirical data provides an opportunity to rather indirectly test the theories, assumptions, and models for a dynamical system. As more and more testing results support the agent-based model, the confidence in the model further increases. That is why it is proposed that the empirical data is used for several steps of testing. In this sense, it is possible to add more tests of model performance using empirical data beyond the tests included in the proposed methodology.

## 5.6 CONCLUSIONS

To better utilize the strengths of ABMS and to gain the full benefit that ABMS can offer construction worker group behavior research, this study proposes a methodology in which

ABMS research is integrated with survey data collection and data analysis. It is suggested that this methodology is effective for achieving a Level 2 model for workers' group behavior. More specifically, it is suggested that empirical data collected by a survey questionnaire can be used for ABMS in three steps: 1) testing the behavior rules used in the agent-based model (i.e., testing the modeling assumptions) (i.e., Level 0), 2) demonstrating the model behavior's qualitative agreement with real workers' behavior (i.e., testing the simulation results against real data in a qualitative manner) (i.e., Level 1), and 3) creating a specific agent-based model with the model parameters that correspond to a specific empirical case in a quantitative manner (i.e., Level 2). A specific agent-based model created in this way then can be seen as a scenario generator that corresponds to a specific reality, and can be used to answer "what if" questions, and therefore can be used to develop policies/interventions to improve workers' behavior in a given situation. The proposed methodology has been illustrated by an example of construction workers absenteeism research, and with this example, the effectiveness of the proposed methodology has been demonstrated.

The main contribution of this study is to show how real data on people's perceptions/attitudes/behavior collected by a survey questionnaire can be used to create an empirically supported agent-based model of worker behavior, which will be useful for developing policies/interventions to improve workers' group-level behavior in construction. It is expected that this expansion of knowledge of agent-based modeling research methodology will ultimately contribute to expanding our knowledge of construction workers' group behavior, and of how to better manage the workforce. More specifically, an empirically supported agent-based model for workers' group behavior can be seen as a scenario generator, with which the effectiveness of different policies/interventions to improve worker behavior at the group level can be tested. For example, the agent-based model for worker absence behavior can be used for this purpose. If a construction manager plans to take some managerial actions to improve workers' attendance at the group level, and if he/she can estimate how much workers' perceptions/attitudes toward formal/social rules in the project may be changed by a managerial action, the construction manager can conduct experiments with the simulation model to predict the effectiveness of each option. An example of the "what if" question in this context would be "what level of group average absence can be expected if managers reward exemplary attendance behavior with gifts at every weekly safety meeting for three months?"

Although the proposed methodology in this study is focused on the agent-based models of worker behavior, the methodology can be applied for research in other domains where agent-based modeling is used to model the complex systems behavior of human organizations, and where the model needs to be supported by empirical data of human perceptions/attitudes/behavior. However, the proposed methodology may not be useful for ABMS with variables that cannot be measured by a survey questionnaire, because survey questionnaire has been proposed as the main method to collect empirical data in this methodology.

This study has limitations. A more thorough validation of the proposed methodology would require many research cases using this methodology. Although the proposed methodology's effectiveness was illustrated by an example research project, more application studies are warranted to show more benefits and constraints of the proposed research methodology. Also, more application studies are required to show the actual benefits of empirically supported agent-based models in providing pragmatic assistance to decision makers in developing policies and interventions to improve worker behavior on jobsites.

# CHAPTER 6

# CONSTRUCTION WORKERS' SOCIAL NORMS AND PERSONAL STANDARDS REGARDING ABSENCE INFLUENCED BY THEIR SOCIAL IDENTITIES

## 6.1 INTRODUCTION

Chapters 3, 4 and 5 concluded that construction workers' absence behavior is under the influence of social norms existing in work groups, and currently social norms in the work groups at the sites that were investigated are favorable for management. For empirical evidence, the conclusion explains that the individual workers who perceived salient social norms regarding absence tend to present a low level of absence, and the crews characterized by a high level of social adaption showed a low level of crew-average absence. However, workers' social norms regarding absence were not actually measured in these studies, but just inferred. With this background in mind, this chapter introduces a study to measure and quantify workers' social norms regarding absence.

In addition, this chapter pays substantial attention to the impact of construction workers' social identities on their social norms and personal standards regarding absence. Social identity describes the part of an individual's sense of self that is derived from his/her perceived association with a social group, and each social identity has a set of corresponding norms for behaviors (Akerlof and Kranton 2005). Despite the potential importance of social identity in determining which social norms mostly influence one's personal standards and behavior, research on construction workers' social identities has been very scarce, and therefore more research is warranted. In particular, the findings presented in Chapter 4—that workers' self-categorization is the most plausible mechanism by which workers are influenced by social controls for absence behavior—augment the need for more studies on the impact of workers' social identities on workers' norms and behaviors. This is because self-categorization involves

perceiving and feeling that one is a member of a social group/organization (Turner 1985; Turner et al. 1987; Hogg and Terry 2000).

With these backgrounds in mind, the objective of this study is twofold: (1) to measure and quantify actual construction workers' social norms regarding absence, and (2) to uncover the impact of construction workers' social identification with organizational entities in a construction project on their social norms and personal standards regarding absence using empirical data.

## 6.2 METHOD

### 6.2.1 Data Collection Tool

This study used two distinctive data collection methods. The first method is a survey questionnaire, which is used to measure the cognitive, affective, and evaluative dimensions of construction workers' social identities. The second method is a novel approach to measuring social norms, called the "norm elicitation technique," developed by Krupka and Weber (2013), which is used to measure construction workers' social norms and personal standards regarding absence on a job site. These two distinctive instruments for data collection were incorporated into a paper-based data collection tool and used in this study [see Appendix D: Survey Questionnaire 3 (Construction Workers' Social Identities, and Social Norms and Personal Standards Regarding Absence and Safety)]. The following sections explain the foundations and details of each of the methods.

#### 6.2.1.1 Measuring Social Identities Using Surveys

Construction workers have multiple identities when they work in a construction project, and the degree to which a construction worker identifies him/herself with a group or an organization—such as a crew (workgroup), company, project, etc.—may differ. To address this, the different kinds of groups/organizations with which a worker may identify him/herself when working in a construction project were discussed with construction managers and workers prior to the development of the survey questionnaire, and, as a result, five groups/organizations were identified: crew (workgroup), company, project, trade, and union. Therefore, every survey item

that measures the level of social identification was repeatedly used for the five groups/organization in the questionnaire.

Researchers have empirically identified the different dimensions[5] of social identity, often as the cognitive dimension, affective dimension, and evaluative dimension (Jackson 2002; Ellemers et al. 1999). The cognitive dimension is defined as knowing that one belongs to a group (Tajfel 1981) and categorizing the self as a part of the group, i.e., depersonalization (Turner et al. 1987). The affective dimension involves emotions and feelings about a group (Jackson 2002; Ellemers et al. 1999). Finally, the evaluative dimension involves value connotations that are attached to a group (Tajfel 1981), such as pride and respect (Ellemers et al. 1999). To address this multi-dimensionality of social identity, many researchers have developed a number of survey items to measure each of the dimensions of social identity[6]. Among them, the items that are thought to be applicable to construction workers' identification with the groups/organizations were selected and adapted for this study.

The cognitive dimension of social identity was measured by one pictorial measurement item and two verbal items. Several researchers have developed a graphical measure of the closeness between the self and the group, which consists of several pictures of two increasingly overlapping circles, labeled 'Self' and 'Group' (i.e., spatial metaphors to describe the relation between a person and a group) (Aron et al. 1992; Bergami and Bagozzi 2000; Bagozzi and Lee 2002; Schubert and Otten 2002). The pictorial measurement item used in this study was proposed by Bergami and Bagozzi (2000) to measure cognitive organizational identification (i.e., self-categorization) as the perceived overlap between one's own identity and the identity of the organization. Figure 6.1 shows an example of the item that was used in this study. As shown in this figure, respondents are asked to select an option that best describes the level of overlap between one's own identity and the group's identity among eight options meaning 'Far apart', 'Close together but separate', 'Very small overlap', 'Small overlap', 'Moderate overlap', 'Large

[5] Some researchers prefer "components" to "dimensions." See: Ellemers, N., Kortekaas, P., and Ouwerkerk, J. W. (1999). Self-categorisation, commitment to the group and group self-esteem as related but distinct aspects of social identity. European journal of social psychology, 29(2-3), 371–389.

6 Jackson, J. W. (2002). "Intergroup attitudes as a function of different dimensions of group identification and perceived intergroup conflict." Self and Identity, 1(1), 11–33, provides an inclusive list of the survey items that are developed as an instrument for measuring each of the multiple dimensions of social identity. However, the categorization of the survey items used in this paper may be controversial.

overlap', 'Very large overlap', and 'Complete overlap'. In addition to this item, two items proposed and validated by Mael and Ashforth (1992) to measure the organizational identification were adapted and used. The two items that were selected and adapted in this study are as follows: (for with-crew identification items) 'When someone criticizes my crew, it feels like I am being criticized' and 'When I talk about my crew, I usually say "we" rather than "they"'. For each item, responses were recorded on a 7-point Likert scale (-3 = strongly disagree; -2 = disagree; -1 = somewhat disagree; 0 = neither disagree nor agree; 1 = somewhat agree; 2 = agree; 3 = strongly agree).

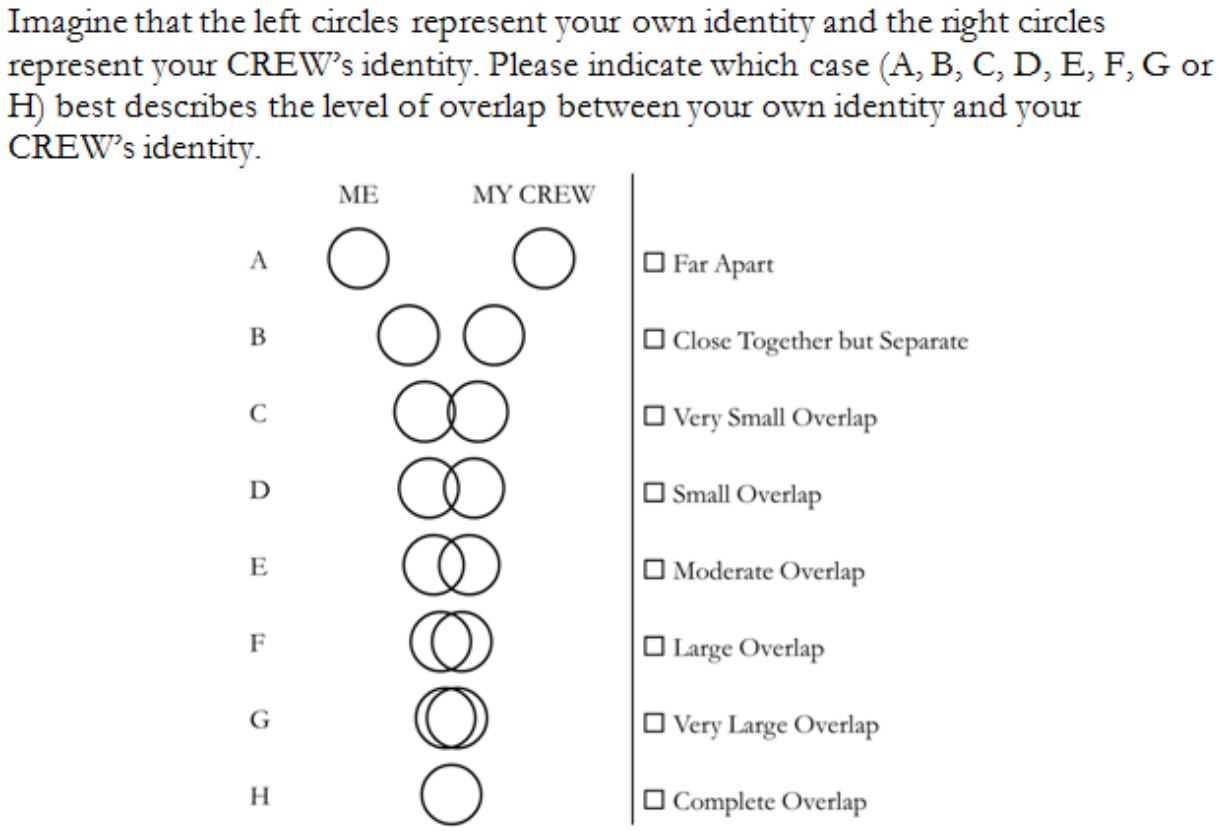



Figure 6.1: An example of pictorial measurement item for the cognitive dimension of social identity

The affective dimension of social identity was measured by two verbal items. Specifically, one of them measures the extent to which the respondent is satisfied with being a member of his/her group, and the other measures how attached the respondent is to the group (Phinney 1992; Ellemers et al. 1999; Bergami and Bagozzi 2000; Bagozzi and Lee 2002; Jackson 2002; Heere and James 2007). The two items that were selected and adapted in this study are as follows: (for with-crew identification items) 'I am happy to be a member of my crew' and 'I am attached to my crew'. For each item, responses were recorded on a 7-point Likert scale (-3 = strongly disagree; -2 = disagree; -1 = somewhat disagree; 0 = neither disagree nor agree; 1 = somewhat agree; 2 = agree; 3 = strongly agree).

The evaluative dimension of social identity was measured by two verbal items. Specifically, these items measure how highly the respondent evaluates his/her group (Phinney 1992; Ellemers et al. 1999; Bergami and Bagozzi 2000; Jackson 2002; Heere and James 2007). Several researchers have provided concepts related to this measure using similar but distinctive terms, such as the value connotation of a particular group membership (Taifel 1981), group self-esteem (Ellemers et al. 1999), or organization prestige (Bergami and Bagozzi 2000). The two items that were selected and adapted in this study are as follows: (for with-crew identification items) 'I have respect for my crew' and 'I am proud to be a member of my crew'. For each item, responses were recorded on a 7-point Likert scale (-3 = strongly disagree; -2 = disagree; -1 = somewhat disagree; 0 = neither disagree nor agree; 1 = somewhat agree; 2 = agree; 3 = strongly agree).

Last, one item was added to the items regarding with-crew identification, and it is as follows: 'I think my foreman is one of us'. This item measures the extent to which the respondent identifies him/herself with the foreman, who is the leader of the group in which he/she spends most of his/her time at work. Therefore, this measure can be seen as an additional item to measure the cognitive dimension of social identity with the crew, and is used to specifically measure one's identification with the leader of his/her workgroup. Responses were recorded on a 7-point Likert scale (-3 = strongly disagree; -2 = disagree; -1 = somewhat disagree; 0 = neither disagree nor agree; 1 = somewhat agree; 2 = agree; 3 = strongly agree).

#### 6.2.1.2 Identifying Social Norms Using a Coordination Game ("Norm Elicitation Technique")

Many researchers have tried to measure the social norms of groups in several ways, and among them the most common is using surveys. Although a survey has the strengths of cost-effectiveness and scalability, it is often doubtful that the respondents reveal their true belief and preferences, especially when the questions ask people's opinions or feelings about sensitive matters[7]. Also, there is the problem of reliability when a questionnaire asks about complicated things, and so requires the respondent to put in a significant intellectual effort to recollect/retrieve/re-construct information in his/her head. All of these shortcomings of surveys make it difficult to effectively measure true collectively held norms regarding people's behaviors using surveys.

In addition, it has been argued that norms collectively held by a group (i.e., social norms) and personal standards need to be clearly distinguished, and a data collection tool to measure social norms should be capable of precisely collecting the collectively held norms, which need not be the same as personal standards (Burks and Krupka 2012). Further, it would be useful if the social norms shared by a group's members and the norms that are desired by the member of out-groups can be separately measured (Burks and Krupka 2012), because this separation can reveal any misalignment of norms to resolve between different groups in an organizational setting.

With these backgrounds in mind, Krupka and Weber (2013) developed a novel approach to measuring social norms in organizations using hypothetical vignettes and the coordination game structure, called the "norm elicitation technique." In this approach, a vignette describes a situation with which participants will be familiar because it is a situation that they have observed or experienced in the workplace. A vignette is given along with a range of actions a person might choose to take in response to the situation. Then, participants are asked to rate each alternative action for each vignette using a 4-point Likert scale, each of which means 'Very inappropriate', 'Somewhat inappropriate', 'Somewhat appropriate', and 'Very appropriate'. Participants are asked not only to evaluate the actions using their personal opinions, but also using their understanding of what a typical member of their team would think about the actions. To facilitate

[7] Burks and Krupka's paper (2012) "Identifying Norms and Normative Expectations Within a Corporate Hierarchy." Management Science, INFORMS, 58(1), 203–217, provides a nice summary of the approaches that have been used to measure social norms, including surveys and observation, each of which has been preferred in a different discipline, such as sociology and economics. The paper also discusses the strengths and weaknesses of these approaches.

this, participants are asked to repeat the rating task several times for each vignette. On the first pass, participants are asked to match their appropriateness evaluations to those of a typical member of their group, and they are told that their responses will be compared with the responses of a randomly selected respondent from the same group, and that they will be paid when their responses match the responses of the target respondent. On the second pass, the same vignette and the same list of alternative actions are used, but participants are asked to match their appropriateness evaluations to those of a typical member of an out-group (i.e., the group with which one does not identify). This matching task also involves incentives, and the incentives encourage participants to share their beliefs about the expectations held by the out-group members. On the third and final pass, participants are asked to provide their personal opinions (i.e., their appropriateness evaluation by their own personal standards) without trying to match their responses with anybody else's.

This study adapted and used this technique for identifying social norms of construction workers' work groups (i.e., crews) and personal standards regarding absence. As a first step to do this, a list of behaviors regarding absence with which construction workers will be familiar was developed. To do this, a focus group discussion—with three construction managers—was used. Table 6.1 shows the final list of behaviors regarding absence to use in this study, sorted in order of appropriateness as identified by the focus group's ex-ante ranking. (The behaviors were randomly re-sorted in the actual data collection tool, and therefore these behaviors were not presented in this order to participants.)

Table 6.1. List of behaviors regarding absence used in the questionnaire

| | Behaviors (Situation: James is a member of your crew, and he has been working with you since your crew started to work at your project site) |
|---|---|
| Absence Behavior 1 | James takes absence without a notice when he does not want to work. |
| Absence Behavior 2 | James takes absence when he does not want to work, and he informs his absence to his foreman early in the morning. |
| Absence Behavior 3 | James takes absence when he has a hangover, and he informs his absence to his foreman early in the morning. |
| Absence Behavior 4 | James takes absence when he has minor illness such as colds and headaches, and he informs his absence to his foreman early in the morning |
| Absence Behavior 5 | James takes absence when he has some personal situation like sickness of a family member, and he informs his absence to his foreman early in the morning |
| Absence Behavior 6 | James takes absence when he feels too sick to work well, and he informs his absence to his foreman early in the morning. |
| Absence Behavior 7 | James does not take absence at all unless he has an emergent situation like severe injury or sickness. |

Workers are asked to provide their evaluation of these behaviors twice (a simplified version of the norm elicitation protocol used by Burks and Krupka (2012)). On the first pass, participants are asked to match their appropriateness evaluations with those of a typical member of their crew; on the second pass, they are asked to provide their personal opinions. The elicitation of social norms is facilitated by monetary incentives for participants in this experiment. Participants are informed that a subset of all of the participants in this experiment will be randomly selected, and their responses on the first pass will be compared with the responses of another randomly selected participant from the same crew; they will be paid ($10) for each of their matching responses. This incentivizing method is clearly stated in the questionnaire.

Construction managers (of the general contractor) are also asked to provide their evaluation of the behaviors twice, but in a slightly different manner. On the first pass for managers, participants are asked to match their appropriateness evaluations with those of a typical construction worker working at the site, and on the second pass, they are asked to match

their appropriateness evaluations with their fellow managers at the site. The construction manager participants are informed that their responses on the first pass (i.e., the matching task) will be compared with the responses of a randomly selected worker participant, and their responses on the second pass will be compared with a randomly selected manager participant. Manager participants have the same chance as workers to be selected, and are paid for the matching tasks in the same manner as worker participants.

If the participant is a construction worker, and his/her responses are matched with another worker, then this technique can elicit the construction worker's belief about the normative evaluations made by his crew members, and when aggregated, a consensus in this belief can be seen as the social norm existing in a crew (Burks and Krupka 2012). If the participant is a construction manager, his/her responses matched with the responses of a worker participant show the manager's belief about the norms held by construction workers at the site, and when aggregated, a consensus in this belief can be seen as managers' common belief about the social norms actually held by construction workers at their site. Likewise, managers' responses matched with the responses of another manager can be seen as managers' desired norm for worker behavior (Burks and Krupka 2012).

### 6.2.2 Participants

For data collection, a building construction site ("Site A") in Ann Arbor, Michigan, was approached. Site A was a large-sized engineering research complex building construction site located on the University of Michigan campus. At the time the site was contacted, the project was in the final phase of construction, and therefore many on-going processes dealt with the finishing work. The number of workers operating daily at this site was about 40–50 with some variation.

With an agreement with the construction managers to conduct the survey at this site, construction workers to participate in the survey were recruited. The purposes and processes of this survey were explained to the foremen in a weekly meeting at the site, and the foremen verbally advertised the survey to their team members. In this way, the construction workers were informed when and where the survey was going to take place, and the workers voluntarily participated in our survey. As a result, a total of 26 workers (of 9 different trades and of 10

different companies) participated in the survey. In addition to this, the 3 construction managers of the general contractor participated in the survey

### 6.2.3 Procedure

The survey was taken during crews' breaks during work hours (e.g., morning break, lunch time, afternoon break) to avoid interrupting the construction work. Construction workers voluntarily visited the area where the survey administrators were, and participated in the survey. When a worker or workers arrive at the survey place, the survey administrators briefly introduced the survey's purpose and processes, including the information about the incentives. Then, the consent form, the survey questionnaire, and pens were provided to the participants. The survey administrators gave an instruction for a section, then participants provided their response for the section, and this step was repeated for every section of the questionnaire (Manager participants filled out only the sections for the norm elicitation, but not the section for the social identification because it is not applicable to managers.). In total, the survey took approximately 20–25 minutes to fill out. Participants who finished the survey were paid a $10 participation fee.

## 6.3 RESULTS AND DISCUSSION

This section presents the results of the data analyses. Firstly, the results from the data collected by the norm elicitation technique are presented, and then the results on the relationship between workers' social identification and their social norms and personal standards follow.

### 6.3.1 Workers' Social Norms and Managers' Desired Norms Regarding Worker Absence

The participants' evaluations of the behaviors were converted into numerical scales: -1, -1/3, 1/3, and 1, for "Very inappropriate," "Somewhat inappropriate," "Somewhat appropriate," and "Very appropriate," respectively. Tables 6.2 and 6.3 present a summary of the evaluations for the absence behaviors provided by the workers and the managers, respectively. Each row in these tables corresponds to an absence behavior that was evaluated by the participants, and these tables separately summarize the participants' evaluations made during the first pass and the second pass on the absence behaviors (Workers' evaluations during the first pass and the second

pass are labeled as “Workers’ social norms” and “Workers’ personal standards” in Table 6.2, and managers’ evaluations during the first pass and the second pass are labeled as “Managers’ desired norms” and “Managers’ belief about workers’ social norms” in Table 6.3.) The columns of these tables present the mean (M) and the standard deviation (SD) of the responses, and then the number of responses for each option (N(-1), N(-1/3), N(1/3), and N(1)), for each behavior in the list.

Table 6.2. Workers’ evaluations summary for the absence behaviors

| Behaviors | Workers’ social norms | | | | | | Workers’ personal standards | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | SD | N (-1) | N (-1/3) | N (1/3) | N (1) | M | SD | N (-1) | N (-1/3) | N (1/3) | N (1) |
| Absence Behavior 1 | -0.97 | 0.13 | **25** | 1 | 0 | 0 | -1 | 0.0 | **26** | 0 | 0 | 0 |
| Absence Behavior 2 | -0.67 | 0.62 | **19** | 3 | 2 | 2 | -0.85 | 0.38 | **22** | 2 | 2 | 0 |
| Absence Behavior 3 | -0.51 | 0.54 | **12** | 10 | 3 | 1 | -0.77 | 0.32 | **17** | 9 | 0 | 0 |
| Absence Behavior 4 | -0.13 | 0.48 | 4 | 10 | **12** | 0 | 0.0 | 0.50 | 3 | 8 | **14** | 1 |
| Absence Behavior 5 | 0.59 | 0.37 | 0 | 1 | **14** | 11 | 0.56 | 0.45 | 0 | 3 | 11 | **12** |
| Absence Behavior 6 | 0.44 | 0.44 | 0 | 4 | **14** | 8 | 0.49 | 0.38 | 0 | 2 | **16** | 8 |
| Absence Behavior 7 | 0.95 | 0.18 | 0 | 0 | 2 | **24** | 0.92 | 0.21 | 0 | 0 | 3 | **23** |

*Note. The numbers in bold type are the mode of responses for each behavior.*

Table 6.3. Managers' evaluations summary for the absence behaviors

| Behaviors | Managers' desired norms | | | | | | Managers' belief about workers' social norms | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | SD | N (-1) | N (-1/3) | N (1/3) | N (1) | M | SD | N (-1) | N (-1/3) | N (1/3) | N (1) |
| Absence Behavior 1 | -1 | 0.0 | **3** | 0 | 0 | 0 | -1 | 0.0 | **3** | 0 | 0 | 0 |
| Absence Behavior 2 | -1 | 0.0 | **3** | 0 | 0 | 0 | -0.56 | 0.31 | 1 | **2** | 0 | 0 |
| Absence Behavior 3 | -1 | 0.0 | **3** | 0 | 0 | 0 | -1 | 0.0 | **3** | 0 | 0 | 0 |
| Absence Behavior 4 | -0.11 | 0.31 | 0 | **2** | 1 | 0 | -0.33 | 0.0 | 0 | **3** | 0 | 0 |
| Absence Behavior 5 | 0.78 | 0.31 | 0 | 0 | 1 | **2** | 0.78 | 0.31 | 0 | 0 | 1 | **2** |
| Absence Behavior 6 | 1 | 0.0 | 0 | 0 | 0 | **3** | 0.56 | 0.31 | 0 | 0 | **2** | 1 |
| Absence Behavior 7 | 1 | 0.0 | 0 | 0 | 0 | **3** | 1 | 0.0 | 0 | 0 | 0 | **3** |

*Note. The numbers in bold type are the mode of responses for each behavior.*

The fact that the modal response for any behavior received more than 46% of the responses—and for most of the behaviors the modal response received more than 60% of the responses when the task is matching their responses with the responses of a peer—showed that there is a general consensus in the belief about the normative evaluations made by the members of their groups, whether it is workers or managers. In particular, the fact that a relatively high level of consensus about their peers' normative evaluations exists among the workers at this site means that to some extent the crews at this site have similar social norms when it comes to which absence behavior is acceptable and which is not—although the norms in the crews may differ when a fine comb is applied. (Actually, when the sample was further separated by the crew, slightly different levels of appropriateness evaluations were observed.)

As expected, the participants' evaluations for the more extreme behaviors—such as Absence Behaviors 1 and 7—are much more convergent than the evaluations for the behaviors in

between. This tells us that the participants perceived some level of ambiguity in the appropriateness of those less extreme behaviors (and, probably, these less extreme behaviors may be the ones that the participants can more often observe/experience). However, the evaluations for the less extreme behaviors that are still convergent tell us that social norms would guide individuals' behavior in a way to reduce such ambiguity.

Tables 6.2 and 6.3 show a general pattern of alignment, but also a measurable difference, between workers' social norms and managers' desired norms regarding absence. The mode of responses for four among eight behaviors was identical, while the mode of responses for the other three behaviors was one option away from each other. To visualize the degree of alignment between workers' social norms and managers' desired norms, the mean of the responses from these two groups for each behavior was plotted, as shown in Figure 6.2. Then, each line in this figure can be seen as a profile of norms held by workers or managers. As shown in this figure, workers' social norms and managers' desired norms regarding worker absence behavior shows a complete agreement as to valence (i.e., whether a behavior is in the "appropriate" side or in the "inappropriate" side). Both groups agreed that absence behaviors 1–4 are considered inappropriate, whereas behaviors 5–7 are considered appropriate. However, the two groups show some disagreement in the intensity of the evaluations. For absence behavior 3, "James takes absence when he has a hangover, and he informs his foreman of the absence early in the morning," for example, all of the managers said that this behavior is "very inappropriate," whereas workers were more likely to say that it is just "somewhat inappropriate." This shows that there is a subtle but measurable misalignment between workers' social norms and managers' desired norms about absence caused by alcohol.

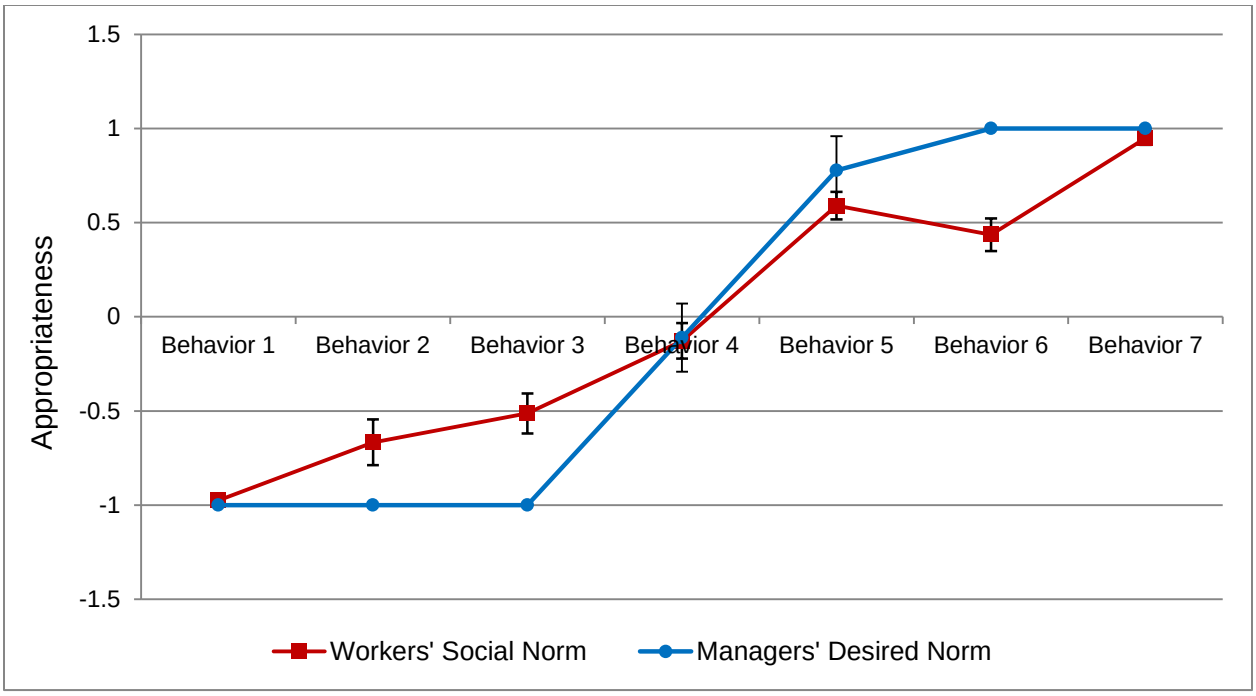



Figure 6.2. Workers' social norms and managers' desired norms regarding worker absence behavior (The means with standard errors)

Another interesting, measurable misalignment between workers' social norms and managers' desired norms was observed for absence behavior 6, "James takes absence when he feels too sick to work well, and he informs his foreman of the absence early in the morning." All of the managers said that this behavior is "very appropriate" while a majority of workers said that it is just "somewhat appropriate"; 4 workers even said that it is "somewhat inappropriate." This result shows that many workers believe that being sick may not be an excuse for an absence that his/her peers approve of, although managers think that it is a perfectly OK excuse.

Although measurable misalignment between workers' social norms and managers' desired norms was observed for specific behaviors, managers were found to have a fair understanding of workers' social norms. Figure 6.3 compares workers' social norms with managers' belief about workers' social norms. As shown in this figure, the average distance between the two lines is much smaller than that of Figure 6.2. This supports the idea that the social norms regarding absence actually exist in the workers' group, and they are even visible to out-group members such as managers—although it may not be as clear as to the in-group members.


Figure 6.3. Workers' social norms and managers' belief about workers' social norms regarding worker absence behavior (The means with standard errors)

In Figure 6.2, the areas of the two polygons created by the misalignment between the line representing workers' social norms and the line representing managers' desired norms are almost the same. Workers have a little more generous norm about worker absence behavior than managers do—like in the case of absence behaviors 2 (absence when not wanting to work) and 3 (absence when having a hangover)—but workers have a norm that is more critical of absence caused by sickness than managers. The fact that the two polygons present about the same area implies that workers' actual absence level is likely to be not too different from the absence level desired by managers. In other words, workers' social norms regarding absence are not too distant from what is desired by managers, although there is some misalignment when it comes to specific absence behaviors. This interpretation may lend an explanation for the low absence level at this site where no stringent formal rules regarding worker absence are exercised; in the absence of stringent formal rules, social norms can guide people's behavior toward a favorable direction and can be helpful for the management.

### 6.3.2 Relationship between Workers' Social Identification and Norm Alignment

As a next step, the responses to the questionnaire items for measuring worker's social identification were analyzed. Among the questionnaire items, the items "When someone criticizes my …, it feels like I am being criticized" and "When I talk about my …, I usually say 'we' rather than 'they'" are thematically very similar, thereby merged into a measure for, namely, With-Group Self-Categorization. Likewise, the items "I have respect for my …" and "I am proud to be a member of my …" were merged to measure together, namely, Group Membership Pride. The items that were merged together to measure a variable showed a high level of inter-items consistency, except for With-Project Self-Categorization. Therefore, the two questionnaire items used to measure the level of self-categorization with the project were not merged but treated as separate variables in the rest of the analysis. As a result, the total number of measures for workers' social identification used for the rest of the analysis was 27. Table 6.4 present means, standard deviations, and Cronbach's α (only for those measures that are made by combining more than one item) of all of the measures after the treatments.

Table 6.4. Descriptive statistics of social identification measures: means (M), standard deviations (SD), and Cronbach's α

| Target group | Measures | Scale | M | SD | α |
|---|---|---|---|---|---|
| Crew | Crew-Self Identity Overlap | 8 point (1–8) | 4.77 | 1.39 | na |
| | With-Crew Self-Categorization | 7 point (-3–3) | 1.75 | 1.41 | 0.73 |
| | With-Foreman Identification | 7 point (-3–3) | 1.65 | 1.60 | na |
| | Attachment to Crew | 7 point (-3–3) | 1.35 | 1.52 | na |
| | Crew Membership Satisfaction | 7 point (-3–3) | 1.92 | 1.35 | na |
| | Crew Membership Pride | 7 point (-3–3) | 2.27 | 0.91 | 0.89 |
| Company | Company-Self Identity Overlap | 8 point (1–8) | 4.38 | 1.47 | na |
| | With-Company Self-Categorization | 7 point (-3–3) | 1.31 | 1.75 | 0.94 |
| | Attachment to Company | 7 point (-3–3) | 1.65 | 1.02 | na |
| | Company Membership Satisfaction | 7 point (-3–3) | 2.15 | 0.83 | na |
| | Company Membership Pride | 7 point (-3–3) | 2.25 | 0.89 | 0.94 |
| Project | Project-Self Identity Overlap | 8 point (1–8) | 3.54 | 1.84 | na |
| | With-Project Self-Categorization (1) | 7 point (-3–3) | -0.23 | 1.70 | na |
| | With-Project Self-Categorization (2) | 7 point (-3–3) | 0.54 | 1.73 | na |
| | Attachment to Project | 7 point (-3–3) | 0.77 | 1.75 | na |
| | Project Membership Satisfaction | 7 point (-3–3) | 1.81 | 1.47 | na |
| | Project Membership Pride | 7 point (-3–3) | 1.83 | 1.56 | 0.95 |
| Trade | Trade-Self Identity Overlap | 8 point (1–8) | 5.85 | 1.69 | na |
| | With-Trade Self-Categorization | 7 point (-3–3) | 1.90 | 1.48 | 0.89 |
| | Attachment to Trade | 7 point (-3–3) | 2.08 | 1.41 | na |
| | Trade Membership Satisfaction | 7 point (-3–3) | 2.31 | 0.93 | na |
| | Trade Membership Pride | 7 point (-3–3) | 2.60 | 0.76 | 0.95 |
| Union | Union-Self Identity Overlap | 8 point (1–8) | 5.00 | 2.26 | na |
| | With-Union Self-Categorization | 7 point (-3–3) | 1.44 | 1.73 | 0.89 |
| | Attachment to Union | 7 point (-3–3) | 1.54 | 1.84 | na |
| | Union Membership Satisfaction | 7 point (-3–3) | 2.08 | 1.29 | na |
| | Union Membership Pride | 7 point (-3–3) | 2.02 | 1.65 | 0.92 |

*Note. na = not available.*

At this point, it is worth mentioning that it was found from this descriptive analysis that workers have a sense of membership (i.e., self-categorization) with their trade (M = 1.90), crew (M = 1.75), union (M = 1.44), company (M = 1.31), and the project (M = -0.23 for the self-categorization measure (1) and M = 0.54 for the self-categorization measure (2)), to a varying degree, and that the strength of the sense of membership is in the order listed here. This implies that workers tend to feel more strongly that they are members of their trade than that they are members of their company or project. In particular, the level of workers' self-categorization is low, which reaffirms the supposition that construction workers are mostly individualistic and view themselves as individual contractors and not as organizational members of a project. Although not exactly, the other dimensions of social identity—such as the affective dimension and the evaluative dimension—tend to follow this general pattern observed in the level of self-categorization with regard to the strength of social identities. This observation is aligned with the proposition that the three dimensions of social identity correlate with one another.

In the meantime, three different misalignment measures were defined to quantify how distant an individual's personal standards are from the social norms held by the groups to which he/she belongs. Each of the measures quantifies (1) the misalignment between a worker's personal standards and his/her crew's social norms, (2) the misalignment between a worker's personal standards and the social norms held by workers in general at the site, and (3) the misalignment between a worker's personal standards and managers' desired norms. These three measures, $M_i^{CSN,PS}$ (the misalignment between person *i*'s personal standards and the social norms of the crew that person *i* belongs to), $M_i^{WSN,PS}$ (the misalignment between person *i*'s personal standards and the social norms held by workers in general at the site), and $M_i^{MDN,PS}$ (the misalignment between person *i*'s personal standards and managers' desired norms), are mathematically defined as follows[8]:

$$M_i^{CSN,PS} = \frac{\sum_j \left| \overline{Evaluation_j}^{CSN_i} - Evaluation_j^{PS_i} \right|}{\sum_j}, \quad (1)$$

[8] These equations were adapted from Burks and Krupka (2012)'s measures.

$$M_i^{WSN,PS} = \frac{\sum_j \left| \overline{Evaluation_j}^{WSN} - Evaluation_j^{PS_i} \right|}{\sum_j}, \quad (2)$$

$$M_i^{MDN,PS} = \frac{\sum_j \left| \overline{Evaluation_j}^{MDN} - Evaluation_j^{PS_i} \right|}{\sum_j}, \quad (3)$$

where $\overline{Evaluation_j}^{CSN_i}$ is the average of person *i*'s crew members' evaluations about the behavior, *j*; $\overline{Evaluation_j}^{WSN}$ is the average of all of the workers' evaluations about the behavior, *j*; $\overline{Evaluation_j}^{MDN}$ is the average of the managers' evaluations about the behavior, *j*; and $Evaluation_j^{PS_i}$ is person *i*'s personal standards about the behavior, j.

Then, correlation analysis was performed to see the relationship between these misalignment measures and the social identification measures, and the result showed that only the misalignment measure $M_i^{MDN,PS}$ has significant correlations with social identification measures. As shown in Table 6.5, the misalignment between ones' personal standards and managers' desired norms was significantly correlated with three social identification measures, Project Membership Satisfaction, Project Membership Pride, and Trade-Self Identity Overlap (2-tail test, $p < 0.05$). The correlation coefficient for Project Membership Satisfaction and Project Membership Pride was negative, whereas the correlation coefficient for Trade-Self Identity Overlap is positive. This result tells us that a worker who has a high level of satisfaction about his/her membership with a project and feels proud to be a member of the project—actually Project Membership Satisfaction and Project Membership Pride have a high level of correlation, $r=0.83$, $p < 0.01$—tends to have personal standards similar to the managers' desired norms. Whereas a worker who thinks his/her identity greatly overlaps with the identity of his/her trade tends to have personal standards distant from the managers' desired norms regarding absence. This suggests that the social norms existing in some trades may be distant from the norms desired by managers, and those who have a strong perception that their identity overlaps with the identity of their trade would more likely follow the social norms of their trade while working at a site. However, if the worker is very proud of and feels happy with his/her membership in the project, the worker may be more willing to accept the managers' desired norms as his/her own personal standards. In other words, if a worker's affective and/or evaluative social identification with the project increases, the worker's identification with the trade may be reduced, and the

worker's personal standards regarding absence may have a higher chance of being assimilated to the norms desired by the managers.

Table 6.5. Significant correlations between the misalignment measure, $M_i^{MDN,PS}$, and social identification measures

| Measures | | Project Membership Satisfaction | Project Membership Pride | Trade-Self Identity Overlap |
|---|---|---|---|---|
| $M_i^{MDN,PS}$ | Pearson Correlation | -0.44 | -0.40 | 0.41 |
| | Significance level (2-tailed) | 0.023 | 0.041 | 0.036 |

*Note. N=26*

## 6.4 CONCLUSIONS

This study began with two objectives: (1) to measure and quantify actual construction workers' social norms regarding absence, and (2) to uncover the impact of construction workers' social identification with organizational entities in a construction project on their social norms and personal standards regarding absence. To achieve these objectives, two research methods were adopted. One was a survey questionnaire. This method was used to measure construction workers' social identification measures, i.e., the cognitive, affective, and evaluative dimensions of social identities that a worker may have when he/she works at a construction site—such as crew (workgroup), company, project, trade, and union. The other method was the norm elicitation technique, which was originally developed by Krupka and Weber (2013). This method was adapted to the field setting, so that it could be used to measure construction workers' norms at construction sites. In particular, 7 different hypothetical yet plausible absence behaviors—which show varying degrees of absence behavior that a construction worker may engage in—were developed through a discussion with construction managers and workers, and then presented to participants in the experiment. In this experiment, participants were asked to evaluate these behaviors twice. If the participant was a worker, the participant was firstly asked

to try to match his/her responses to the responses of another member of his/her crew; the participant was told that he/she would be paid for any matching responses. The participant was then asked to provide his/her own opinions about the behaviors. If the participant was a manager, the participant was firstly asked to try to match his/her responses to the responses of a randomly selected construction worker at the site, and secondly asked to match his/her responses with the responses of other managers; the manager was told that he/she would be paid for any matching responses.

Using the norm elicitation technique, construction workers' social norms and personal standards, managers' belief about workers' social norms, and managers' desired norms regarding worker absence behavior at a construction site were elicited, and they were visualized as a profile represented by a line connecting 7 points in the plots (e.g., the lines in Figures 6.2 and 6.3). Analyses on the differences between workers' social norms and managers' desired norms revealed that there is a general pattern of alignment, but also a measurable difference, between workers' social norms and managers' desired norms regarding absence. It was also found that workers' social norms regarding absence are not too distant from what managers desire, although there is some misalignment when it comes to some specific absence behaviors. This relatively favorable social norms existing among workers at this site may be the reason why a low absence level was observed at the site where there was no stringent formal rules to regulate workers' absence.

With an aim to uncover the influence of workers' social identification with organizational entities in a construction project on workers' social norms and personal standards regarding absence, a correlation analysis was conducted, with the misalignment measures between workers' personal standards and social norms being the main variables of interest. This correlation analysis revealed that the misalignment between a worker's personal standards and managers' desired norms regarding absence have a medium-level of correlation ($|r| \approx 0.4$) with the affective and the evaluative dimensions of social identification with the *project* and the cognitive dimension of social identification with the *trade*. This result suggests that those workers who have a higher level of social identity with the project, and those workers who perceive less of an overlap between themselves and the trade tend to have the personal standards that are similar to managers' desired norms regarding absence.

The results of this study are significant. Firstly, the social norms held by construction workers were elicited separately from workers' personal standards and managers' desired norms. This distinction allows for a clear picture of the current social norm existing in workers' groups, and possibly lends an explanation for workers' behaviors on job sites given that the social norms play an important role in shaping workers' behavior on job sites. Secondly, revealing the influence of a worker's social identification with organizational entities in a construction project on the worker's personal standards allows for an in-depth understanding of the social mechanisms of worker behavior at construction sites. An enhanced understanding of the mechanism—not just the description of a phenomenon—by which workers perceive the social norms of their work groups and the norms desired by managers allows for much richer discussions on how to improve people's behavior in an organizational setting if necessary. Moreover, defining the misalignment between the different kinds of norms and standards provides an idea regarding which misalignment should be reduced or resolved to guide workers' behaviors toward what is most desirable. Considering the dependence of construction processes on labor, there is no doubt that improved worker behavior will benefit construction projects.

This study has limitations. The greatest weakness of this study is the small sample size used in the analysis. Actually, there were several more correlations that were not included in the results due to its marginal significance of the correlation. If more data is collected, chances are not low that those correlations with marginal significance can turn into significant correlations, and then contribute to producing more insights and implications regarding the relationship between workers' social identification and their behavioral standards. Another weakness of this study is the smallness of the sample size for each crew. In this study, the largest sample size for a crew was 4, which was not enough to yield statistically significant results. If more crews participate in the future study, more discussions on the difference between crews regarding their social norms would be made possible. Last but not least, if data are obtained from several sites located in the different regions or situated in different background cultures, it will be very interesting to research the difference in social norms between the different construction sites due to their different environments.

# CHAPTER 7

# CONCLUSIONS AND RECOMMENDATIONS

## 7.1 SUMMARY OF RESEARCH

This research began with the following research goals: (1) to enhance our understanding of the dynamic processes of the emergence and exertion of social controls for worker absence behavior in construction, (2) to extend our understanding of the group-level absence phenomenon in construction, and (3) to identify effective policies and interventions to reduce absenteeism by creating positive social norms in construction projects. With these goals in mind, this research had five specific objectives as follows: (1) to identify workgroup cohesion characteristics that influence individual construction workers' absence, (2) to identify the relationship between workers' perceptions and attitudes toward social rules and their absence behavior, (3) to create a formal behavior model for construction workers' absence influenced by both formal rules and social rules, (4) to explore group-level absence phenomena in workgroups in construction under the influence of social norms on worker absence behavior, and (5) to measure construction workers' actual social norms regarding absence.

To achieve these research objectives, five interrelated studies were conducted. A summary of these studies' results and implications are as follows.

***1. Influence of Workgroup Cohesion Characteristics on Construction Workers' Absence:*** This study firstly found that construction workers' attendance and overall effectiveness are strongly correlated. This implies that workers' attendance not only shows whether the worker is punctual, but also indicates his/her overall performance. This study revealed that workers' attendance as well as overall performance is positively correlated with their perception of team cohesion characteristics, such as perceived team cohesion, perceived communication and

cooperation, and perceived team support. This finding is the evidence that team cohesion actually affects workers' behavior in construction, and also hints that construction workers' absence behavior is affected by some kind of social mechanism.

***2. Influence of Social Norms on Construction Workers' Absence:*** This study found that construction workers who perceive salient social norms in their team are less likely to be absent from a job site. This is clear evidence that workers' absence behavior is affected by the social controls for absence within workgroups. Also, it can be inferred from the result that the workgroups of the construction workers who participated in the survey have favorable social norms regarding absence (because the workers who perceived salient social norms tended to be absent less often). From statistical analyses for the data from each job site, it was found that workers at different job sites may have different perceptions/attitudes toward formal/social rules regarding absence—possibly due to managers' different approaches to absenteeism—and that the different perceptions/attitudes of workers may be the reason for different absence rates. In addition, this study found that workers perceive social norms more likely by self-categorization than by interpersonal exertion of social controls.

***3. An Agent-Based Model and Thought Experiments to Explore Construction Workers' Absence Behavior Under the Influence of Social Norms:*** In this study, a formal behavior model based on Bandura's Social Cognitive Theory of Self-Regulation was proposed. In this model, a construction worker's personal standards regarding absence are formed based both on formal rules and social rules as perceived, and are the basis for his/her absence behavior. This model also makes it explicit that workers may have varying degrees of the adaptation to formal rules and of the adaptation for social rules. This behavior model was transformed into computational behavior rules, and used for agent-based simulations. The results of simulation experiments reaffirmed that high social adaptation can work as a force to either increase or decrease workers' absence rates, and that the combination of a high level of the strictness of self-regulation and a high level of social adaptation in workers is key to the development of a favorable norm in workgroups. It was also inferred from observing the model behavior that attachment and commitment to the current project are important variables for workers' self-regulations, and therefore play a significant role in creating favorable social norms over time in workgroups. With these findings, it was recommended that managers try to promote cohesion in the

workgroup while motivating workers' attachment and commitment to the project in order to create favorable social norms that can prevent excessive absenteeism on a job site.

***4. Comparison Between the Agent-Based Model Behavior and Real Workers' Absence Behavior:*** This study attempted to achieve methodological advancement in using the agent-based modeling and simulation approach for research on organizational behavior, such as worker absenteeism, by proposing a methodology to test an agent-based model for organizational behavior using empirical data collected by surveys. This study specifically shows how human perceptual/attitudinal/behavioral data collected by surveys can contribute to creating agent-based models that correspond to a specific reality. These specific agent-based models, then, can be used to answer "what if" questions and to develop policies/interventions to improve worker behavior. Using the proposed methodology, the credibility of the agent-based model for worker absence behavior was assessed. As a result, the agent-based model was validated for its capability to replicate specific empirical cases and to provide explanations for the observations. In addition, the empirical data analysis showed that workgroup's mean level of social adaptation and mean level of formal rule adaptation can explain variance in the group-level absence rate, which is aligned with the results of agent-based simulation experiments.

***5. Influence of Construction Workers' Social Identification on Their Social Norms and Personal Standards Regarding Absence:*** This study attempted to measure construction workers' actual social norms regarding absence, and to uncover the impact of workers' social identification with organizational entities in a construction project—such as a crew, company, project, trade, and union—on their social norms and personal standards regarding absence. Using the norm elicitation technique, workers' social norms as well as mangers' desired norms were measured. Analyses on the difference between workers' social norms and managers' desired norms revealed that there is a general pattern of alignment, but also a measurable difference. Construction workers' social norms regarding absence were assessed as not too distant from what mangers would desire, and the favorable social norms were conjectured to contribute to a low level of absence at the site where no stringent formal controls for absence are exercised. The analysis on the relationship between workers' social identification and their personal standards regarding absence revealed that workers who have emotional and/or evaluative identification with their project tend to have personal standards that are similar to what their managers desire.

From this result, it was suggested that managers need to pay attention to workers' affective and evaluative components of identification with the project in order to motivate workers to have favorable behavioral standards.

In sum, the results of this research provide empirical evidence that social norms influence construction workers' attendance, identify the factors that play important roles in the processes of emergence and exertion of social norms regarding absence in construction projects, and offer insights into what construction managers should do to make workers have desirable social norms regarding absence. As mentioned in the introduction, costs increase nonlinearly in the rates of absenteeism in construction, and therefore, maintaining a low absence rate is critical to cost-effective construction. Due to the nonlinearity of costs caused by absenteeism, reducing absenteeism by just one or two percent may reduce labor costs by more than that. Given that labor costs of a construction project are easily millions of dollars, reducing excessive absenteeism will significantly improve the cost performance of a construction project. The results of this research provide ideas for how worker absence in construction can be approached in norm-oriented ways. It is expected that the norm-oriented approach to worker absence will compensate the insufficiency in the traditional, formal rule-oriented approach to the problem. The control of workers' behavior using external means, such as rules and associated rewards and penalties, might be costly and require constant monitoring and interventions on worker behavior by managers, and may inadvertently fortify a culture that works against the organization's interest. However, the norm-oriented approach to worker absence will improve worker attendance in a more durable and cost-effective way, and therefore, is expected to significantly benefit construction organizations especially in the long term.

## 7.2 FUTURE RESEARCH

This research has by no means revealed every aspect of worker absence behavior that is influenced by social rules in organizations. Actually, the results of this research have produced more questions than answers, and these questions need to be addressed in future research. A few examples of the questions are:

*1. How strong is the impact of social norms on absence behavior as compared to other mechanisms of worker absence, such as fatigue, personal economic status, personality, and self-motivation?*

*2. What is the mechanism by which a worker's personal absence standard determines his/her absence behavior, and to what extent?*

*3. What is the mechanism by which a worker perceives a social norm and internalizes it in workgroups? If workers' social identification is involved in this process, what is the mechanism by which construction workers' social identification affects the perceiving and the accepting social norms?*

*4. What is the role of workgroup leaders (such as foremen) in creating and exerting social controls for absence behavior?*

*5. How, and to what extent, does the project environment (e.g., the state of economy in the region) affect the social norms of a workgroup in construction?*

*6. How will the diversity of perceived norms and personal standards in a workgroup affect the group behavior of the workgroup?*

*7.What would be feasible managerial actions that can effectively promote favorable norms and work cultures in workgroups?*

## 7.3 FINAL REMARK: BEYOND ABSENCE BEHAVIOR

The influence of social norms on worker behavior in construction projects has been relatively overlooked in the academia as well as in the industry. However, as Goette et al. (2006) said, it is difficult to fully control workers' behavior with incentives and contracts, and the success of a project depends on construction workers' willingness to take actions that are unselfish and beneficial for the project. Akerlof and Kranton (2005) called them "motivational capital" the favorable social norms in organizations that can motivate people to put in high effort rather than low effort. The importance of such social norms is not only for attendance.

It is believed that the insights gained from this research can be applied to other types of worker behavior, such as safety behavior and engagement behavior, which have great impacts on construction project performance. Actually many concepts used in this research—such as team cohesion, social cognition, social adaptation, social norm, norm salience, and social identification—are not "absenteeism-specific." One can reasonably assume that, therefore, the social variables and mechanisms that were investigated in this research have something to do with other types of worker behavior too in construction. More research efforts on the social mechanism regarding other kinds of worker behavior will enhance our knowledge about worker behavior in general, and will greatly contribute to creating favorable social norms and cultures in construction.

# APPENDIX A

## SURVEY QUESTIONANNAIRE 1 - 1: CONSTRUCTION WORKER'S PERCEIVED TEAM COHESION CHARACTERISTICS

## Read to Each Potential Participant

(*after each point, stop and ask if there are questions*)

1. You are invited to take part in a brief survey of all Tunnel Team members. As you may know, the Tunnel Team has a very positive reputation within and outside the City. Now management, in consultation with several engineering professors at the University, would like to learn more about why this team is so successful and to get some ideas on where to improve.

2. The focus of this survey is on the TEAM and not on individual team members. None of the questions here will ask you to single out individual members or team leaders. All of the questions ask you to think about the team, in general.

3. We want to hear from as many members of the Tunnel Team as possible, but this is completely voluntary. You should feel no pressure to participate or to answer any question. If you feel uncomfortable with any question, simply say that you would rather not answer. If you would like to stop now, that is okay too.

4. If you choose to participate, you should know that your responses will be combined with the responses of other team members. These data will be analyzed by the university consultants and not by anyone at the City of Edmonton. Results will be summarized and shared at a later date.

5. The survey should take about 15 minutes to complete. The interviewer (***me***) will read about 20 statements that may or may not apply to your crew. All you have to do is tell me if you ***agree*** or ***disagree*** with the statement. The interviewer will be recording responses on the sheet. There are no right or wrong answers. We are just looking for your opinion. Near the end we have a few open ended questions where you can offer suggestions if you feel like it.

**Would you like to participate?** If "YES" then continue. If "NO" then thank the team member for their time. Wait for the next interview session.

## Survey Questions (read each statement; wait for response; record response)

The following statements may or may not describe your personal experiences within the Tunnel Team. Please indicate your AGREEMENT or DISAGREEMENT with each statement using the 7-point scale below.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| *Strongly Disagree* | *Disagree* | *Slightly Disagree* | *Neither Disagree Nor Agree* | *Slightly Agree* | *Agree* | *Strongly Agree* |

### Part A: Tell me About Your Team

| | Circle Responses | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. In general, my team members get along with each other. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2. My team members like each other. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3. The members of my crew really stick together, especially when things get tough. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 4. I cannot accomplish my job without information/materials from others in my crew. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 5. My team members depend on me for information/materials needed to perform their jobs. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 6. Within my crew, the jobs performed are related to one another | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 7. Team members are very willing to share information with each other about our work. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8. When it comes to getting the work done, members of my crew communicate well | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9. Members of my crew cooperate with each other to get the work done | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 10. The team's expectations for its members are clear | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11. As a group, we tend to see things the same way | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12. As a group, we learn how to behave by watching each other | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 13. Members are influenced by what others on the team expect of them. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 14. Working in a team allows me to provide support to other members | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 15. Working in a team increases my opportunties for positive social interactions | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 16. Members of my team help each other out at work when needed | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

### Part B: Tell me About the Work Rules and Policies That Impact the Team

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 17. We are aware of the formal work rules and policies (e.g., safety, attendance) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 18. Work rules and policies are applied fairly and consistently by supervisors | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 19. I feel my behavior within the team is very controlled by work rules and policies | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 20. The formal rules and policies help me understand what is expected on the job | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

### Part C: Which Influences You More? (*NOTE: The response format is different*)

***Have the respondent draw a mark on the line below that best represents how he or she feels.***
When it comes to day-to-day decisions how to act on the job, are you more influenced by the formal work rules/policies or by what you see your team mates doing?

|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|

**Formal Work Rules** **Team Members**

### Part D: Suggestions to improve the management of the team (in your opinion). Take notes

1. Do you think promotion of crew is fair? How can it be improved to increase fairness?
2. Do you think that training opportunities are fair? How can selection of crew for specific training be improved?
3. Should we increase the review of safety incidents? Any ways this process can be improved?

# APPENDIX B

## SURVEY QUESTIONNAIRE 1 – 2 (BEHAVIOR RATING SHEET)

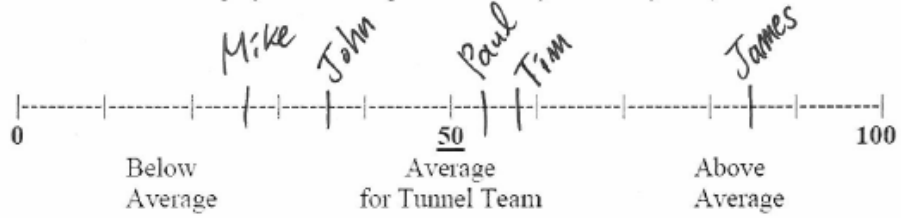
(Names are fictitious)

# Crew # 1

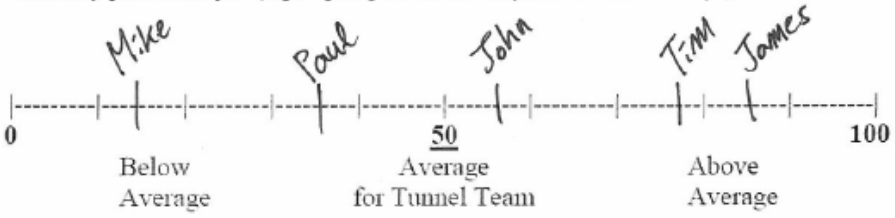
Using the RPM method described earlier, rate each of the crew members on the following work behaviours.

A. Mike
B. John
C. James
D. Tim
E. Paul

1. Compared to others, rate this individual's ***attendance*** (examples: the extent to which you can count on this employee to show up for work, "day-in and day-out").




2. Compared to others, rate this individual's ***overall effectiveness on the job***. This includes how well the employee performs expected job duties as well as duties that are not formally part of the job (e.g., "going above and beyond the call of duty")

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# APPENDIX C

## SURVEY QUESTIONANNAIRE 2: CONSTRUCTION WORKERS' PERCEPTIONS/ATTITUDES TOWARD FORMAL RULES AND SOCIAL NORMS, AND THEIR ABSENCE BEHAVIOR

## CONSTRUCTION CREW SURVEY

This study is performed by University of Michigan. The goal of this survey is to find out the most significant causes of construction workers' daily decisions and behavior. The result of this survey will help improve jobsite conditions and project/company policies for you and your fellow workers.

- Participating in this survey is VOLUNTARY.
- All of your answers on this questionnaire will be CONFIDENTIAL.
- Your answers will be used ONLY FOR RESEARCH PURPOSES.

| DATE | COMPANY (IF APPLICABLE) | PROJECT LOCATION |
|---|---|---|
| | | |
| **TRADE/CRAFT** | **NAME (OPTIONAL)** | **HOW LONG HAVE YOU BEEN WORKING IN THIS PROJECT?** |
| | | |

**PLEASE MARK THE BOX THAT BEST FITS YOUR FEELING**

| | Statement | Agree | Somewhat Agree | Neutral | Somewhat Disagree | Disagree |
|---|---|---|---|---|---|---|
| 1 | Overall, I am satisfied with my job in this project. | | | | | |
| 2 | Overall, I am satisfied with labor control policies (for example, sick-day policy or lateness policy) in this project. | | | | | |
| 3 | I can communicate with project management team (for example, superintendent) for talking about my needs. | | | | | |
| 4 | I think the rules and regulations for this project are inflexible (for example, about absence or lateness). | | | | | |
| 5 | I worry about breaking project rules. | | | | | |
| 6 | I always try to adapt my behavior to comply with project policies. | | | | | |
| 7 | I think our crew members' behavior (for example, absence rate or lateness rate) are similar to one another. | | | | | |
| 8 | If somebody in my team is doing something wrong, my team members will tell them that it is wrong. | | | | | |
| 9 | My team members have a high degree of agreement about which behavior is wrong. | | | | | |
| 10 | I am worried about upsetting my team members by breaking "our rules" in the team. | | | | | |
| 11 | I learn how-to-behave in the jobsite by watching others. | | | | | |
| 12 | I always try to match my behavior to my team's behavior. | | | | | |
| 13 | I would like to perform a better job than the average worker in the team. | | | | | |
| 14 | When someone is absent in my team, it disrupts the work of the entire team. | | | | | |
| 15 | I am worried when I am absent from work, because I might get penalized (for example, lay-off). | | | | | |
| 16 | When I am absent, I worry about how my coworkers view my absence. | | | | | |

HUM 00052356

The following questions are about workers' attendance. Again, all your answers will be used ONLY FOR RESEARCH PURPOSES, and they will not be revealed to anybody else. Your project/company will be given a summary of the group results, but they will not have access to individuals' responses to the questionnaire.

**THE FOLLOWING ITEMS ARE ASKING FOR A NUMERICAL ESTIMATE**

1. How many days in this project have you been absent from work?

_____ day(s)

2. On average, how many days per year is a worker in your team absent from work? (For example, if your coworkers in your team are usually absent once every other month, you would answer "6")

_____ day(s)/year

3. About how many days of absence per year do you think is OK?

_____ day(s)/year

4. As far you know, what is the maximum number of days of absence per year that would not cause you any penalties, according to the project/company policy?

_____ day(s)/year

**THANK YOU SO MUCH FOR YOUR PARTICIPATION.**

**WE APPRECIATE IT.**

HUM 00052356

# APPENDIX D

## SURVEY QUESTIONANNAIRE 3: CONSTRUCTION WORKER'S SOCIAL IDENTITIES, AND THEIR SOCIAL NORMS AND PERSONAL STANDARDS REGARDING ABSENCE AND SAFETY

# ***CONSTRUCTION CREW SURVEY***

This study is performed by the University of Michigan. The goal of this survey is to find out the most significant causes of construction workers' daily decisions and behavior. The result of this survey will help improve jobsite conditions and project/company policies for you and your fellow workers.

- Participating in this survey is VOLUNTARY.
- All of your answers on this questionnaire will be CONFIDENTIAL.
- Your answers will be used ONLY FOR RESEARCH PURPOSES

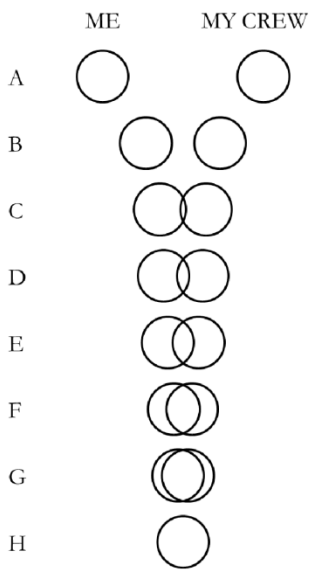
Please proceed to the next page if you agree to participate in this survey.

IRB Study ID: HUM00052356 IRB Amendment ID: AME00045440

## SECTION 1.

Take a moment to think about your crew (a crew usually means a group of workers who work with the same foreman).

Imagine that the left circles represent your own identity and the right circles represent your CREW's identity. Please indicate which case (A, B, C, D, E, F, G or H) best describes the level of overlap between your own identity and your CREW's identity.



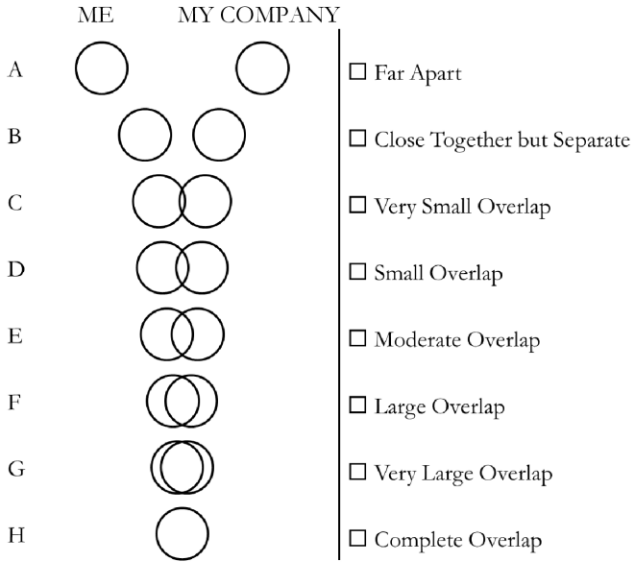

- ☐ Far Apart
- ☐ Close Together but Separate
- ☐ Very Small Overlap
- ☐ Small Overlap
- ☐ Moderate Overlap
- ☐ Large Overlap
- ☐ Very Large Overlap
- ☐ Complete Overlap

Please circle the answer that best describes your feelings for each statement.

| | Statement | Strongly Disagree | Disagree | Somewhat Disagree | Neither agree nor disagree | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| 1 | When someone criticizes my crew, it feels like I am criticized. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 2 | When I talk about my crew, I usually say 'we' rather than 'they'. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | I think my foreman is one of us. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 4 | I am attached to my crew. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 5 | I am happy to be a member of my crew. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 6 | I have respect for my crew. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 7 | I am proud to be a member of my crew. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |

What is your COMPANY?

Imagine that the left circles represent your own identity and the right circles represent your COMPANY's identity. Please indicate which case (A, B, C, D, E, F, G or H) best describes the level of overlap between your own identity and your COMPANY's identity.

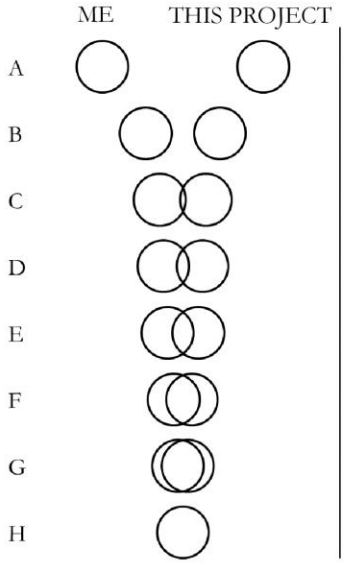



Please circle the answer that best describes your feelings for each statement.

| | Statement | Strongly Disagree | Disagree | Somewhat Disagree | Neither agree nor disagree | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| 1 | When someone criticizes my company, it feels like I am criticized. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 2 | When I talk about my company, I usually say 'we' rather than 'they'. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | I am attached to my company. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 4 | I am happy to be a member of my company. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 5 | I have respect for my company. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 6 | I am proud to be a member of my company. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |

What is your PROJECT SITE?

Imagine that the left circles represent your own identity and the right circles represent your PROJECT's identity. Please indicate which case (A, B, C, D, E, F, G or H) best describes the level of overlap between your own identity and your PROJECT's identity.



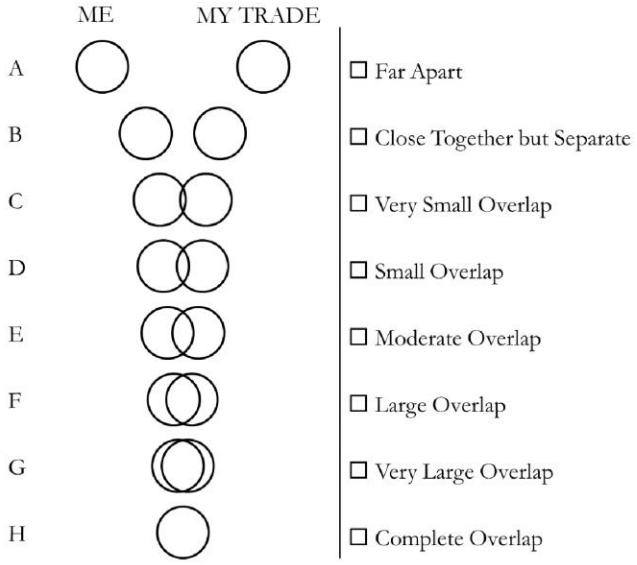

- ☐ Far Apart
- ☐ Close Together but Separate
- ☐ Very Small Overlap
- ☐ Small Overlap
- ☐ Moderate Overlap
- ☐ Large Overlap
- ☐ Very Large Overlap
- ☐ Complete Overlap

Please circle the answer that best describes your feelings for each statement.

| | Statement | Strongly Disagree | Disagree | Somewhat Disagree | Neither agree nor disagree | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| 1 | When someone criticizes this project, it feels like I am criticized. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 2 | When I talk about this project, I usually say 'we' rather than 'they'. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | I am attached to this project. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 4 | I am happy to be a member of this project. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 5 | I have respect for this project. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 6 | I am proud to be a member of this project. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |

What is your TRADE (e.g., carpenter, laborer, plumber,….)?

Imagine that the left circles represent your own identity and the right circles represent your TRADE's identity. Please indicate which case (A, B, C, D, E, F, G or H) best describes the level of overlap between your own identity and your TRADE's identity.



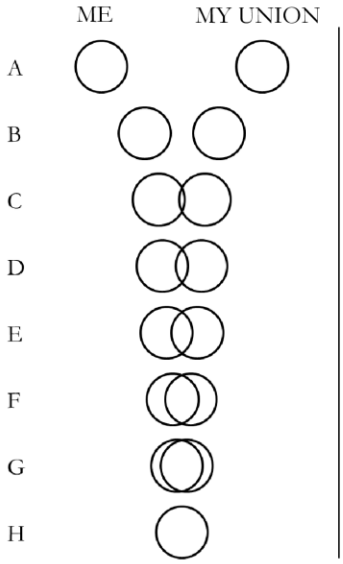

Please circle the answer that best describes your feelings for each statement.

| | Statement | Strongly Disagree | Disagree | Somewhat Disagree | Neither agree nor disagree | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| 1 | When someone criticizes my trade, it feels like I am criticized. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 2 | When I talk about my trade, I usually say 'we' rather than 'they'. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | I am attached to my trade. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 4 | I am happy to be a member of my trade. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 5 | I have respect for my trade. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 6 | I am proud to be a member of my trade. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |

Are you a union member? If yes, what is your union?

If you are not a union member, skip this page.

Imagine that the left circles represent your own identity and the right circles represent your UNION's identity. Please indicate which case (A, B, C, D, E, F, G or H) best describes the level of overlap between your own identity and your UNION's identity.




- ☐ Far Apart
- ☐ Close Together but Separate
- ☐ Very Small Overlap
- ☐ Small Overlap
- ☐ Moderate Overlap
- ☐ Large Overlap
- ☐ Very Large Overlap
- ☐ Complete Overlap

Please circle the answer that best describes your feelings for each statement.

| | Statement | Strongly Disagree | Disagree | Somewhat Disagree | Neither agree nor disagree | Somewhat Agree | Agree | Strongly Agree |
|---|---|---|---|---|---|---|---|---|
| 1 | When someone criticizes my union, it feels like I am criticized. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 2 | When I talk about my union, I usually say 'we' rather than 'they'. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 3 | I am attached to my union. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 4 | I am happy to be a member of my union. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 5 | I have respect for my union. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 6 | I am proud to be a member of my union. | -3 | -2 | -1 | 0 | 1 | 2 | 3 |

## SECTION 2.

In this section, you have a chance to win a maximum of $100 monetary reward!

We will randomly select 10% of all respondents in this survey. If you are selected, your responses in this section will be compared with the responses of another respondent among your crew, and you will receive $10 for each of your responses matched with the responses of the target respondent. The maximum of the reward is $100, which means that even if you get more than 10 responses of yours matched with the responses of the target respondent, you will receive $100. If you do not have any response that is matched with the response of the target respondent, you will not receive any incentives. Therefore, the range of incentives that you can receive is $0 - $100. If you are interested in receiving the incentives, please provide your address at the end of the survey so that we can send the incentives to you. The incentives will be mailed in a form of gift certificate. If you do not complete the section 2, you will not be considered for the award.

Please proceed to the next page if you agree to participate in this survey.

Please imagine that James is a member of your crew, and he has been working with you since your crew started to work at your project site.

Please choose WHAT A TYPICAL MEMBER OF YOUR CREW WOULD THINK if James shows behavior listed below.

| Behavior | Very Inappropriate | Somewhat Inappropriate | Somewhat Appropriate | Very Appropriate |
|---|---|---|---|---|
| 1 James takes absence when he has a hangover, and he informs his absence to his foreman early in the morning. | | | | |
| 2 James does not take absence at all unless he has an emergent situation like severe injury or sickness. | | | | |
| 3 James takes absence without a notice when he does not want to work. | | | | |
| 4 James takes absence when he feels too sick to work well, and he informs his absence to his foreman early in the morning. | | | | |
| 5 James takes absence when he has some personal situation like sickness of a family member, and he informs his absence to his foreman early in the morning. | | | | |
| 6 James takes absence when he does not want to work, and he informs his absence to his foreman early in the morning. | | | | |
| 7 James takes absence when he has minor illness such as colds and headaches, and he informs his absence to his foreman early in the morning | | | | |

Please imagine that Robert is another member of your crew. He works at a workspace where a fall protection is required by the OSHA regulation.

Please choose WHAT A TYPICAL MEMBER OF YOUR CREW WOULD THINK if Robert shows behavior listed below.

| | Behavior | Very Inappropriate | Somewhat Inappropriate | Somewhat Appropriate | Very Appropriate |
|---|---|---|---|---|---|
| 1 | Robert always connects his snaphooks to an anchor point. If he cannot find an object he can securely connect his snaphooks to, he does not continue to work. | | | | |
| 2 | Robert connects his snaphooks to an anchor point only when he perceives a danger of falling. | | | | |
| 3 | Robert does not connect his snaphooks to an anchor point even if he works on a dangerous task and the fall protection system does not bother his work. | | | | |
| 4 | Robert always connects his snaphooks to an anchor point whenever a fall protection is required. However, he continues to work even if he cannot find an object he can securely connect his snaphooks to. | | | | |
| 5 | Robert connects his snaphooks to an anchor point only when he perceives a danger of falling and the fall protection system does not bother his work. | | | | |

## SECTION 3.

In this section, you are asked to TELL US YOUR PERSONAL OPINION ABOUT THE ACTIONS listed in the section 2.

Please choose WHAT YOU WOULD THINK if James shows behavior listed below.

| | Behavior | Very Inappropriate | Somewhat Inappropriate | Somewhat Appropriate | Very Appropriate |
|---|---|---|---|---|---|
| 1 | James takes absence when he has minor illness such as colds and headaches, and he informs his absence to his foreman early in the morning. | | | | |
| 2 | James takes absence when he has a hangover, and he informs his absence to his foreman early in the morning. | | | | |
| 3 | James takes absence when he does not want to work, and he informs his absence to his foreman early in the morning. | | | | |
| 4 | James does not take absence at all unless he has an emergent situation like severe injury or sickness. | | | | |
| 5 | James takes absence when he has some personal situation like sickness of a family member, and he informs his absence to his foreman early in the morning. | | | | |
| 6 | James takes absence when he feels too sick to work well, and he informs his absence to his foreman early in the morning. | | | | |
| 7 | James takes absence without a notice when he does not want to work. | | | | |

Please choose WHAT YOU WOULD THINK if Robert shows behavior listed below.

| Behavior | Very Inappropriate | Somewhat Inappropriate | Somewhat Appropriate | Very Appropriate |
|---|---|---|---|---|
| 1 Robert connects his snaphooks to an anchor point only when he perceives a danger of falling. | | | | |
| 2 Robert always connects his snaphooks to an anchor point. If he cannot find an object he can securely connect his snaphooks to, he does not continue to work. | | | | |
| 3 Robert always connects his snaphooks to an anchor point whenever a fall protection is required. However, he continues to work even if he cannot find an object he can securely connect his snaphooks to. | | | | |
| 4 Robert does not connect his snaphooks to an anchor point even if he works on a dangerous task and the fall protection system does not bother his work. | | | | |
| 5 Robert connects his snaphooks to an anchor point only when he perceives a danger of falling and the fall protection system does not bother his work. | | | | |

## SECTION 4.

| NAME (Necessary For Payment) | How long have you been working at this site? | Who is your foreman? (Necessary for crew identification) |
|---|---|---|
| | | |

**ADDRESS (Necessary For Payment)**

**THANK YOU SO MUCH FOR YOUR PARTICIPATION.**

**WE APPRECIATE IT.**

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