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The Dyadic Nature of Improvisation in Construction

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Abstract: Workflow disruptions are ubiquitous on construction sites, and as a result, a foreman must be prepared to respond to task disruptions in real-time in order to continue making progress. One way to rapidly adjust to disruptions is by improvising. Research on improvisation that occurs in organizations has typically focused on improvised decision-making that occurs by a team of people. However, on the construction site, improvisation typically involves a dyad that consists of the foreman and the crew member who has been disrupted. Data collected from construction workers revealed that the role of the crew member as well as the *type of disruption* influences *who* improvises, where journeyman are given much greater latitude to make improvised decisions than apprentices, but the foreman tends to make many more improvised decisions than either journeymen or apprentices.

1 Introduction to Improvisation on Construction Sites

Disruptions are ubiquitous on construction sites, and they often interfere with efforts to complete the planned daily tasks. Although “better planning” has been offered as a critical strategy for limiting the impacts of unexpected disruptions, daily interruptions persist and create chaotic conditions that make plan-following difficult to achieve. Consequently, construction workers must be able to “think on their feet” and quickly adapt to unexpected conditions on the jobsite. One way that workers can quickly adapt to changing conditions is by *improvising*.

Improvised decision-making involves "reworking knowledge to produce a novel action in time to meet the requirements of the situation" (Mendonça and Wallace 2002). Thus improvising involves deliberate human actions that are driven by intuition, experience, competence, and context (Ciborra 1999). In fact, there is evidence that individuals and groups that improvise tend to “enact strategies based on recognizing characteristics of past problems in the current one” – a process called Recognition Primed Decision-making (Klein 1998). Consequently, improvisation draws heavily from individuals’ abilities to recognize patterns in their daily flow of work and to apply their tacit knowledge to the current unplanned-for situation so that work can continue. Such fast thinking and acting can augment more careful planning thus providing a mechanism for increasing productivity, which would otherwise decline as a result of numerous disruptions.

Over the past two decades, organizations have begun to take improvisation seriously and to cultivate the benefits of fast, creative thinking and actions. As a result, numerous studies have been conducted on improvisation that occurs within organizations and particularly by teams that must quickly coordinate their actions (Crossan et al. 1996; Leybourne 2006; Mendonca and Wallace 2007; Moorman and Miner 1998a). Recently, Menches and Chen (In press-a) discovered that improvisation on construction sites typically involves two people – a dyad that consists of the foreman and a crew member. When a crew member’s work is interrupted, the crew member typically interacts with the foreman to improvise a fast decision and action about how to respond to the interruption. A two-stage process then ensues that

involves improvising a new plan of action and then subsequently executing the plan, where the foreman improvises the new plan and the crew member implements the improvised plan. However, no prior studies have focused on the unique nature of dyads in improvisation within organizations. Yet, the phenomenon of one party improvising the plan and a different party executing the improvised plan is prevalent in many organizations. Consequently, this article aims to contribute to the growing body of research on organizational improvisation by reporting on the role of the foreman and the crew member in improvising as a dyad when the daily work gets disrupted and how the type of disruption influences this dyadic relationship.

2 Background on Improvisation in Organizations, Useful Concepts, and Points of Departure

Organizational improvisation is an emerging field of research that began in the 1990s with the study of how jazz and theater improvisation concepts could be successfully applied to organizations (for an excellent overview of the history of organizational improvisation research, see Cunha et al. (1999)). This "first-generation" research led to "second-generation" research that began to study improvisation in organizations much more directly through anecdotes, case studies, and empirical evidence. This "second-generation" research essentially moved organizational improvisation away from the arts and into the field (Cunha et al. 2002). More recent studies have attempted to measure the effects of improvisation in organizations more directly (Moorman and Miner 1998a), and the research reported in this article attempts to make a contribution to the measurement of the influence of improvisation in organizations. The next few paragraphs highlight just a few of the many excellent studies on the evolving nature of improvisation in organizations.

2.1 Improvisation in Theater Groups

Traditional theater is script-based, with the well-developed script and roles as its foundation. Every line of the script is planned, the storyline as a whole is completely developed, and the actors have memorized their parts prior to launching a performance. In contrast, *improvisational theater* relies on the ability of individuals to think on their feet and improvise decisions, actions, and conversations while interacting with other performers on the stage. Thus, the success of improvisational theater depends on the ability of individuals to independently improvise as well as the ability of collective teams to improvise together in a cohesive way. Crossan et al. (1996) compared improvisational theater groups to company teams and noted numerous ways that organizations can adapt improvisation as a success strategy. Of particular note, Crossan et al. (1996) discussed "the cast" and how they resemble members of an organizational team. Important concepts that they felt could transfer from theater improvisation to organizational improvisation included: (1) reading cues among the team members in order to manage momentary struggles or challenges; (2) allowing different team members to take the lead at different times when appropriate; and, (3) learning to reciprocate by giving and receiving information or items, and acknowledging the skills and abilities of the other. Consequently, many of the concepts that transfer from theater improvisation to organizational improvisation could also transfer to improvisational decisions and actions on construction sites. However, until now, the phenomenon of improvisation on construction sites has never been studied in detail.

2.2 Improvisation in New Produce Development

Competition to bring a new product to market before a competitor inspires numerous companies to innovate, collaborate, and deploy plans quickly. New product development and deployment typically involves a team of individuals brought together to contribute individually to a collective process. Consequently, the creative process that results in a new product often involves improvisation. Moorman and Miner (1998a) investigated new product development activities in two companies and noted that, while individuals often contributed creative ideas, the larger team built on these individual improvised decisions and actions thus producing "collective improvisation" (Moorman and Miner 1998a). The new product development team often used collective improvisation to solve specific problems that resulted from surprise during the development process. For example, design problems, storage issues, faulty prototype parts, and improper timing of activities were among the problems addressed by the new

product development team (Miner et al. 2001). Likewise, unexpected opportunities also inspired collective improvisation. For example, when parts and/or packaging were delayed in shipment, the team improvised new parts or packaging, thus creating an opportunity to improve the final product. Although collective improvisation in organizations was the focus of Moorman and Miner's studies (Miner et al. 2001; Moorman and Miner 1998a; Moorman and Miner 1998b), they also noted instances in which individual technical improvisations were incorporated into company business practices. However, their studies did not specifically examine how an individual improvised decision or action from a single team member was adapted and built-upon by the larger team. The research presented in this article attempts to partially fill this gap by addressing the interaction between individual and joint improvisational decisions and actions.

2.3 Improvisation in Emergency Response

Natural disasters and emergencies generate non-routine situations that often require nearly simultaneous generation and execution of new plans. In fact, Mendonca and Wallace (2007) note that "the onset of an emergency usually creates a need for action that is timely" and "managing the response to an emergency is likely to require multiple decision-makers, who must reason and make decisions about complex sociotechnical systems." These decision-makers consist of individuals from a variety of organizations who come together to form an emergency response organization (ERO) and who work together to manage the response to the emergency. However, as noted by Mendonca and Wallace (2004) these individuals are responsible for *management*-level decisions, rather than the *operations*-level decisions. Consequently, their decisions are communicated to, and implemented by, field personnel.

Many of the decisions made by EROs are guided by standard response procedures. However, when the procedures cannot be followed, decision-making generally evolves as a two-stage process. In the first stage, the ERO "recognizes that either no planned-for procedure applies to the current situation or an appropriate planned-for procedure cannot be executed" and "once the need to depart from the plan has been recognized, the second stage is the real-time development *and deployment* of new procedures" (Mendonca and Wallace 2007). Decisions and actions may include *substitution* (e.g., using a school bus to transport injured persons rather than an ambulance), *development of new procedures* (e.g., transporting water from a pond to a water treatment plant using fire trucks), or improvisation of roles (Mendonca and Wallace 2007). Role improvisation can occur at the management level but Webb (2004) has documented numerous instances of improvised roles, decision, and actions among those that are already engaged in the act of deploying new (i.e., improvised) plans. Such multi-level improvising is a result of management modifications to an existing plan when an un-planned for event prevents deployment of the original plan and subsequent modification of the new plan deployment by the operations-level implementer. Changing the implementation procedures is often necessary to overcome unexpected challenges, such as lack of resources, environmental conditions, or time constraints (Webb 2004).

Hence, Mendonca and Wallace suggest that emergency response decision-makers engage in the real-time development of new plans but that the deployment of the new plans is delegated to field personnel. In fact, their research focuses on improvisation that occurs at the management level, but they did not investigate improvisation that occurs by the field personnel who implement the new plan. Webb (2004) likewise acknowledges that improvisation can occur at multiple levels, but he did not address the interaction of improvisers at these various levels. The research presented in this article, by contrast, focuses on the interaction between the individual that improvises a new plan (i.e., the foreman) and the individual that implements the new plan (i.e., the crew member).

3 Research Objectives and Hypotheses

The study reported in this article addressed fundamental questions about who improvises on construction sites. Specifically, the researchers investigated the types of disruptions that occur and how such disruptions influence *who* improvises a decision and an action (i.e., foreman, journeyman, or apprentice). Accordingly, two research objectives were identified:

Objective 1: Determine how *the role of the crew member* (i.e., journeyman or apprentice) influences *who* improvises decisions and actions on the jobsite.
Objective 2: Establish *the types of disruptions* that influence *who* improvises decisions and actions on the jobsite.

By posing the objectives in this way, the following testable hypotheses were generated:

Hypothesis 1 (H1): The role of the crew member (i.e., journeyman, or apprentice) influences *who* improvises (i.e., foreman, journeyman, or crew member).
Hypothesis 2 (H2): The *type of disruption* that occurs influences *who* improvises.

4 Research Method

Electrical construction workers from the Chicago metropolitan area in the United States were recruited to participate in the study. Five participants were apprentices and four participants were journeymen. Data was collected from four jobsites using an Ecological Momentary Assessment (EMA) method, in which workers completed real-time brief momentary assessments of their decisions and actions on a digital device (i.e., a smartphone) at random times throughout the workday (Menches and Chen In press-b). EMA was especially appropriate because it captures the thoughts, decisions, and actions of workers while they are performing their tasks in their natural job setting. During the workday, the worker received five random alarms on the smartphone device which signaled them to stop what they were doing and fill out the momentary assessment form on the device. Consequently, the EMA method allowed the researchers to capture a task disruption and the worker's step-by-step response to the disruption shortly after it occurred. Data was collected from each worker for five days, with each worker responding to approximately 18 surveys during the week. A total of 162 valid responses were captured from all workers.

A data collection cycle occurred across two weeks. The cycle involved (1) training the workers to use the digital devices on Monday morning of Week 1, (2) collecting momentary assessments (i.e., digital surveys) on the smartphone from each worker for one week, (3) retrieving the devices on Friday afternoon of Week 1 and downloading the data over the weekend, (4) studying the data and creating printouts for the exit interviews, and (5) conducting the exit interviews during Week 2. To launch a data collection cycle, two researchers met with the participating workers at the jobsite before work started on Monday morning. One researcher explained the procedures while the other researcher demonstrated the operation of the device. The workers completed one trial survey on the device, and then the workers placed the device in a carrying case, attached the carrying case to their belt, and went to work. The devices were programmed to send five random alarms per day to the workers between the hours of 7:30 AM and 3:00 PM. At the end of the week, a researcher returned to the site to collect the devices from the workers. The following week, the researchers conducted exit interviews to discuss the results of the data collection effort with the workers.

5 Digital Survey Questions

The digital survey consisted of four sections, including (1) context questions about the worker's environment, (2) questions about being disrupted (as applicable), (3) questions about the work when the worker was not disrupted (as applicable), and (4) state of mind questions. The device was programmed so that the workers only answered the "questions about being disrupted" if they responded that they had been disrupted since they were last alarmed. If they indicated that they had not experienced a disruption, the device was programmed to present only the "questions when not disrupted."

1. *Context Questions.* The context questions asked the workers about their location, who they were with, and whether their work had been disrupted since they were last alarmed.
2. *Questions About Being Disrupted*. The *questions about being disrupted* asked the workers about the type of disruption, whether the disruption caused them to work on the same or a different task, and how a decision and action were selected when the assigned task could not be completed as planned.

Workers were also asked to identify the type of task they were working on before and after the disruption, how similar the new task was to the original task, and how much time was spent on making the decision to alter the task.

3. *Questions When Not Disrupted*. Similarly, the *questions about the work when the worker was not disrupted* were nearly identical to the "questions about being disrupted" but were asked in order to better understand the worker's decisions and actions when the tasks proceeded as planned. Furthermore, any deviation from the planned work task that was not caused by a disruptive event was assumed to be voluntary rather than being caused by a disruption to the work. For example, a worker might decide to use a motorized tool rather than a manual tool because the motorized tool might lead to an increase in efficiency.
4. *State of Mind Questions*. The state of mind questions asked workers about a variety of positive and negative emotions experienced as a result of the disruption.

6 Research Findings on Improvisation on Construction Sites

To test the two hypotheses – that the role of the crew member influences improvisational decisions and actions and that the type of disruption influences who improvises – the researchers followed a logic-driven data analysis process. First, the researchers identified what causes improvisation to occur (e.g., disruptions), and then the researchers identified the types of disruptions that occur on the jobsite and with what frequency. Next, using appropriate analytical methods, the researchers identified who makes improvisational decisions when the work is disrupted. Finally, the researchers identified how the type of disruption influences who makes improvisational decisions.

6.1 What Causes Improvisation to Occur on Construction Sites

An underlying premise of the research was that disruptions influence the frequency that workers improvise decisions and actions. Previous analysis of a data set collected during a pilot study supported this premise (Menches and Chen In press-a), but the researchers conducted an analysis on the current data set to establish further support for this premise. To investigate whether the electricians improvised more frequently when they had been disrupted versus when they had not been disrupted, the researchers analyzed their responses to the following questions:

1. (When disrupted) How different is your new task (following the disruption) from your planned task?
2. (When not disrupted) How similar is your current task to your planned task?

The possible answers to these questions included: (1) I am performing the same task in the standard way, (2) I am performing the same task in a non-standard way, (3) I am performing an entirely different task in the standard way, and (4) I am performing an entirely different task in a non-standard way. These questions explored how the disruptions or lack of disruptions impacted the electricians' abilities to complete their assigned tasks as planned. The assumption made by the researchers was that the decision to select a totally new or different task that requires a non-standard completion method (Response 4) is more improvisational than performing the same task as planned with no adjustments (which requires no improvisational decisions or actions) (Response 1). Hence, the ordering of the responses reflects the increasing degree of improvisational decisions and actions that might be taken when disrupted or when not disrupted in order to remain productive, where the ordering of improvisation can be thought of as none (Response 1), minor (Response 2), major (Response 3), and total improvisation (Response 4).

The data was divided into two types of responses per person: "when disrupted" and "when not disrupted." The researchers compared the frequency of improvisational acts per worker when the worker reported being disrupted and when the worker reported not being disrupted in order to determine whether there was an association between a greater number of workflow disruptions and a greater number of improvisational acts. Table 1 presents the percentage of time that each worker responded that they had adjusted their task (i.e., improvised) either (1) when they were disrupted (Column 5), or (2) when they had not been disrupted (Column 8). The workers, on average, reported improvising their tasks 67% of the

time that they were in a disrupted state; in contrast, the workers, on average, reported improvising only 14% of the time when they were not in a disrupted state. A two-sample comparison of frequency of improvisational actions when disrupted and when not disrupted was conducted using the Mann-Whitney U Test (a non-parametric test used to determine whether the mean of two groups are different from each other). A statistically significant difference was noted ($U = 18$; $Z = -2.02$; $p = 0.05$), thus indicating that the electricians tended to improvise their decisions and actions more often when they were in a disrupted state than when they were not disrupted.

Table 1: Frequencies of Disruptions and Improvised Actions

(1) Subj ID	(2) Percent of Improvised Acts Reported for All Self-Reports	(3) Frequency of Reported Disruptions	(4) Frequency of Reported Improvised Acts	(5) Percent of Improvised Acts When Disrupted	(6) Frequency of Reports of No Disruptions	(7) Frequency of Reported Improvised Acts	(8) Percent of Improvised Acts When Not Disrupted
1	44%	7	7	100%	11	1	9%
2	5%	3	1	33%	18	0	0%
3	21%	5	3	60%	19	2	11%
4	63%	7	4	57%	17	11	65%
5	25%	7	6	86%	17	0	0%
6	14%	1	1	100%	6	0	0%
7	7%	8	1	13%	6	0	0%
8	67%	8	8	100%	4	0	0%
9	50%	11	6	55%	9	4	44%
AVG	33%	6	4	67%	12	2	14%

6.2 Types of Disruptions that Occur on Construction Sites and their Frequency

The momentary assessment survey queried workers about the types of disruptions they experienced. Possible choices and the frequency that they were reported included:

- Another individual interrupted the work (19 / 12%)
- Something was in the way (17 / 11%)
- Change in sequence (5 / 3%)
- Lack of resources or information (4 / 2%)
- Other (10 / 6%)
- None (107 / 66%)

Given that the electricians tended to improvise decisions and actions more often when they were in a disrupted state than when they were not disrupted, the researchers sought to better understand the nature of improvisational decisions and actions as well as how the type of disruption influenced who made the decisions and who executed the actions.

6.3 Who Makes Improvisational Decisions and Actions When the Work is Disrupted

One question on the momentary assessment survey was designed to query workers about *who* improvised when the work was disrupted. The question asked: “What happened when your work was disrupted?” The possible responses included:

- My supervisor assigned a totally different task or developed a workaround to the same task
- I worked jointly with my supervisor to select a totally different task or develop a work-around to the same task
- I decided myself to work on a totally different task or develop a workaround to the same task
- I continued working on exactly the same task

The ordering of questions reflected an increase in latitude given to the worker to make a fast improvisational decision when the work was disrupted, where responses were coded as “Supervisor Only” made the decision (i.e., the foreman), “Jointly” made the decision, “Crew Member Only” made the decision, or no improvisational decision was needed or made. Hence, when the work was disrupted, the researchers wanted to determine *who* made the decision to improvise and whether the role of the crew member (i.e., journeyman or apprentice) was associated with more or less decision-making latitude. Thus, because the researchers were only interested in improvisational decisions and actions, the data set was reduced to eliminate those cases in which no improvisation occurred.

A total of 49 cases of improvisation were reported, and these cases were used to examine the question of *who* improvised when the work was disrupted. The dataset was complex because it consisted of responses from multiple participants who were either an apprentice or journeyman electrician and who each responded to multiple surveys each day for five days about various types of disruptions, resulting in stratified repeated measures categorical data. Consequently, typical parametric statistical techniques, such as linear regression or analysis of variance, were inappropriate for the analysis because many of the standard assumptions about the distribution of the data were not met. Consequently, the researchers selected non-parametric statistical methods, called the Generalized Cochran-Mantel-Haenszel (CMH) set of tests, for analysis. The CMH tests are aimed at detecting an association between two categorical variables observed in one or more strata (Stokes et al. 2000). For example, a CMH test can detect a relationship between the “type of disruption experienced” and “who improvised a decision and action” when controlling for the role of the responder (i.e., journeyman versus apprentice). As a result, the CMH procedures assemble the data into contingency tables to tabulate frequencies and analyze associations. The benefit of using a CMH test is that CMH procedures require minimal assumptions. The only assumption that must be met is that the subjects must be randomized to the level of the row variables (e.g., there must be a random occurrence between a subject and a disruptive event). Another advantage of CMH procedures is that the sample size requirements are based on frequencies summed across tables rather than on individual cell frequencies; thus, stratification can increase the power of the test to detect associations in small sample (Stokes et al. 2000). The outcome statistic appropriate for the data set included the *general association statistic* (Q_{GMH}), which is appropriate when both the row and column variables are nominally scaled (i.e., have no inherent order). The null hypothesis for the statistic is “no association between row and column variables” while the alternative hypothesis is “a general association exists” (Stokes et al. 2000).

To test hypothesis 1 (H1) (the role of the crew member influences *who* improvises), a contingency table was constructed as shown in Table 1. The rows indicate the role of the crew member (i.e., journeyman or apprentice) while the columns indicate who made the decision to improvise (Supervisor-Only, Jointly, or Crew Member-Only). The null hypothesis was “there is no association” between the role of the crew member and who made the decision to improvise, while the alternative hypothesis was “there is a general association” between variables. The test statistic Q_{GMH} was not significant at the $\alpha = 0.05$ level ($Q_{GMH} = 5.70$; $p = 0.058$), where the α-level is defined as the probability of rejecting the null hypothesis when, in fact, the null hypothesis is true. However, the test statistic Q_{GMH} was significant at the $\alpha = 0.10$ level, indicating a general association between the role of the crew member and who made the decision to improvise. An examination of the contingency table revealed that when the worker is an apprentice, most improvisational decisions are made by the supervisor only (69%) (i.e., the foreman) or jointly between the supervisor and apprentice (23%), while very few improvised decisions (8%) are made by the apprentice only. In contrast, when the worker is a journeyman electrician, improvised decision-making is much more evenly distributed. In fact, 43% of the decisions are made by the supervisor only, 22% are made jointly between the supervisor and the journeyman, and 35% are made by the journeyman only.

Consequently, the researchers found statistical support for the hypothesis that the role of the crew member influences *who* improvises, where journeyman are given much greater latitude to make improvised decisions than apprentices, but the supervisor (i.e., foreman) tends to make many more improvised decisions than either journeymen or apprentices.

Table 1: Contingency table of role of the crew member by who improvised

Role of the Crew Member	Who Improvised							
	Supervisor-Only		Jointly		Crew Member-Only		Total	
	Freq	Pct	Freq	Pct	Freq	Pct	Freq	Pct
Journeyman	10	20.41%	5	10.20%	8	16.33%	23	46.94%
Apprentice	18	36.73%	6	12.24%	2	4.08%	26	53.06%
Total	28	57.14%	11	22.45%	10	20.41%	49	100%

6.4 How the Type of Disruption Influences Who Improvises

To test hypothesis 2 (H2) (the *type of disruption* that occurs influences *who* improvises), a contingency table was constructed as shown in Table 2. Because the role of the crew member is associated with who makes improvisational decisions, the analysis controlled for the effects of the variable "crew member." Hence, the rows indicate the type of disruption while the columns indicate who made the decision to improvise (Supervisor-Only, Jointly, or Crew Member-Only), and the table was stratified by the role of the crew member. The null hypothesis was "there is no association" between the type of disruption and who made the decision to improvise, while the alternative hypothesis was "there is a general association" between variables. The test statistic Q_{GMH} was not significant at the $\alpha = 0.05$ level ($Q_{GMH} = 16.24$; $p = 0.093$). However, the test statistic Q_{GMH} was significant at the $\alpha = 0.10$ level, indicating a general association between the type of disruption and who made the decision to improvise when controlling for the role of the crew member.

Table 2: Contingency table of type of disruption by who improvised controlling for role of the crew member

Type of Disruption	Who Improvised							
	Supervisor-Only		Jointly		Crew Member-Only		Total	
	Freq	Pct	Freq	Pct	Freq	Pct	Freq	Pct
ROLE = JOURNEYMAN								
Individual interrupted work	3	13.04%	1	4.35%	2	8.70%	6	26.09%
Something was in the way	0	0%	2	8.70%	4	17.39%	6	26.09%
Change in sequence	2	8.70%	1	4.35%	0	0%	3	13.04%
Lack of resources/info	0	0%	1	4.35%	1	4.35%	2	8.70%
Other	2	8.70%	0	0%	0	0%	2	8.70%
None	3	13.04%	0	0%	1	4.35%	4	17.39%
Total	10	43.48%	5	21.74%	8	34.78%	23	100%
ROLE = APPRENTICE								
Individual interrupted work	6	23.08%	2	7.69%	0	0%	8	30.77%
Something was in the way	4	15.38%	4	15.38%	0	0%	8	30.77%
Change in sequence	2	7.69%	0	0%	0	0%	2	7.69%
Lack of resources/info	0	0%	0	0%	1	3.58%	1	3.85%
Other	4	15.38%	0	0%	1	3.58%	5	19.23%
None	2	7.69%	0	0%	0	0%	2	7.69%
TOTAL	18	69.23%	6	23.08%	2	7.69%	26	100%

An examination of the contingency table revealed that journeymen electricians were given more latitude to independently improvise decisions when another individual interrupted the work or when something was in the way. Under the same conditions, both journeymen and apprentices also tended to jointly improvise a decision with their supervisor, but apprentices did not independently improvise. When there was a change in the sequence of the work, either the foreman improvised a decision or the foreman and the journeyman jointly improvised. And, when there was a lack of resources, the crew members (both journeymen and apprentices) were given more latitude to improvise a decision. Consequently, the

researchers found statistical support for the hypothesis that the *type of disruption* that occurs influences *who* improvises.

6.5 The Dyad: Foremen Improvise the Plan and Crew Members Improvise the Execution

The results of the statistical analysis and the researchers' observations and qualitative data support the notion that the foreman plays a pivotal role on the jobsite. Daily and weekly planning is performed by the foreman, who then delegates the execution of the plans to the crew members. Hence, decision-making about the tasks that need to be completed each week and each day is the responsibility of the foreman, and execution of those tasks is the responsibility of the crew members. However, when a disruption occurs that impedes the crew member's task, the foreman, the crew member, or both parties may need to improvise decisions and actions in order to permit the work to continue. In the majority of instances, the foreman improvises a change to the plan (i.e., engages in "plan improvisation") and then delegates responsibility for executing the new plan to the crew members. Hence, if the planned task cannot be completed according to the plan, journeymen and apprentices often rely on the foreman to adjust the plan, and then they execute the new plan.

Sometimes the foreman will work together with the crew member to improvise a new plan when the task is disrupted, and then the crew member is responsible for executing the new plan. And occasionally, crew members who are journeyman are given the latitude to improvise a decision and action when their task is disrupted, followed by implementation of a new plan, but these instances are often dependent on the specific circumstances surrounding the disruption. In some cases, the journeyman electrician may improvise a change to the method for executing the original or new task (i.e., engage in "execution improvisation"), and much less frequently, apprentices may improvise a change to the method for executing the original or new task, but these improvised acts tend to occur when they lack the proper resources to proceed with the task, such as when a tool breaks. To conclude, improvisation in construction most often involves a dyad that consists of the foreman who improvises a new plan and a crew member who executes the new plan. This focus on the dyadic nature of improvisation in construction is unique, but this phenomenon likely exists in numerous other organizations.

7 Summary and Future Studies

This paper reported the results of a study that developed and tested two hypotheses on improvisation in the construction industry. Hypothesis 1 (H1) stated that the role of the crew member (i.e., journeyman, or apprentice) influences *who* improvises (i.e., foreman, journeyman, or crew member), and Hypothesis 2 (H2) stated that the *type of disruption* that occurs influences *who* improvises. A statistical analysis provided support for both hypotheses. Additional research on improvisational decisions and actions on construction sites is on-going, and the researchers expect to publish additional results on this fascinating phenomenon over the next few years.

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