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Self-Regulating Teamwork Behaviors in Low-Volume & High-Complexity Production

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SELF-REGULATING TEAMWORK BEHAVIORS

IN LOW-VOLUME & HIGH-COMPLEXITY PRODUCTION

by

Aaron W. Powell
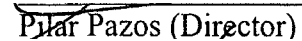B.S. May 1989, University of Tennessee
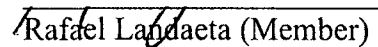M.E. May 1999, University of Virginia

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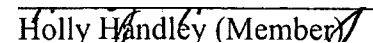Requirements for the Degree of

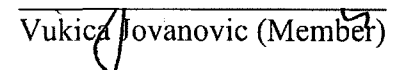DOCTOR OF PHILOSOPHY

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ABSTRACT

SELF-REGULATING TEAMWORK BEHAVIORS
IN LOW-VOLUME & HIGH-COMPLEXITY PRODUCTION

Aaron W. Powell
Old Dominion University, 2014
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An environment of ever increasing competition drives manufacturing organizations to continually search for ways to improve the performance of their production operations. Lean manufacturing, born out of the Toyota Production System (TPS), has become the dominant improvement method sought to meet this need. Although well established in high-volume production settings, the application of lean production methods in low-volume and high-complexity (LVHC) manufacturing contexts has not been as successful. A commonly cited reason is a biased focus on the technical aspects of implementing lean methods with little regard for the social system involved in the change. In the LVHC manufacturing context, the support required to make lean manufacturing methods successful resides in production work teams.

Prior research has demonstrated that high performance teams use self-regulating teamwork behaviors (SRTB) to prepare for work accomplishment, collaborate on taskwork, assess their performance, and make adjustments to meet their goals. The impact of SRTB on team performance is expected to be greater when the work cycle is longer, task complexity is higher, and people not technology control the pace of work. With those being primary features of the LVHC context, unique opportunities for enacting SRTB are present but how those behaviors can be accomplished in this context is not fully understood.

Our knowledge of how production operations can be improved through the socio-technical system of work teams can be significantly enhanced by conducting naturalistic empirical research under real-world conditions. The multiple case study method was used for this research in a LVHC manufacturing plant to explore how team composition, team context, and organizational context influence the generation and development of SRTB in

production work teams. From this research, the major factors and relationships that drive SRTB in this setting were identified and mapped, resulting in the formulation of propositions and a theoretical framework. Although especially relevant to LVHC manufacturers, this research also makes a theoretical and practical contribution to the discipline of engineering management by identifying critical factors and relationships in team composition and context for accomplishing SRTB.

This dissertation is dedicated to my wife and best friend, E.

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Learning and sharing what so many people have taught me over the years has always been important to me. Reaching this point in my lifelong journey of learning and teaching feels like I've landed (safely) on the moon and I realize that in no way did I get here by myself.

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Above all, I thank God. Thank you for giving me this opportunity and for creating in me a desire to continuously learn about what you have created.

NOMENCLATURE

SRTB	Self-Regulating Teamwork Behavior(s)
LVHC	Low-Volume High-Complexity
I-P-O	Input-Process-Output
IMOI	Input-Mediator-Output-Input
LSS	Lean Six-Sigma
TPS	Toyota Production System
EIP	Employee Involvement Program
Takt Time	Available time for work divided by the demand during the same period
WIP	Work In Process
HPU	Hours Per Unit (inverse productivity; common measure for LVHC production)
IOP	Internal Operating Plan
KSA	Knowledge, Skills, and Abilities

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CHAPTER 1

INTRODUCTION

1.1 Background of the Problem

Methods to improve manufacturing performance have long been a focus for operations management. Lean manufacturing, described by Womack, Roos, and Jones (2006) as a waste-focused philosophy that uses less of everything – less material, less labor, less time, and less space – has become the dominant improvement method sought. Born out of the Toyota Production System (TPS), lean manufacturing is established in high-volume production settings beyond the automotive industry but it is also reported that many companies have difficulty sustaining even half of the results from lean interventions in their manufacturing operations (Fraser, Harris, & Luong, 2007; Laraia, 1999). Furthermore, there has been limited success from attempts to introduce lean manufacturing practices into contexts different from where it originated, such as low-volume and high-complexity (LVHC) production. The LVHC production context is markedly different from the high-volume context; the work cycle is considerably longer, the scope of taskwork is significantly larger, and people not technology control the pace of work. To succeed in an environment of intense competition, LVHC producers need a better understanding of what is required to successfully implement and sustain the benefits of lean manufacturing methods.

An apparent reason for the difficulty in implementing and sustaining lean manufacturing methods is a historically biased focus on technical aspects with little regard for the social system involved in the change. Most all studies in the research literature involving lean production focus on technical performance outcomes, without empirically measuring human resource outcomes (Farris, Van Aken, Doolen, & Worley, 2009). A contemporary definition of lean production offered by Shah and Ward (2007) is an attempt to correct this bias; "Lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal variability" (p. 791). According to the socio-technical systems theory for work design, any technological change can disrupt the existing social

system and reduce the anticipated benefits of the new technology if the social system is not supportive and able to cope with the changes (Appelbaum, 1997).

In manufacturing, much of the social system support required to make process performance improvements successful involves production work teams. Teamwork is a fundamental feature of new manufacturing organizations and is widely reported as being required to enact and support many strategic and tactical innovations in manufacturing (Tranfield & Smith, 2002). Teamwork is also one of the five core values of TPS (Liker & Franz, 2011). Thus to understand how to increase manufacturing performance in LVHC contexts while developing the human resource support necessary for sustainment, future research should explore production work team factors (Doolen, Van Aken, Farris, Worley, & Huwe, 2008; Farris et al. 2009a; Farris, Van Aken, Doolen, & Worley, 2008).

It is now widely accepted that successful implementation and sustainment of lean manufacturing methods depends on both technical and social aspects (Fraser et al., 2007). Much research has been accomplished on the technical aspects of lean manufacturing and the methods to apply lean principles in production operations are well established. However, the focus on technical aspects has resulted in a mechanistic approach toward implementation, neglecting the social system that ultimately determines its effectiveness and sustainability. As noted by Liker and Franz (2011) in their book describing Toyota's approach toward continuous improvement, unless the social system involved in the process adopts new ways of thinking and behaving while developing skills that enable them to manage and improve the process themselves, "it will be a one-off change in their process, and over time you will see it degrade" (Liker & Franz, 2011, p. 19).

The social system most involved in a manufacturing process is the people that directly add value to the customer's product, often in the form of production work teams. There has been a substantial amount of research directed toward increasing our understanding of how a team's effectiveness is influenced. Among the multitude of factors bearing on a production work team's ability to be effective, those that comprise ways of thinking and behaving and skills that enable teams to manage and improve the process themselves may be at the heart of the matter for achieving and sustaining lean manufacturing methods.

In the case of work accomplished in a team setting, this multi-faceted collection of factors refers to behaviors that enable teams to collaboratively take on responsibilities for self-regulating their task accomplishment toward the achievement of established and shared team goals (Morgan, Salas, & Glickman, 1993; Rousseau et al., 2010; Rousseau et al., 2006). Used in combination, self-regulating teamwork behaviors (SRTB) encompass ways of thinking and behaving that can be used to effectively manage and improve performance. Although SRTB are typical of autonomous or self-managed teams, simply conferring a work team the autonomy to self-manage their performance does not necessarily translate into them using SRTB. Other factors internal and external to the team such as teamwork training, team resources, technical and interpersonal skills, reward/recognition systems and organizational support have been found to be critical in achieving and sustaining high performance in self-managed work teams (Wageman, 1997).

The LVHC context provides unique opportunities for enacting self-regulating teamwork behaviors in support of the complex interdependencies in the activities performed by teams. The temporal nature and complexity of the taskwork is significantly different than what is experienced by workers in high volume and low complexity production. These features of the taskwork require an increased reliance on SRTB to have a positive impact on a work team's performance.

Because the markets for LVHC producers are generally high-value products with low volume, the takt time required to meet customer demand can be considerably longer than that required of high-volume producers. The takt time is basically how often a product must be completed and LVHC production workers experience it as the rhythm of their process. Whereas the takt time in a high-volume setting may be measured in seconds or minutes, the takt time in a low-volume setting is usually measured in days. Thus, a significant and contrasting feature of the taskwork for LVHC production work teams is the *fundamental work cycle*. Defined as the smallest meaningful unit of collective activity for a team (Devine, 2002), the fundamental work cycle constitutes the input-process-output cycle around which team activity is structured and measured in terms of effectiveness. According to Devine (2002) work groups with longer work cycles

should have the "luxury" of engaging in optimal behaviors to manage and improve their performance, such as SRTB.

The *scope of taskwork* assigned to team members in LVHC production is also larger than that of high-volume producers, bringing more complexity to their work. Task scope refers to the breadth or range of taskwork, or the extent to which a team's task may be divided into several subtasks (Rothrock, Harvey, & Burns, 2005). The large scope of LVHC taskwork increases component complexity, the number of distinct acts and information cues that must be processed to complete a task (Wood, 1986). As component complexity increases so too do the knowledge and skill requirements for the taskwork. The scope also increases the number of input-process relationships and sequencing requirements for tasks, or coordinative complexity (Wood, 1986). According to Man and Lam (2003) work groups with complex tasks need to adopt diverse teamwork behaviors, which should lead to increased interdependency and cohesion.

In high-volume production, the typical use of machinery and automation to accomplish work links people to technology in a fashion that controls the pace of taskwork (e.g. an automobile assembly line or machine cell). However, manual fabrication and assembly is prevalent in the LVHC context such that the pace for taskwork is normally governed by people and not the technology being used. A direct match to *taskwork pace control* could not be found in the taxonomies of prior literature reviewed for this research. However, it is similar to Hackman's (1987) definition of *task autonomy* which is the degree to which team members experience substantial freedom, independence, and discretion in their work. Task autonomy is proposed to increase internal work motivation through the experience of responsibility (Hackman, 2002).

The impact of SRTB on team performance is expected to be greater when the work cycle is longer, task complexity is higher, and people not technology control the pace of work. Thus, the contributions of this research are especially relevant to LVHC manufacturers. The problem for this research is that effective self-regulating teamwork behaviors are thought necessary to achieve high performance in LVHC production but we do not fully understand how those behaviors can be accomplished in this context.

1.2 Central Research Question

Although team research has made many advancements over the years, there still remains a lack of explicit guidance to enable leaders of organizations to create and support effective production work teams within the complexity of their specific manufacturing context. Many factors can influence work team effectiveness but the behaviors that enable teams to manage and improve the process themselves have been labeled as a black box (Salas, Burke, & Cannon-Bowers, 2000). Prior research on the self-regulation of team performance also suggests that understanding the surrounding organizational context is necessary to create effective work team designs (Morgeson, Johnson, Campion, Medsker, & Mumford, 2006).

To close this gap in understanding, there is a genuine need to advance empirical research on production work teams in their real-life context, or putting it another way "to conduct research in the wild" (Salas, Stagl, & Burke, 2004, p. 68). This research answers that call by providing empirical evidence for how team composition and context influence SRTB in a LVHC production setting. The research used the exploratory case study method to conduct in-depth field-studies of production work teams in their real-life context.

The context-specific knowledge gained from this research will increase our understanding of the factors and relationships that are conducive to effective teamwork. This study will also contribute to practice by shedding light on the key factors driving SRTB in the LVHC context and providing a roadmap for creating and supporting more effective production work teams..

The case study method is relevant when trying to obtain in-depth answers to *how* or *why* some social phenomenon works under situations in which there will be many more variables of interest than data points (Yin, 2009). In qualitative research such as the case study, the intent is to explore, explain, or describe the complex set of factors surrounding a central phenomenon. For this research, SRTB is the central phenomenon.

While quantitative studies typically rely on hypotheses tests to build knowledge, qualitative studies contribute to theory development by answering broader research questions. These questions assume two forms: a central question and associated

subquestions. The central research question should be the broadest question that can be asked of the study so as to not limit the inquiry while still providing a focus for data collection and analysis from multiple sources of evidence (Creswell, 2009). Much of the prior research on self-managed work teams has centered on the aspect of creating conditions that promote or support team self-management; less is known about what causes those behaviors to be generated. The intent of this research was not only to understand how SRTB can be supported but also to understand how it can be created in the first place. Thus, the central question for this research was *how can self-regulating teamwork behaviors be accomplished in LVHC production work teams?*

To answer the central question of this research, the exploratory case study method was used on purposefully selected work teams to provide replication of how composition and context influence SRTB. Unlike experimentation, case study research cannot actually prove anything but embedded in its findings is a potential causal path that can point to possible cause-and-effect relationships (Yin, 2003). This research provides an in-depth understanding of how and why the phenomenon of SRTB works in a real-world setting of LVHC production and it provides supporting evidence for potential causal relationships.

The organization participating in the research (the site) is part of a larger Fortune 500 corporation located in the eastern United States that designs and manufactures a variety of high-value products for both commercial and defense global markets. The site currently employs over 500 people. Of the total employees at the site, approximately 65% comprise the production workforce that is organized through a national labor union. The site's senior leadership considers effective production teamwork to be a key success factor for improving its operational performance and maintaining its competitive advantage.

CHAPTER 2

LITERATURE REVIEW AND FRAMEWORK

This chapter explains the development of the theory related to the research. Following a review of the literature on the subject, the theoretical framework for the research is presented.

2.1 Literature Review

Empirical research on the topic of lean production work teams is in short supply. To develop a theoretical framework to adequately address the complex problem for this research, a review of the most relevant published literature over the last 30 years was performed on team effectiveness in general and lean production work teams in particular.

Several databases in the Old Dominion University (ODU) online library were searched to obtain articles for the literature review from journals such as Academy of Management Journal, Engineering Management Journal, International Journal of Production Research, International Journal of Productivity and Performance Management, International Journal of Production Economics, Journal of Operations Management, International Journal of Operations and Production Management, Small Group Research, and Team Performance Management. From the search, over 300 articles were reviewed for their applicability to this research problem, including empirical research, meta-analysis, literature reviews, and conceptual articles. Those articles found to have relevant and substantial information to support the research problem were selected to understand the current state of knowledge from prior research conducted on this topic.

2.1.1 Team Effectiveness

The most common frameworks used to study the performance of teams have their origins in the I-P-O (input-process-output) model (Hackman, 1987; McGrath, 1984; Steiner, 1972). In this model, a team is described in terms of a system which transforms inputs into measurable outputs through team processes. However, in reality teams are complex and dynamic systems that are influenced over time by their contexts, mutual

interactions, and performance feedback. Thus, a simple cause and effect model for team effectiveness does not accurately capture their real world complexity. Following much research on team effectiveness, the most contemporary integrated framework for studying team effectiveness is known as an Input-Mediator-Output-Input (IMOI) model depicted in Figure 1 (Mathieu, Maynard, Rapp, & Gilson, 2008).
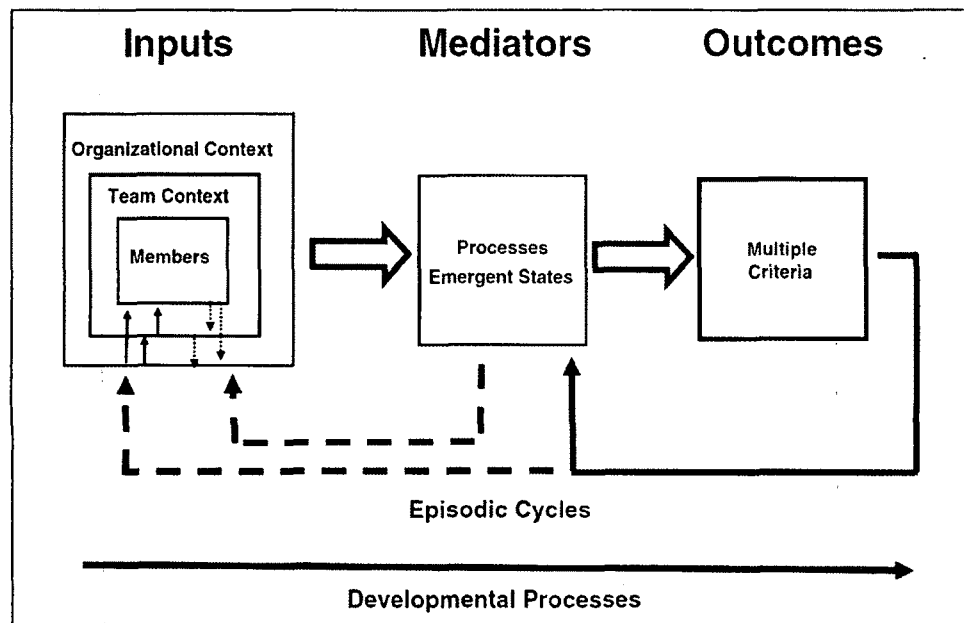
Figure 1. Contemporary Framework of Team Effectiveness (Mathieu et al., 2008)

The IMOI model is more adequate in characterizing teams because it includes important features missing in the simpler I-P-O model. For instance, it recognizes that many factors that mediate the influence of inputs to outcomes are not actually processes but instead are emergent cognitive or affective states associated with the team (emergent states). It also emphasizes that team performance develops over time and may also be cyclic in nature where traditional outputs like team performance become inputs that will influence future episodes (Ilgen, Hollenbeck, Johnson, & Jundt, 2005). Even though the IMOI framework is more conducive to understanding team dynamics, it still does not propose mechanisms that generate effective teamwork (Millward, Banks, & Riga, 2010).

What constitutes *team effectiveness* is a complex issue and a review of prior research reveals that team effectiveness criteria have evolved to include different forms and they depend on the nature of the team and its objectives (Mathieu et al., 2008). However, throughout the literature it is generally recognized that a team's effectiveness can be evaluated from their impact on outcomes such as performance, team member attitudes, and team member outcome behaviors (Cohen & Bailey, 1997; LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Mathieu et al., 2008; Pina, A. Martinez, & L. Martinez, 2008; Ross & Jones, 2008). This approach proposed by Cohen and Bailey in 1997 seems to have stood the test of time. Several earlier publications contain elements that point toward this eventual categorization of multi-dimensional effectiveness (Campion, Medsker, & Higgs, 1993; Guzzo & Shea, 1996; Hyatt & Ruddy, 1997; Sundstrom, DeMeuse, & Futrell, 1990) and most recent publications either use it outright in their model to conduct research on team effectiveness or acknowledge its validity to do so (LePine et al., 2008; Mathieu et al., 2008; Pina et al., 2008; Ross & Jones, 2008).

Performance has been the most frequently studied outcome variable in work team effectiveness research. In a broad sense, performance can be thought of as acceptability of output to customer expectations (within or outside the organization) regarding quantity, quality, timeliness, and cost reliability (Bond, 1999; Ross & Jones, 2008; Sundstrom et al., 1990). Performance measures involve the technical system and are studied using both objective and subjective means. Objective performance measures are usually specific to the team's type of work and goals. A varied list of examples appearing in the literature includes productivity, response times, customer complaints, quality metrics, financial ratios, and ideas generated (Campion et al., 1993; Cohen & Bailey, 1997; Guzzo & Dickson, 1996; Hyatt & Ruddy, 1997; Mathieu et al., 2008; Pina et al., 2008). Subjective performance measures can be obtained from survey instruments designed to assess perceptions of team performance from team members themselves, from managers, or both (Brown & Mitchell, 1991; Campion et al., 1993; Doolen, Hacker, & Van Aken, 2003; Hyatt & Ruddy,1997; LePine et al., 2008; O'Connell, Doverspike, Cober, & Philips, 2001).

Attitude is a social construct that represents team members' affect toward their involvement in the work team or the larger organization and it is often assessed quantitatively from items on survey instruments. Unlike personality, attitudes may change as a function of experience. Common attitudinal measures found in the work team literature include team member satisfaction, commitment, and trust in management (Campion et al., 1993; Cohen & Bailey, 1997; Doolen et al., 2003; LePine et al., 2008; Mathieu et al., 2008; Pina et al., 2008). Team viability is also an affective construct often found in the research literature that considers the extent to which individuals want to remain as members of the team (Mathieu et al., 2008; Guzzo & Dickson, 1996; Sundstrom et al., 1990; Wageman, Hackman, & Lehman, 2005).

Behavior, as a social system outcome, considers how team members act in response to each other, to job circumstances, and to perceived controls on behavior (Ross & Jones, 2008). Examples of behavioral outcome measures include absenteeism, turnover, and safety (Cohen & Bailey, 1997; O'Connell et al., 2001) or more complex measures such as team process improvement, learning behaviors, and cognitive task performance (Mathieu et al., 2008).

2.1.2 Team Inputs

The most recent comprehensive review of team effectiveness literature by Mathieu et al. (2008) succinctly categorized numerous team input factors into three separate dimensions: team composition, team context, and organizational context. Following is a description of the most researched input factors and their proposed influence on the effectiveness of teams.

2.1.2.1 Team Composition

Team composition involves the member attributes and their collective impact on the team's effectiveness. Empirical results for the significance of team composition on work team effectiveness have yielded mixed results (Barrick, Stewart, Neubert, & Mount, 1998). For example, the results from team research examining the effects of *demographic diversity* (e.g. age, race, gender, tenure, and education) and *functional diversity* on a

team's effectiveness have given mixed results, especially when viewed from a longitudinal perspective. That is, the effects from diversity may change as members spend more time interacting (Campion et al., 1993; Mathieu et al., 2008).

The *flexibility* of members in terms of job assignments is thought to enhance performance by providing the capability to support or fill in for other team members when needed. As another example of mixed results, empirical findings from one study supported a significant and positive relationship between member flexibility and team effectiveness, but only as viewed from the judgment of managers and not from the team's perspective (Campion et al., 1993).

Team research has more clearly demonstrated that individual member attributes such as *social skills, personality characteristics,* and *teamwork knowledge* can affect the individual's value in a team setting (Morgeson, Reider, & Campion, 2005). In studies of assembly work teams, different aspects of team member personality have been found to directly influence both team performance and team viability (O'Connell et al., 2001; Barrick et al., 1998). Specific personality traits have also been found to influence team viability through the mediator team cohesion (Barrick et al., 1998).

The interaction required in self-managed team settings brings out the need for a unique set of knowledge, skills, and abilities (KSA) that members should possess in order to be effective team contributors. According to a review of team literature performed by Stevens and Campion (1994), KSAs required of self-managed team members can be categorized as *conflict management, collaborative problem solving, communication,* and *self-management.*

Conflict inevitably arises as a consequence of group functioning. Having a team composed of members that possess the KSAs to effectively manage conflict is crucial to a team's effectiveness. Stevens and Campion (1994) postulate that for a team to be capable of managing conflict productively, members should possess the KSAs to differentiate between desirable and undesirable conflict, recognize the type and source of conflict, and use an integrative (win-win) strategy to resolve conflict. Beyond handling conflict, self-managed teams are expected to *take the initiative* to solve all of their problems on their own. As such, team members must possess the KSAs to identify situations requiring

collaborative problem solving, recognize the obstacles preventing this behavior, and implement corrective actions to accomplish it (Stevens & Campion, 1994).

Effective communication is known to positively impact team effectiveness, but it involves more than just the ability to converse with others (Campion, et al., 1993). Individual team members must possess certain KSAs related to communication to be valuable team contributors. Members must be capable of communicating openly, listening without evaluating, recognizing and interpreting nonverbal messages, engaging in important small-talk, and understanding how networks can enhance the effectiveness of communication (Stevens & Campion, 1994).

In self-managed teams, members must possess the KSAs appropriate to control the direction and execution of the team's tasks. First, members must be capable of assisting the team to prepare for work accomplishment by establishing goals. Next, team members must be helpful in defining task and role expectations among team members to ensure proper work load balancing. Workload sharing may remove the negative effects of social-loafing or free-riding and has been found to be strongly predictive of productivity as well as manager's judgments of effectiveness (Campion et al., 1993). To effectively execute the team's planned activities, all members must be willing and capable of participating in the coordination and synchronization of activities and information. Finally, members must possess the capability to monitor, evaluate, and provide feedback on both individual and overall team performance.

2.1.2.2 Team Context

The design of a team's job is a team-level input that has received much attention in the team effectiveness research. Relying on motivational job design theory, Campion et al. (1993) composed a theme of job characteristics that have been used to predict the effectiveness of work teams. The job design theme includes factors such as self-management, participation, task variety, task significance, and task identity.

Self-management is considered for the work team to be analogous to autonomy at the individual job level. Self-managing work teams are groups of individuals with interdependent tasks who are responsible for relatively whole tasks such as making a

product or providing a service and who possess the autonomy to make decisions such as work assignments, work methods, and scheduling of activities (Cohen, Ledford, & Spreitzer, 1996; Rousseau & Aube, 2010). Even though a team's self-management takes on some operational duties traditionally performed by a supervisor, a direct supervisor or team leader may still be assigned to self-managing teams to encourage them to manage their work activities and provide boundary-spanning support (O'Connell et al., 2002). Self-management puts decision-making authority at the operational level, reducing the response time and increasing the accuracy of problem solving (Tata & Prasad, 2004).

Participation is a measure of the degree that team members participate in making decisions that impact aspects of the team. Both self-management and participation are thought to enhance work team effectiveness by improving the quality of decisions while also creating an increased sense of shared responsibility (Campion et al, 1993; Cohen et al., 1996). Empirical research has found both self-management and participation to have a strong impact on performance and attitudinal criteria of effectiveness such as job satisfaction, organizational commitment, and trust in management but results from their impact on behavior have been mixed (Campion et al., 1993; Cohen & Bailey, 1990).

A team's *taskwork design* in relation to its variety, significance, and identity is hypothesized to increase effectiveness in work teams as a result of their impact on motivation and self-regulation according to socio-technical theory (Cohen et al., 1996). The extent to which team members accomplish their work in a consistent or repetitive manner, or *task routineness*, has also been found to moderate the relationship between self-management behaviors and a team's performance and viability (Rousseau & Aube, 2010). That is, the impact of team self-management behaviors on performance and viability is higher when the degree of task routineness is low (i.e. work is more complex).

Task interdependency is a factor that has received substantial attention in team effectiveness research (Mathieu et al., 2008). Task interdependency describes the extent that team members must interact, share resources, and work cooperatively to accomplish their work tasks. The level of required interaction among team members increases with the type and complexity of interdependency (pooled, sequential, reciprocal, and intensive) (Beal, Cohen, Burke, & McLendon, 2003). Under conditions of the lowest

level of task interdependence, called *pooled*, no interactions or exchanges between group members are required to accomplish the group's goals. The workflow involves tasks that aggregate individual performances of the members to the group level. *Sequential* interdependence involves a workflow of tasks that move from one member to another but not in a back-and-forth manner. Thus, group performance depends on how the work progresses through each member of the group. *Reciprocal* interdependence is similar to sequential but the workflow is bidirectional; members can exchange work with one another multiple times before their product leaves the group. The highest level of interdependency, called *intensive*, is when work flows between all members of the group and the entire group must collaborate to accomplish the task.

An interdependent task design has been shown to positively impact performance with higher levels of interdependency also facilitating internal processes such as cooperation and learning (Cohen & Bailey, 1997). Task interdependency has also been found to moderate the effect of both individual and team-level autonomy on the performance of work teams (Langfred, 2005). Research indicates that in order to obtain higher team performance, teams with high task interdependence should be given high team-level autonomy but low individual autonomy.

The content of training is a team context factor that may address both the technical skills required for taskwork and the social skills required for interpersonal processes. Most researchers agree that technical skills training should be directed toward individual team members but teamwork skills training should be delivered to the intact team (Mathieu et al., 2008). A particular type of technical skills training in production work teams, called *cross-training*, increases a team's flexibility by distributing skills such that members can rotate jobs. Job rotation has been shown to positively impact team performance by enhancing team problem solving and providing an even distribution of multi-functionality among production team members (McDonald, Ellis, Van Aken, & Koelling, 2009; Slomp & Molleman, 2002). The availability of training has also been found to significantly impact attitudes among production work teams, with a team's access to training and their perceptions of its quality both being positively related to team member satisfaction (Campion et al., 1993; Doolen et al., 2003).

Finally, *leadership* is a significant team context input that impacts a team's effectiveness. Leadership can be provided to a team in various ways, but most commonly it comes from an individual external to the team such as a supervisor or a coach/mentor (Mathieu et al., 2008). In a field study involving over 100 manufacturing teams from 3 different organizations, the actions of external leaders were found to have the effect of reducing or enhancing team empowerment experiences. The empowered teams were found to be more effective, having higher levels of productivity, job satisfaction, and commitment (Kirkman & Rosen, 1999).

2.1.3 Mediators of Team Inputs

In the I-P-O framework for team effectiveness, team processes have been defined as "members' interdependent acts that convert inputs to outcomes through cognitive, verbal, and behavioral activities directed toward organizing taskwork to achieve collective goals" (Marks, Mathieu, & Zaccaro, 2001, p. 357). Put more succinctly, a team's process factors can be described as "those things that go on in the group that influence effectiveness" (Campion, et al., 1993, p. 829). Much research has been devoted to understanding the processes that transform team inputs into outcomes. Along the way, many different models have been developed in an attempt to accurately describe this team phenomenon. The prior research presented in this section follows the approach that teams change and develop over time as they adapt to their contexts and make adjustments while receiving performance feedback (Marks et al., 2001; Mathieu et al., 2008; Rousseau, Aube, & Savoie, 2006; Sundstrom et al., 1990).

In their review and synthesis of prior research on team processes, Marks et al. (2001) proposed a temporally-based framework that has been accepted in subsequent literature as an appropriate means for studying the processes of work teams (LePine et al., 2008; Mathieu et al., 2008; Dineen & Noe, 2003; Rousseau et al., 2006). Through this framework the work of production teams can be viewed as a series of related Input-Process-Outcome cycles composed of action and transition phases that accrue performance while receiving feedback and managing interpersonal relationships (Marks et al., 2001). The episodes are identified by goal accomplishment periods and are often

broken down into subsections of more limited scope that contribute to a larger effort. The conclusion of one episode can initiate the beginning of another, or in more complex arrangements the episodes may overlap.

Following on the team processes work of Marks et al. (2001), Rousseau et al. (2006) developed an integrative framework of teamwork behaviors by performing an inductive content analysis of many different teamwork models appearing in the research literature. In the research literature, the term *team processes* tends to combine all of the behavioral, cognitive, and affective phenomena existing in teams to describe how their inputs are transformed into outputs. *Teamwork behaviors* are distinct among the processes in that they are observable and measurable actions that can affect the social and physical environment (Rousseau et al., 2006).

The model for teamwork behaviors posited by Rousseau et al. (2006) has a hierarchical structure that is framed from the perspective of when certain teamwork behaviors are most likely to occur and have their intended effect. The teamwork behaviors are categorized into two broad dimensions related to either the achievement of task-related team goals (*regulation of team performance*) or holding team members together (*management of team maintenance*).

To organize the dimensions of behaviors associated with the regulation of team performance, Rousseau et al. (2006) relied on *action regulation theory* (Frese & Zapf, 1994). Action regulation theory posits that individuals can attain high performance by applying sequential regulation functions during task accomplishment, namely preparation, execution, evaluation, and adjustment. Converting these functions into a teamwork context, the work of teams can also be explained from temporal-based behaviors used to achieve their goals.

First, teams prepare for work accomplishment by orienting themselves to standards for subsequent action (*preparation of work accomplishment*). They then work together on task-related activities by executing planned actions (*task-related collaborative behaviors*). Meanwhile, teams receive feedback on their performance by monitoring and evaluating progress toward their goals (*work assessment behaviors*). Finally, depending on the feedback received, teams may make adjustments to complete

task-related goals (*team adjustment behaviors*). As in the Marks et al. (2001) model for teamwork processes, these team regulation functions can also be present in cyclical episodes that are simultaneously performed on multiple tasks to achieve sub-goals while building on the accomplishment of a larger goal. Figure 2 depicts this sequence for the regulation of team performance behaviors according to Rosseau et al. (2006).

| Preparation of work accomplishment | → | Task-related collaborative behaviors | → | Work assessment behaviors | → | Team adjustment behaviors |

Figure 2. Sequential Regulation of Team Performance (Rousseau et al., 2006)

2.1.3.1 Self-Regulating Teamwork Behaviors

According to Rousseau et al. (2006), the teamwork behaviors involved in the preparation for work accomplishment include team mission analysis followed by goal specification and then planning. Marks et al. (2001) referred to these sequential behaviors as occurring during transition phases, when teams focus on performance evaluation or planning activities to guide goal accomplishment between periodic episodes. This group of team processes has little empirical evidence to indicate its relation with team effectiveness (Mathieu et al., 2008).

When a team collectively interprets and evaluates the team's purpose and main tasks, they are preparing for work accomplishment by performing *mission analysis*. This teamwork behavior is especially important for members who have not worked together before, since it ensures that all members understand and share a common vision (Rousseau et al., 2006). Performing a thorough mission analysis enables team members to subsequently focus their attention and efforts on what is really important from the perspective of the team's reason for being (Sundstrom et al., 1990).

Once the mission to be accomplished has been established for the team, *goal specification* involves the identification and prioritization of goals and subgoals that will provide the team with an aligned and time-based strategy in preparation for work accomplishment (Rousseau et al., 2006). To be effective, a team's goals must be specific, challenging, and accepted by all members of the team (Stevens & Campion, 1994). Ineffective goal specification negatively affects team performance (Marks et al., 2001).

To complete the transition phase between episodic work cycles, *planning* (or strategy formulation) is used to develop alternative courses of action for mission accomplishment (Marks et al., 2001). During the time that this teamwork behavior is accomplished, decisions are made about how members will approach their tasks, who will do what work, how work will be prioritized, what the expectations are for each member during subsequent task accomplishment, and the communication of the plan to all members. Team effectiveness has been found to depend on a team's capacity to plan and coordinate tasks and information, and the amount of planning and coordination required increases as a team's level of interdependency increases (Stevens & Campion, 1994). Teams are more effective when their plans consider situational and time constraints, the availability of team resources, the capabilities of team members, and the changing nature of the team's context and external environment (Marks et al., 2001).

Subsequent to the preparation of work accomplishment, collaborative behaviors used for task execution can be categorized into three dimensions: integrating team member's activities (*coordination*), working together on a task (*cooperation*), and sharing task-related information (*information exchange*) (Rousseau et al., 2006). Collaborative teamwork behaviors have been found to positively predict cohesion and effectiveness through the outcomes attitude and performance (Marks et al. 2001). Regarding collaboration, task interdependency has been shown to moderate the effect of cohesion on performance, i.e. teams with higher task interdependency show a larger effect from cohesion on their performance (Cohen & Bailey, 1990).

Coordination involves the integration of team members' activities to ensure that their tasks are properly sequenced, synchronized, and accomplished within established

time constraints without duplicating or wasting efforts (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995).

Cooperation involves the willful act of team members working together during interdependent task execution to complete what would be difficult or even impossible to complete otherwise. Cooperative behaviors should be considered different from backup behaviors in that they are shown when team members work together to accomplish collective tasks at the same time (Rousseau et al., 2006). Research has shown that cooperation improves team effectiveness and the presence of a single disagreeable member within the team can hamper their ability to work cooperatively (Barrick et al., 1998; Hyatt & Ruddy, 1997).

Team members sharing task-related information between themselves is called *information exchange* by Rousseau et al. (2006). The exchange of information may involve the availability of resources, changes in demands from customers and receipts from suppliers, delays in task accomplishment, and direction from management. When the exchange of information flows well within teams, their effectiveness is improved because each member possesses the information necessary to accomplish their part of the team's work and to enact backup behaviors when required (Campion et al., 1993, Marks et al., 2001).

As in the Marks et al. (2001) model for action phase processes, Rousseau et al. (2006) recognize two work assessment behaviors used to monitor a team's performance and environment while making progress toward their goals. These work assessment behaviors include *performance monitoring* and *systems monitoring*.

Performance monitoring involves tracking progress toward goal attainment and communicating progress between members (Marks et al., 2001). The provision of task feedback is critical to accomplish this behavior effectively, especially for self-managing work teams (Cohen et al., 1996). Performance monitoring functions as a means of self-regulation, alerting teams when performance deficiencies are present and enabling them to adjust accordingly (Marks et al., 2001). Teams are most effective when their performance monitoring involves keeping track of other team members' taskwork in addition to their own (Rousseau et al., 2006).

Systems monitoring refers to the behavior of tracking the team's internal resources such as personnel, equipment, materials, and the information necessary to complete taskwork (Marks et al., 2001). Inevitably, the conditions that teams work in will change over time. Teams that monitor their internal resources are better suited to adjust their task strategies and respond more quickly to the changes that occur (Cannon-Bowers et al., 1995; Marks et al., 2001).

Following the evaluation of team performance from feedback, team members may need to make adjustments in order to affect progress meeting their goals. To account for unexpected performance demands, such as a lack of resources or equipment failures, teams adjust by backing up and coaching other team members, solving problems collaboratively, and practicing innovation as a team (Rousseau et al., 2006).

Providing that team members have the time, resources, and skills to help their team members, *backup behavior* can take the form of helping someone complete their task, filling in for an absent team member, helping to correct task-related errors, or providing resources or supplies that are not available to all team members (Rousseau et al., 2006). For backup behavior to occur effectively, team members must be informed of others' assignments and task status in order to be capable of identifying when and what type of assistance is required (Marks et al., 2001).

A team may also use team adjustment behaviors by recognizing ineffective individual performance and providing feedback or *intra-team coaching* to correct performance-related mistakes. Intra-team coaching allows team members to learn from each other, as long as this type of retroaction from fellow members is openly received (Rousseau et al., 2006). Research has shown that intra-team coaching positively influences self-management, cohesion, and member attitude (Wageman, 2001).

Many of the technical problems experienced by teams may lead them to collaborate in solving problems or to innovate and develop improved ways of accomplishing tasks. *Collaborative problem solving* brings out multiple perspectives on a situation and can increase decision quality while *team practice innovation* can make it possible for the team to react more effectively when faced with future changes in task requirements (Rousseau et al., 2006).

Several cases of research on these team behaviors (task-related collaboration, work assessment, adjustment) have demonstrated significant relationships with team effectiveness criteria such as team performance, member satisfaction, and viability and with the emergent states cohesion and team potency (Campion et al., 1993; Doolen et al., 2003; Hyatt & Ruddy, 1997; LePine et al., 2008; Mathieu et al., 2008; Sundstrom et al., 1990). Research has also shown these relationships may be moderated by a team's level of interdependence and size (Doolen et al., 2003; Lepine et al., 2008).

2.1.3.2 Team Emergent States

A review of the prior research reveals that many of the factors influencing the relationship between a team's inputs and their outputs are not actually processes, but instead are mediating factors now termed emergent states (Ilgen et al., 2005; Marks et al., 2001; Mathieu et al., 2008). Including such constructs as team potency, cohesion, empowerment, trust, and group norms, emergent states characterize the dynamic properties of teams that result from their previous experiences and contribute to future effectiveness (Marks et al., 2001). Unlike team process or behavior factors that involve member interaction, emergent states describe the cognitive, motivational, and affective states of teams that emerge from a series of related work cycles and can be considered as both inputs and outcomes (Marks et al., 2001).

The three emergent states receiving the most attention in the research literature and found to significantly impact teamwork behaviors and outcomes are cohesion (Barrick et al., 1998; Dineen & Noe, 2003; Guzzo & Dickson, 1996; Ilgen et al., 2005; LePine et al., 2008; Mathieu et al., 2008; Sundstrom et al., 1990), potency (confidence/efficacy) (Campion et al., 1993; Dineen & Noe, 2003; Hyatt & Ruddy, 1997; LePine et al., 2008; Mathieu et al., 2008), and team empowerment (Kirkman & Rosen, 1999; Mathieu et al., 2008; Mathieu et al., 2006).

Cohesion has been demonstrated to relate positively with both performance and team member affective constructs such as attitude and team viability (Mathieu et al., 2008). Cohesion can be defined as members' attraction and commitment to their team, its members, and the team's task (Lepine, et al, 2008). The degree of cohesion associated

with a team may depend on the proximity of work locations for members, with tighter physical arrangements allowing for more informal, face-to-face interaction (Sundstrom et al., 1990). The cohesion of a team is also proposed to be affected by team fluidity, or the turnover that occurs in a team over time (Dineen & Noe, 2003). Prior research has also demonstrated that member attributes such as extraversion and emotional stability are associated with team viability through the mediating factor cohesion (Barrick et al, 1998). In addition to directly impacting team effectiveness, cohesion has also been found to mediate the relationship between team potency and effectiveness (Ilgen et al., 2005).

Potency, or the belief among team members that they can be effective, is a motivational construct that has been found to be the strongest predictor of work team effectiveness when studied along with other mediators such as psychological support, workload sharing, communication, and cooperation within a team (Campion et al., 1993). Potency is a mediating factor that is thought to be very sensitive to the time it is measured. That is, teams that have been performing well by meeting their goals and possibly being recognized by management may report a higher level of potency than other groups not yet receiving this feedback (Hyatt & Ruddy, 1997). The degree of teamwork behaviors observed within a group have been found to be strongly related to potency, i.e. the more a team practices positive teamwork behaviors the higher they report their level of potency (Lepine et al., 2008). As with cohesion, team potency is also proposed to be negatively affected by team fluidity (Dineen & Noe, 2003). Potency has also been defined as a dimension of team empowerment (Kirkman & Rossen, 1999).

Two different concepts for team empowerment exist in the literature: structural and psychological (Mathieu et al., 2006). *Structural empowerment* involves the practice of delegating authority and responsibility to employees, drawing on job design characteristics such as self-management. Basically focusing on work arrangements, structural empowerment alters the role of external leadership and many responsibilities traditionally handled by management are shifted to team members. However, just because a work team is conferred autonomy does not necessarily translate into psychological empowerment. The extent to which team members have the ability to make business decisions, are accountable for the outcomes of their decisions, accept

responsibility for the outcomes of their decisions, and can solve problems on their own is *psychological team empowerment* (Hyatt & Ruddy, 1997). This concept of empowerment is a perceived authority that members may possess regarding their ability to control their work and assume responsibility for their work outcomes (Mathieu et al., 2006).

Team empowerment has been found to have a positive impact on effectiveness outcomes such as productivity, team process improvement, customer service, job satisfaction, organizational commitment, and team commitment (Kirkman & Rossen, 1999). Antecedents of psychological team empowerment are thought to include factors such as external leader behavior, regulation of team performance, and team-based human resource policies (e.g. team-based rewards, cross-training) (Kirkman & Rosen, 1999).

2.1.4 Prior Research Involving Lean Production Work Teams

Teams play a crucial role in lean production, emerging as the "heart of the lean factory" (Womack et al., 2006, p. 9). Teamwork is reported as critical in cellular manufacturing, a lean production method often found in high-volume production settings. Cellular manufacturing is a form of group technology where dissimilar machines, equipment, or processes are co-located to produce products similar to one another using a small multi-functional and interdependent team (Bidanda et al, 2005; Brown & Mitchell, 1991; Olorunniwo & Udo, 2002). The combination of people and equipment utilized in this production technique is known as a *cell*. The cellular manufacturing approach most often results in superior technical performance compared to traditional batch manufacturing where the machines, equipment, or processes are organized and co-located by similar function. However, cellular manufacturing requires the human resources to possess a higher level of technical skills and flexibility (multi-functionality) and to have the ability to work effectively in teams (interdependently) (Bidanda et al., 2005).

It is now widely accepted that successful implementation and sustainment of team-based cellular manufacturing depends on both technical and social elements but little quantitative research has been conducted to date on this topic (Fraser et al., 2007). However, in a qualitative study of cellular manufacturing implementation at 46 different

sites it was observed that human resource issues outnumbered technical issues in producing negative results (Wemmerlov & Johnson, 1997).

One of the most commonly noted factors affecting implementation of team-based cellular manufacturing is employee involvement in the cell design process. Prior research indicates that successful implementation of team-based manufacturing cells requires significant involvement in the design and development activities from those who will eventually operate, manage, support, and maintain the cell (Fraser et al., 2007; Hyer, Brown, & Zimmerman, 1999; Olorunniwo & Udo, 2002; Wemmerlov & Johnson, 2000). Whether team members are selected to work in a cell from volunteers or chosen by management may have a differential impact on the sustained success of the cell but research has not supported this hypothesis (Olorunniwo & Udo, 2002). However, team composition has been found significant in predicting performance. Members must possess the ability to work collaboratively, be trainable to develop multiple skills, and have developed communication skills for problem resolution and conflict management (Fraser et al., 2007; Olorunniwo & Udo, 2002).

A high level of task-interdependence is inherent in team-based cellular manufacturing, most often sequential or reciprocal. Prior research shows that both managers and workers perceive cellular manufacturing to require more coordination activities and reliance on co-workers than traditional batch-type manufacturing (Brown & Mitchell, 1991; Park & Han, 2002). In light of the high level of interdependency, a particular team-level input found to significantly improve the effectiveness of cellular manufacturing teams is *cross-training*. Cross-training involves duplicating the knowledge and skills for multiple tasks in a work cell among different team members to achieve increased flexibility, a shared sense of responsibility, and a balanced workload (McDonald et al., 2009). Cross-training has been found to improve teamwork processes, communication, and task performance (Olorunniwo & Udo, 2002; Volpe, Cannon-Bowers, Salas, & Spector, 1996). However, it has been found that as the level of cross-training increases the relative improvement in performance decreases (Bidanda et al., 2005; McDonald et al., 2009).

It has been found that when cellular manufacturing teams autonomously coordinate and track job status within their cells by monitoring goal progress and the status of their systems (e.g. availability of equipment, materials, and other support resources), that delivery response, product quality, and costs tend to improve (Olorunniwo & Udo, 2002). Likewise, it would seem that team monitoring in the forms of providing feedback or coaching, partial assistance in carrying out actions, or assuming and completing a task for a teammate would also tend to improve other team processes and performance but no evidence of research on this work team factor could be found involving cellular manufacturing teams.

It has been suggested that even though the physical layout used in cellular manufacturing allows for an immediate detection and response to variances in performance among team members, employees may feel uncomfortable providing feedback to their peers (Huber & Brown, 1991). It is thought that for team monitoring and backup behavior to occur effectively, individuals within the team must possess the KSAs to constructively provide feedback on both individual and overall team performance and be sufficiently cross-trained in order to be capable of identifying when and what type of assistance is required (Marks et al., 2001). Thus, team composition and team flexibility are antecedents for this action-based team behavior.

Because team-based cellular manufacturing involves high goal and task interdependency between members, occurrences of both task and relationship conflict are likely. The issue of conflict management has been shown to be more of a concern to cellular manufacturing workers than to managers, supposedly because workers are on the front-line for conflict management. (Bidanda et al, 2005). Cellular manufacturing teams that report higher levels of internal conflict management also report higher levels of job satisfaction and cohesion (Huber & Hyer, 1985).

Cohesion is an emergent state that has the potential of being high among cellular manufacturing teams due to the co-location and high degree of interdependency associated with such teams (Huber & Brown, 1991). However, no empirical research was found relating perceived degree of cohesiveness to team effectiveness criteria. Also, although no supporting empirical evidence was found, the degree of team empowerment

is thought to positively impact the performance, attitudes, and behavior of cellular manufacturing teams (Bidanda et al., 2005; Fraser et al., 2007; Hyer et al., 1999). This may occur first from the delegation of authority to the team (*structural empowerment*) through the direct involvement of team members in the cell design process followed by a shared responsibility for work outcomes as the team experiences work cycles requiring team-problem solving skills (*psychological empowerment*) (Hyer et al., 1999).

Several studies have demonstrated that many lean manufacturing cells rely on the larger production system for complete processing of the product (Brown & Mitchell, 1991; Shambu & Suresh, 2000; Wemmerlov & Johnson, 2000). In this case of hybrid-cellular manufacturing, where parts leave a cell for additional processing and then return, integration of the cell's team into the larger organization becomes critical (Wemmerlov & Johnson, 2000). In these cases, the external resources may be shared by other teams or departments making coordination and synchronization with external suppliers critical to the team's effectiveness (Sundstrom et al., 1990).

2.2 Theoretical Framework

For exploratory case study research, the role of existing theory is to assist in the selection of cases, guide the data collection process, provide a framework for analysis, identify rival theories, and generalize the results to other cases (Yin, 2008; Yin, 2003). As found from the literature review, the most common theoretical frameworks used to study team effectiveness have their origin in the I-P-O model (Hackman, 1987; McGrath, 1984; Steiner, 1972). However, the contemporary IMOI model constructed by Mathieu et al. (2008) seems more adequate to address work teams in their real world complexity. Thus, the IMOI model was used as the overarching theoretical framework for this research.

The effectiveness criteria found in most all teamwork models (performance, member attitudes, and outcome behaviors) seem applicable to LVHC production work teams. The nested arrangement of team inputs in the framework of Mathieu et al. (2008) including team composition, team context, and organizational context are also expected to influence LVHC work teams to adopt SRTB. Based on the review of research literature involving cellular manufacturing teams, composition factors expected to

influence LVHC production work teams to engage in SRTB include member personality, taskwork skills, teamwork skills, team flexibility, and team stability. Team-context factors expected to be important for SRTB in LVHC work teams include external leadership, coaching, structural empowerment, and team task design. The organizational context may also influence LVHC work teams to use SRTB effectively. Based on prior research involving cellular manufacturing teams, boundaries control may be particularly relevant for LVHC work teams.

Regarding factors that mediate the relationship between the inputs just described and effectiveness criteria, the approach taken by both Marks et al. (2001) and Rousseau et al. (2006) in describing teamwork behaviors and emergent states seems appropriate for research involving LVHC work teams. As well as being outcomes, the emergent states of a team are also inputs for teamwork behaviors (Marks et al., 2001). Thus teamwork behaviors used to regulate performance (SRTB) can be viewed as occurring within a "context" of emergent states.

The cyclic nature of activity that LVHC work teams experience corresponds well with the episodic viewpoint depicted in the team effectiveness models proposed by Marks et al. (2001) and Mathieu et al. (2008). In addition, the duration of team existence normally present in a LVHC manufacturing context provides both the individuals and team with the capability to develop over time. Therefore, Figure 3 depicts the integrated overarching theoretical framework for this research. In this framework, constructed from prior research on team effectiveness, the central phenomenon of SRTB appears in the mediators section.

INPUTS MEDIATORS OUTCOMES

Organizational Context

Team Context

Team Composition

Emergent States

SRTB

Effectiveness

Episodic Cycles

Developmental Processes
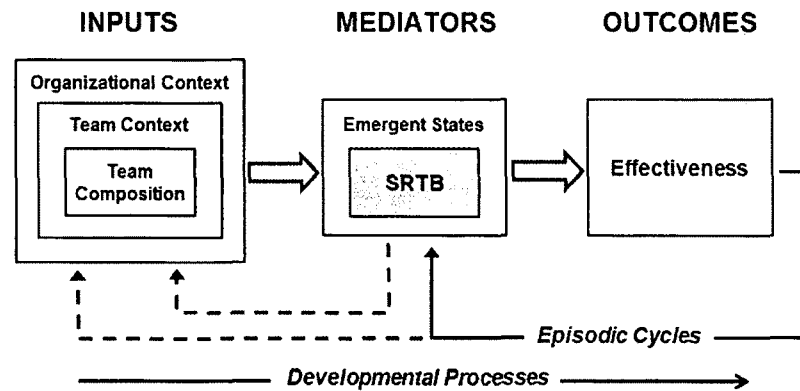
Figure 3. Overarching Theoretical Framework

To provide a focus for the research subquestions in the development of the research protocol, a more specific research model was created as shown in Figure 4.

OUTCOME
SELF-REGULATING TEAMWORK BEHAVIORS

INPUTS

Context & Composition

Work Preparation

Taskwork Collaboration

Team Adjustment

Work Assessment
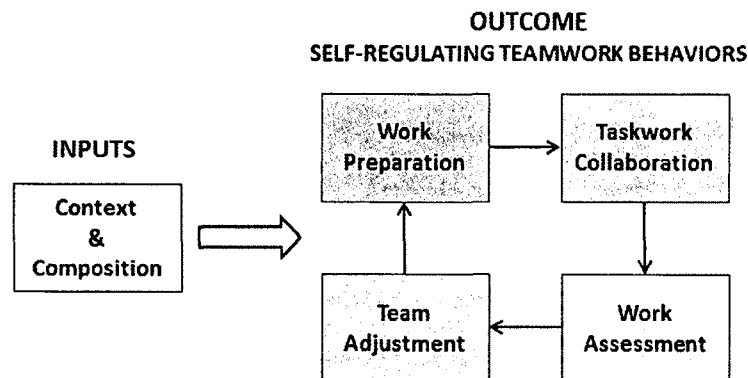
Figure 4. Research Model

The research model contains the SRTB phases proposed by Rousseau et al. (2006) that function as mediators between team inputs and outcomes in team effectiveness models. For this research, SRTB was considered as an outcome dependent on team composition and context (organizational context, team context, team composition, and emergent states). The research model corresponds to the research subquestions and was used for guidance in selecting work teams for the case studies and in designing the interview and observation protocols.

CHAPTER 3

METHODOLOGY

This chapter discusses the methodology used to answer the central research question. The study design, research subquestions, description of the research site, case selections procedure, strategy and methods for data collection and analysis, data validity and reliability, and ethical considerations for the research are presented here.

3.1 Study Design

This research involves understanding how SRTB can be accomplished in LVHC manufacturing work teams. Prior research has demonstrated that SRTB can positively influence the effectiveness of work teams in general. However, the antecedents for SRTB are not clear for work teams in the LVHC manufacturing context.

Our knowledge of how production operations can be improved through the socio-technical system of work teams can be significantly enhanced by conducting naturalistic empirical research under real-world conditions. Naturalistic inquiry is research that focuses on how people behave when absorbed in the genuine life experiences of their natural settings. It is a qualitative method that emphasizes understanding social actions from the perspective of the actors that can only be achieved from first-hand eyewitness accounts of *being there* (Erlandson, Harris, Skipper, & Allen, 1993; Schwandt, 2007). The features of naturalistic inquiry and empirical case study designs were relevant to this research (Platt, 1992; Yin, 2009).

Foremost, the research question is an attempt to provide in-depth answers to how a contemporary social phenomenon (in this case SRTB) works under the situation in which there will be many more variables of interest than data points. Furthermore, in order to obtain valuable answers to this research question, the phenomenon needs to be studied within its real-life context where the boundaries between the phenomenon and context are not clearly evident. Finally, the antecedent factors that may influence the outcome SRTB cannot be controlled during the study.

A case study design uses purposeful sampling and multiple sources of evidence such as interviews, surveys, direct observation, documentation, and physical artifacts to

provide in-depth answers that are surfaced from the context of the phenomenon. This approach to research ensures that the issue is explored through a variety of lenses such that multiple facets of the phenomenon can be revealed and thus more fully understood. The purpose of this research was to gain knowledge and understanding toward the development of explanatory theory. Knowledge of how manufacturing operations systems work (in this case the socio-technical system of a production work team) can significantly be enhanced by performing empirical research under real-world conditions. The case study research method is widely recognized as a primary means to accomplish this objective (Barratt, Choi, & Li, 2011; Baxter & Jack, 2008; Eisenhardt, 1989; McCutcheon & Meredith, 1993; Meredith, 1998; Stuart, McCutcheon, Handfield, McLachlin, & Samson, 2002; Voss, Tsikriktsis, & Frohlich, 2002).

The process of gaining knowledge and understanding from case-based research generally consists of three different phases of theory building (Handfield & Melnyk, 1998; Stuart et al., 2002). The link between the research purpose in the process of theory building and the central research question determines the appropriate case study method.

The first phase of theory building is that of discovery and description, traditionally called exploration (Benbasat, Goldstein, & Mead, 1987) but more recently termed descriptive case study research by Yin (2009). During this phase, the research typically seeks answers to questions about some social phenomenon such as what is going on, what are the key issues, or what is happening. During this phase of research, there may be no a priori theory when the events are examined and important constructs are not likely to be defined (McCutcheon & Meredith, 1993). The potential output of such research is a description of the events and outcomes to enable subsequent researchers to better understand the phenomenon and its context. Usually, cases for this type of research are of an exemplar nature having extreme or unique circumstances or they may be the first attempt at examining the phenomenon for research purposes.

In the second phase of theory building, the research attempts to map factors and build relationships to ultimately formulate propositions or hypotheses (Benbasat et al., 1987). During this phase of case study research, termed exploratory by Yin (2009), typical research questions are posed to identify key variables or categories, find patterns

or links between the variables, and suggest why those relationships should exist. For exploratory case study research, some a priori theory should exist and be used to select constructs to be examined from multiple cases having maximum differences in order to highlight the commonalities and differences in the observed phenomenon (Eisenhardt, 1989; McCutcheon & Meredith, 1993).

In the final phase of theory building, the theory that has been developed is validated, extended, or refined by hypothesis testing (Benbasat et al., 1987). This phase of research is called explanatory by Yin (2003, 2009) and theories that are rich in structure, attempting to explain complex multivariate relationships, are appropriate for conducting causal case studies. It attempts to determine if the theories generated are able to stand up to the test of empirical data and determine the applicability of the theories to different contexts (Handfield & Melnyk, 1998). Typical research questions are directed at where the theory applies and what the constraints are (Stuart et al., 2002). The theory and perhaps operational measures of constructs are sufficiently defined to allow for hypotheses to be proposed prior to conducting explanatory case study research, with the potential output being confirmation or disconfirmation of theory.

Based on the prior research, the central research question, and the research purpose, the exploratory case study method was the appropriate strategy for this research. There has been substantial progress through empirical research on the topic of team effectiveness such that many potential drivers of effectiveness have been identified. However, the process by which teams reach high levels of effectiveness through a combination of those factors is not well understood in the context of LVHC production work teams. Figure 5 (adapted from Handfield & Melnyk, 1998) outlines the phased approach toward theory-building and shows where exploratory case studies fits in.

**Principal Information
Components**

Research Methods, Purpose, and Questions

```
┌─────────────────┐     ┌──────────────────────────────────────────────┐
│  Observations   │     │ Descriptive Case Studies                       │
│                 │     │ Discovery                                      │
└─────────────────┘     │   - What is going on?                          │
                        │ Description                                    │
┌─────────────────┐     │   - What are the key issues?                   │
│  Empirical      │     │   - What is happening?                         │
│  Generalizations│     └──────────────────────────────────────────────┘
└─────────────────┘     ┌──────────────────────────────────────────────┐
                        │ Exploratory Case Studies                       │
                        │ Mapping                                        │
                        │   - What are the key variables, themes, patterns?│
┌─────────────────┐     │ Relationship building                          │
│   Theories      │     │   - What are the links between variables?      │
│                 │     │   - Why should these relationships exist?      │
└─────────────────┘     └──────────────────────────────────────────────┘
                        ┌──────────────────────────────────────────────┐
                        │ Explanatory Case Studies                       │
                        │ Theory validation                              │
┌─────────────────┐     │   - Does theory survive test of empirical data?│
│  Hypotheses     │     │ Theory extension/refinement                    │
│                 │     │   - Where does the theory apply?               │
└─────────────────┘     │   - Where doesn't the theory apply?            │
                        └──────────────────────────────────────────────┘
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Figure 5. Model of Phased Theory-Building Research (Handfield & Melnyk, 1998)

The sequence of activities used to conduct this research is shown in Figure 6. The case studies were conducted separately, following the sequence shown in the figure. Once the case studies were complete, a cross-case analysis was performed.

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                  ┌──────────────┐          ┌─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─┐
          ┌──────►│ Case Selection│          │  ┌──────────────┐   │
          │       └──────────────┘          │  │  Supervisor  │   │
          │              │                  │  │  Interview   │   │
          │              ▼                  │  └──────────────┘   │
Replicates│       ┌──────────────┐  ═══►    │         │          │
          │       │ Collect/Analyze│         │         ▼          │
          │       │  Case Data   │          │  ┌──────────────┐   │
          │       └──────────────┘          │  │    Direct    │   │
          │              │                  │  │ Observation  │   │
          │              ▼                  │  └──────────────┘   │
          │       ┌──────────────┐          │         │          │
          └───────│ Case Write-up│          │         ▼          │
                  └──────────────┘          │  ┌──────────────┐   │
                         │                  │  │ Team Member  │   │
                         ▼                  │  │  Interviews  │   │
                  ┌──────────────┐          │  └──────────────┘   │
                  │  Cross-Case  │          └─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─┘
                  │   Analysis   │
                  └──────────────┘
```
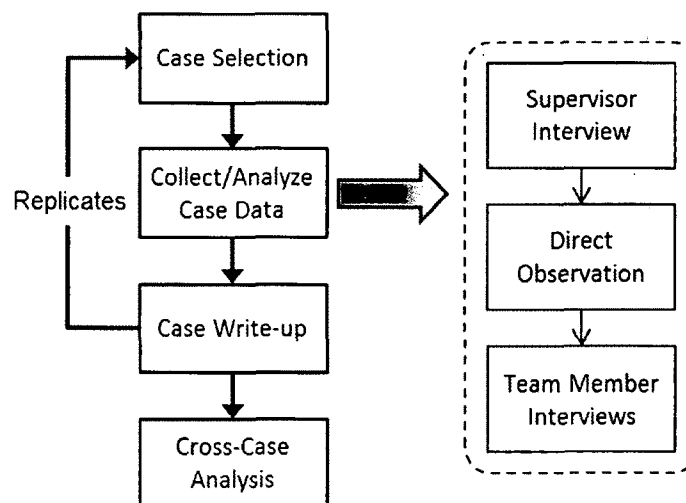
Figure 6. Design and Sequence of Research Activities

3.2 Research Subquestions

The purpose of research subquestions in a qualitative study is to narrow the focus while leaving open the questioning (Creswell, 2009). The subquestions of this research were designed to explore how contextual and composition factors influence work teams to use the different phases of SRTB to manage their performance.

The framework presented by Rousseau et al. (2006) for SRTB under episodic conditions was used to formulate subquestions for the research:

Q1. How do composition and context influence work preparation behaviors?

Q2. How do composition and context influence task-related collaborative behaviors?

Q3. How do composition and context influence work assessment behaviors?

Q4. How do composition and context influence team adjustment behaviors?

3.3 Research Site

The research site is part of a corporation that serves several different global markets for high-value products. The site operates manufacturing plants making up nearly one million square feet of manufacturing and office space. There are currently over 500 people working at the site (approximately 75% male, 65% hourly labor) and the production workforce is organized through a national labor union.

Since its establishment, the site has gone through a series of changes including the markets served, growth via merger and acquisitions, and changes in the hourly personnel's bargaining organization. In 2008, the company's top leadership directed the intervention of Lean and Six Sigma (LSS) principles and practices to improve upon the site's culture and operational performance. Out of this directive a six-member LSS group was formed from individuals in the site to function as a full-time resource to implement a continuous improvement program. The Ph.D. candidate is a certified LSS Black Belt that was assigned to that group.

The site designs, develops, and manufactures high-value products for commercial and military applications. The manufacturing operations are organized to support substantially different product types. For all product types, the customer demand is relatively low but still requiring repetitive production activities lasting from months to

years. Based on the customer demand rates for each product type, typical takt times can range from one to twenty working days.

All production work teams at the site have management supervisors. The role of the supervisor includes the traditional responsibilities of selecting members, communicating work assignments, scheduling activities, monitoring performance, and intervening as required to adjust performance. However, some degree of engagement in SRTB by a few production work teams is present.

The taskwork of production work teams at the site can be described as complex manual fabrication and assembly with long work cycles. The work is functionally divided among work teams in the site to accomplish a particular process (or series of processes) on a single product or product type. The complex nature of the entire manufacturing process of each product type often requires special production, inspection, or test processes to be completed in addition to the manual fabrication and assembly processes. Those special processes are normally executed outside the boundaries of the production work teams but still within the site by other individuals or functional groups.

3.4 Case Selections

The samples used in case study research should be purposefully selected using a theoretical groundwork (Eisenhardt, 1989; Miles & Huberman, 1994). Cases should be strategically selected to obtain the most useful information to answer the research question and to increase transferability. Transferability addresses whether a study's findings are appropriate to situations outside the case study by generalizing the results to a broader theory.

An appropriate method to increase the transferability of case studies is to employ a replication logic by carefully selecting and studying multiple cases including those that differ as widely as possible from each other (Eisenhardt, 1989; Flyvbjerg, 2006; Yin, 2009). The case replicates can be of a literal nature where similar results are predicted or of a theoretical nature where dissimilar results are predicted. Typically those predictions are based on existing theory. Using those guidelines, three case studies of work teams in the site were selected based on management's report of how extensively they were

thought to engage in SRTB and their perceived effectiveness. Furthermore, a team's salient composition and contextual factors were taken into consideration to obtain as much variation as possible between the literal replicates but as little as possible between the literal replicates and the theoretical replicate. The process and criteria used to select the case studies is depicted in Figure 7.
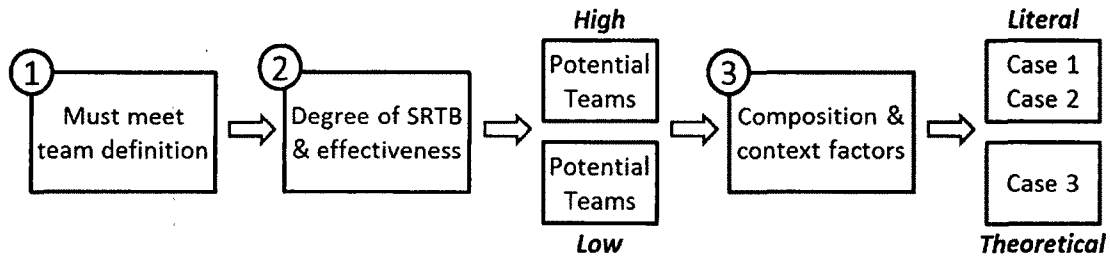
Figure 7. Case Study Selection Criteria and Process

Discussions with the site's senior management (above supervisor level) were used throughout the duration of the research to select appropriate work teams. A PowerPoint script was used during each of the case selection discussions to describe the purpose and process of the research, the research model and questions, and the definitions being used for a work team, SRTB, and work team effectiveness.

The first criteria for case selection involved determining if a work group met the definition of a work team by research standards. It has been noted that case study research of work teams in manufacturing settings is often impeded because the researchers discover that the managers' definitions of teams do not correspond to what is considered a team by research standards (Pagell & LePine, 2002). Several definitions of work teams exist in the research literature. Teams are predominately defined as "two or more individuals interacting adaptively, interdependently, and dynamically toward a common and valued goal (Salas et al, 2000, p. 341). More specifically for the context of work organizations, work teams are typically considered as

collectives who exist to perform organizationally relevant tasks, share one or more common goals, interact socially, exhibit task interdependencies, maintain

and manage boundaries, and are embedded in an organizational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity. (Kozlowski & Bell, 2003, p. 334)

These definitions were used to establish the following criteria to ensure that a work group was in fact a *real team* by research standards:

- The work group is stable and bounded. Members and outsiders have a clear idea of who is on the team and its membership is generally stable.
- Members of the work group share goals and responsibility for performance outcomes.
- The work group has task interdependence. Members must interact, share resources, and work collaboratively to accomplish their work tasks.

The second criteria for case selection involved managements' account of the extent that a work team is engaged in using SRTB and their perceived effectiveness. The definitions for SRTB and team effectiveness criteria listed in Appendix A were used in the PowerPoint script to guide the case selection process.

The third step for case selection involved comparing the salient aspects of each work team's composition and context. Compositional factors included team size and team stability. Elements of the context included the fundamental work cycle, spatial arrangement, task interdependence, task routineness, task identity, and obvious features of structural empowerment. See Appendix B for the case selection criteria matrix.

3.5 Data Collection

Each case study used an overlapping method of data collection and analysis and each case was conducted separately rather than concurrently. A sequential approach for research using multiple case studies is preferable for the development or refinement of theory because it allows for flexible data collection and improvements in the protocol between replications (Eisenhardt, 1989). The protocol includes the documented procedures and general rules for collecting data and is one of the tactics used when conducting a case study to ensure its dependability. A baseline protocol was developed prior to collecting data from the first case study and it is described in this section.

Each case followed the same sequence for data collection as depicted in Figure 8. Once a work team had been selected for the research and after the participants' consent had been obtained (the procedure for gaining informed consent is explained in Section 3.8 Ethical Considerations), each case study commenced by conducting an interview with the team's supervisor. This was followed by a period of direct observation of the work team's activities, lasting from nine to 15 work days. Individual interviews with the team members were then conducted to conclude the data collection for each case. Depending on the team size, the time span for gathering data from team member interviews ranged from three days to three weeks. Physical evidence from documentation and artifacts was also collected to support the data from observation and interviews.

```
┌─────────────┐      ┌─────────────┐      ┌─────────────┐
│ Supervisor  │ ───▶ │   Direct    │ ───▶ │   Member    │
│ Interview   │      │ Observation │      │ Interviews  │
└─────────────┘      └─────────────┘      └─────────────┘
──────── Documentation & Physical Artifacts ────────▶
```
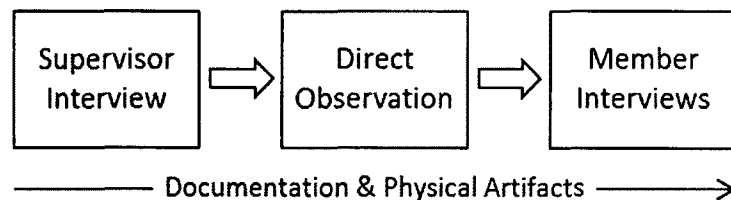
Figure 8. Case Study Data Collection Sequence

Each case study started by interviewing the supervisor (first-line manager) to get their perspective of *how the team's composition and context influenced the team's engagement in SRTB*. Following the guidelines of Yin (2009) for case study questions, the baseline protocol consisted of a semi-structured interview corresponding to the research subquestions (see Section 3.2 Research Subquestions). Additional questions (not predetermined) were asked as appropriate to further explore specific information on a topic. The interview included four sections, each with two sets of questions designed to explore how the team's composition and context influenced each of the SRTB phases:

Question Set #1:   Are the behaviors in this category enacted? How?

Question Set #2:   Why is it that way? How could they be improved?

Each supervisor's interview was initiated by first describing that the interview contained four separate sections regarding how the team's goals and work plans are established, how the team accomplishes its taskwork, how performance monitoring is

accomplished, and how adjustments are made to counteract problems. The baseline questions for the supervisor interviews remained unchanged during the research and are listed in Table 1 along with their associated research subquestion.

Table 1. Supervisor Interview Questions

Research Sub-Question		Supervisor Interview Questions
How do composition and context influence *work preparation behaviors*?	1.1	Does the team set goals and make plans to accomplish its work? How or in what ways does the team do this?
	1.2	Why do you think it's done that way? Do you think the team's work preparation can be improved and if so how?
How do composition and context influence *task-related collaborative behaviors*?	2.1	How does the team carry out its work? Are their work activities coordinated? How is cooperation used? How is task-related information exchanged?
	2.2	Why do you think the team works that way? Do you think the team's collaboration could be improved and if so how?
How do composition and context influence *work assessment behaviors*?	3.1	Do team members monitor their own work performance against the goals and plans? If so, how do they do that? Does the team monitor each other's work performance? If so, how is that done?
	3.2	Why do you think the team monitors its performance that way? How do you think the team could be more effective in monitoring its performance?
How do composition and context influence *team adjustment behaviors*?	4.1	What are some of the problems that interfere with the team's performance? How are those problems usually handled?
	4.2	Why do you think the team's problems are handled that way? How could the team be more effective in working together to solve those problems?

A pilot mock-interview using these questions was conducted with a member of the LSS group (who also assisted with the code-checking to be explained later) to validate the integrity of the interview's design. Responses from the supervisor interviews were transcribed and then typed on the same day. The interview transcript was provided to the supervisor within two days of the interview and they were requested to review it for accuracy within a week. All supervisors agreed with the accuracy of the transcripts and indicated that no changes were necessary.

Direct observation of the team was used next in the sequence of data collection. The goal of the observations was twofold. First, to verify if and how SRTB were being used in the team's day to day activities and to provide evidence for how the composition and context were enabling or inhibiting the behaviors. Second, to obtain information that

could be used to design the team member interviews as effectively as possible. As available, evidence from physical artifacts was also collected.

Although the observation period for each case study varied based on the team's work cycle, it provided sufficient time to observe the completion of two takt time goals or two full weeks of work, whichever was shorter. During the daily observations, the researcher spent time with individual members of a team to watch and record their work, interactions, and comments. There was also observation time devoted to looking at the group overall. The researcher also asked questions to team members at certain times when it was less likely to interfere with their work.

To assist with the collection and subsequent coding of data from observation, a standard template was created to record data. On each day of observation, a new form was started such that data was collected and recorded sequentially. The observation template included separate sections to record information about the team composition, team context, and SRTB while associating it with relevant factors identified from the literature review. The hand-written notes were scanned and then typed into the Excel database at the end of each observation period (the Excel database is described in Section 3.6 Data Analysis). Data from observation were then used to design a standard and more specific protocol for the team member interviews.

Semi-structured individual team member interviews were the last stage of the data collection for each case. The purpose of the member interviews was to gain more depth into how the composition and context enabled or inhibited the team to engage in SRTB from the members' perspective. There was a standard list of questions for each case that mapped to the research subquestions (see Table 2). Additional and more specific questions arising from data collected during the supervisor interview or observation period were added to the standard interview protocol as appropriate. Each member's interview was initiated by first describing that the interview contained four separate sections regarding how the team's goals and work plans are established, how the team accomplishes its taskwork, how performance monitoring is accomplished, and how adjustments are made to counteract problems. Prior to asking the first question in a set corresponding to one of the four phases of SRTB, relevant notes from the observation

period regarding those behaviors were shared with the member and they were asked if they agreed with the researcher's assessment.

Table 2. Team Member Interview Questions

Research Sub-Question		Team Member Interview Questions
How do composition and context influence *work preparation behaviors*?	1.1	Do you agree with that? Do you think the team's leads are effective in working with the team to set goals and make plans? Why or why not?
	1.2	How do you think the team's work preparation (goal setting and making plans) could be improved? How do you think it could be worsened?
How do composition and context influence *task-related collaborative behaviors*?	2.1	Do you think the team is effective in working together to coordinate your tasks, providing help when needed, and sharing task information? Why or why not? What do you think is driving the way your team works together?
	2.2	How could the team's collaboration (coordination, cooperation, or task-related information exchange) be improved? How could it be worsened?
How do composition and context influence *work assessment behaviors*?	3.1	Does the work performance of the team or of individual members ever cause conflict? If so what is it usually about and how has it usually been handled?
	3.2	Do you think the team's performance monitoring could be improved and if so how? How could it be worsened?
How do composition and context influence *team adjustment behaviors*?	4.1	Why do you think the team works together the way it does to make those kinds of adjustments when faced with problems?
	4.2	Do you think the team's adjustment behaviors (backing each other up, collaboratively solving problems, and innovating on how you work together) could be improved and if so how? How could it be worsened?

As with the supervisor interviews, the member interviews were documented by transcribing the responses during the interview, typing the interview questions and responses on the same day, providing the transcripts to the member within two days of the interview, and requesting the member to review the interview transcript for accuracy within a week. No changes to the interview transcripts were requested by the members.

3.6 Data Analysis

Eisenhardt (1989) points out that "Analyzing data is the heart of building theory from case studies, but it is both the most difficult and the least codified part of the process" (p. 539). According to Yin (2009), the preferred strategy for analyzing case study evidence is to follow the theory that led to the case study. The proposed research model is founded on prior empirical research that examined the links between inputs,

mediating variables, and the resulting effectiveness of work teams. Thus, the strategy for analysis of the case study evidence was to examine it in light of the existing theory. The sequence followed for data analysis consisted of:

- Coding the data from observation and interviews

- Compiling the coded data into a filterable spreadsheet

- Arrangement of the coded data into ordered displays

- Performing within-case and cross-case causal network analysis.

These analysis techniques organize empirically based patterns from a case study's independent and dependent variables and compares them with patterns that are predicted from the existing theory (Yin, 2009).

3.6.1 Data Coding

The first step in analyzing each case study was to code the data, a process that was initiated once the interview transcripts were validated by the respondents (supervisor and members). Codes are tags or labels used to assign units of meaning to the descriptive or inferential information compiled during a qualitative study. Following the guidance of Miles and Huberman (1994) for qualitative data analysis, excerpts from the interviews and notes from the observation were carefully compared to the most recognized definitions of the composition, context, and emergent state factors appearing in the research literature. *A priori* theory on factors that are known to be potential drivers of work team effectiveness was used to create a preliminary list of codes for the analysis. The definitions of the factors used in the research are in Appendix A.

Working in a Word file that contained the responses from an interview, initial datum codes associated with a particular section of text were inserted in the margin. As Miles and Huberman (1994) point out about the technique of coding, "…it's not the words themselves but their meaning that matters" (p. 56). Thus, selecting codes for the data involved making a choice about the information's significance in the context of the case study. Basically, a decision was made about what the information provided by the respondent "stood for". Furthermore, a particular technique for coding (called dual-coding, double-coding, or simultaneous coding in the qualitative research literature) was

used to infer causal relationships from each datum by identifying what was being influenced and what was influencing it (Saldana, 2013). Thus, each datum was assigned dual-codes; one code was assigned to the independent factor and another code was assigned to the dependent factor occurring in the same datum.

For example, when asked what they thought influenced their group to set goals and make plans to accomplish their work a member responded "*I think it's more of a type of person thing, an over-achiever thing, all throughout our group. I think all of us are over-achievers. I don't think it's as much the support we get as the people in the group, they're very hard workers.*" The dual-code MBR-PERS → SRTB was assigned to this datum, inferring that the team's SRTB (in this case work preparation) was influenced by the composition of the team (member personality). The independent factor in this datum was identified as member personality from references made to the cause being *"a type of person thing"*, describing members of the group as over-achievers and hard workers. The dependent factor in this datum was identified as self-regulating teamwork behaviors because the information was given in response to a specific question about what influenced the group's work preparation behaviors.

Another example from the case study data of the dual-coding technique demonstrates a potential causal relationship between an independent factor and an emergent state as the dependent factor. When asked if they thought members of their group felt safe to participate in making decisions regarding their group's work, a member responded *"Mostly, yes. But you might have some that feel intimidated if a dominating person in the group takes the lead in decision making."* The dual-code MBR-PERS → CLIMATE was assigned to this datum, inferring that the team's emergent state climate (in this case a climate of participative safety) was influenced by the composition of the team (member personality). The independent factor in this datum was identified as member personality from the reference to a *"dominating person in the group"* taking the lead in decision making. The dependent factor in this datum was identified as team climate because the information was given in response to a specific question about whether members in the group felt safe to participate in making the team's decisions.

The dual-coded data were entered into a case study database that was used for the process of check-coding (Saldana, 2013) and then the data analysis.

3.6.2 Case Study Database

The dual-coded data for each case was transferred into an Excel workbook on a spreadsheet that could be sorted and filtered for check-coding and data analysis. Each row of the spreadsheet contained a datum, its associated dual-codes for independent and dependent factors, the source of the datum (observation or interview with coded identity), the query associated with the datum (SRTB phases), and the stage (generation or development) thought to be associated with the datum. An unsorted excerpt from one of the case study spreadsheets is provided in Appendix C. Following along the columns of the first row in the spreadsheet excerpt provided in Appendix C, the information can be read as "*According to member ATech1 of Team Sep, the taskwork skills of the members influences the emerging team climate of task excellence.*" If a datum contains bold print for some of the text, it is an indication that more than one dual-code was assigned to it and it appears in a different row of the spreadsheet.

The data spreadsheet was used for the process of checking the coding with a peer member of the site's LSS group. The code-checker had a B.S. in Industrial Engineering, was a certified LSS Green Belt, and was an original member of the site's LSS group established in 2008. The code-checker was already acquainted with each of the three case study work teams prior to the code-checking process and assisted in the implementation of lean methods for one of the work teams.

Prior to the code-check process, the code-checker had reviewed the proposal for the research and had become familiar with the factor definitions from a list provided by the researcher. A collaborative process of check-coding was accomplished over many meetings with the code-checker and the data for each case study were checked separately. Each code-check meeting for a case study was used to focus on particular factors by filtering the codes and comparing the data with the most recognized definitions of the factors included in the research. By filtering on a particular code in the spreadsheet, all of the data assigned to that code were reviewed as a whole. While discussing the meaning of

each reported datum and the factor definition, the originally assigned code was either confirmed or changed. The coding was checked for each case in a systematic manner, completing each category of factors in sequence (organizational context, team context, team composition, and emergent states).

3.6.3 Ordered Displays

The next step of data analysis involved creating ordered displays called factor matrices and causal waterfalls. These two qualitative analysis tools were used to synthesize the data from the spreadsheet in a stepwise manner. An ordered display can be any visual format that presents case study information systematically such that "complicated things can be made understandable by reducing them to their component parts" (Miles & Huberman, 1994, p. 90). Commonly used ordered displays in qualitative research resemble tables or matrices, allowing large amounts of information to be absorbed quickly. The factor matrices used for this research are such a tool. The causal waterfall display is an original concept developed from this research used to span the gap between description and explanation or "making complicated things understandable by showing how their component parts fit together" (Miles & Huberman, 1994, p. 90).

A factor matrix was created by filtering the independent and dependent factor codes in the data spreadsheet to arrive at a count of the different sources reporting a dual-coded relationship and then displaying that information in matrix form. Each case study had a maximum number of sources that could report a relationship between two factors (the sum of supervisor interview, observation, and the number of member interviews). Thus, source repetition was used for the counts in the factor matrix to provide evidence of triangulation. Using the source repetition method prevented source bias from affecting the data analysis. A section of the complete factor matrix from one of the case studies is shown in Table 3 for an example. Each number in the matrix indicates how many different sources reported an influence from the independent factor (rows) on the dependent factor (columns). For example, in the member personality row eight different sources (one supervisor interview and seven member interviews) provided at least one datum that indicated an influence from member personality on SRTB. Similarly, only one

source (a member interview) provided at least one datum that indicated an influence from member personality on the team's mental models.

Table 3. Example Section of a Factor Matrix Display

		Integration	Climate	Cohesion	Empowerment	Mental Models	SRTB	Sum
		STATES						
COMPOSITION	Team Size				2		1	3
	Member Personality	5	6	3		1	8	23
	Skills - Taskwork	1	1				3	5
	Skills - Teamwork		1	1	1		5	8
	Team Flexibility						1	1
	Team Stability	1				1		2

From the factor matrix, a causal waterfall was created to display the relative significance of the independent factors and to delineate their links to dependent factors in a tiered fashion. A section of the complete causal waterfall from one of the case studies is shown in Table 4 for an example.

Table 4. Example Section of a Causal Waterfall Display
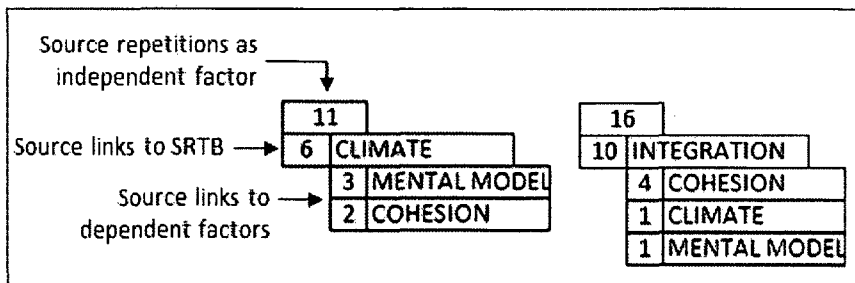
The significance of relations between factors is shown in the causal waterfall by placing dependent factors below the independent factor in decreasing order of source

repetitions. In the example shown above, six different sources from the case study provided at least one datum that indicated an influence from team climate on SRTB. Three different sources provided at least one datum indicating an influence from team climate on the team's mental models. Two different sources provided at least one datum indicating an influence from team climate on team cohesion. Thus, insight into the relative importance of each independent factor can be viewed from its total repetition count, i.e. the extent that it was reported by different sources to influence both SRTB and the emergent states as shown in the *sum* column of the factor matrix and the top number in the causal waterfall.

3.6.4 Causal Network Analysis

Causal network analysis involves pulling together the case study data into a single summarized form. The methods used in this research to accomplish causal network analysis are well recognized in the qualitative research literature (Barratt et al., 2011; Eisenhardt, 1989; McCutcheon & Meredith, 1993; Miles & Huberman, 1994; Stuart et al., 2002; Yin, 2009). Within-case analysis typically involves creating a detailed and descriptive write-up for a case as a stand-alone entity, allowing the unique patterns of a case to emerge before comparing it to other cases. Cross-case analysis is then used to compare and contrast the patterns emerging from the detailed case write-ups. Two commonly cited tactics for performing cross-case analysis were used in this research. The first tactic involved looking for within-group similarities and inter-group differences between the case replicates (i.e. the two literal replicates with high SRTB versus the theoretical replicate with low SRTB). The second tactic was to compare and contrast pairs of cases based on salient features of their composition or context.

The information in the causal waterfall display was transformed into a visual representation of the data called a causal network map. The map provides a holistic perspective of the relative influence of factors and the most significant links between them. Figure 9 provides an example of a causal network map.
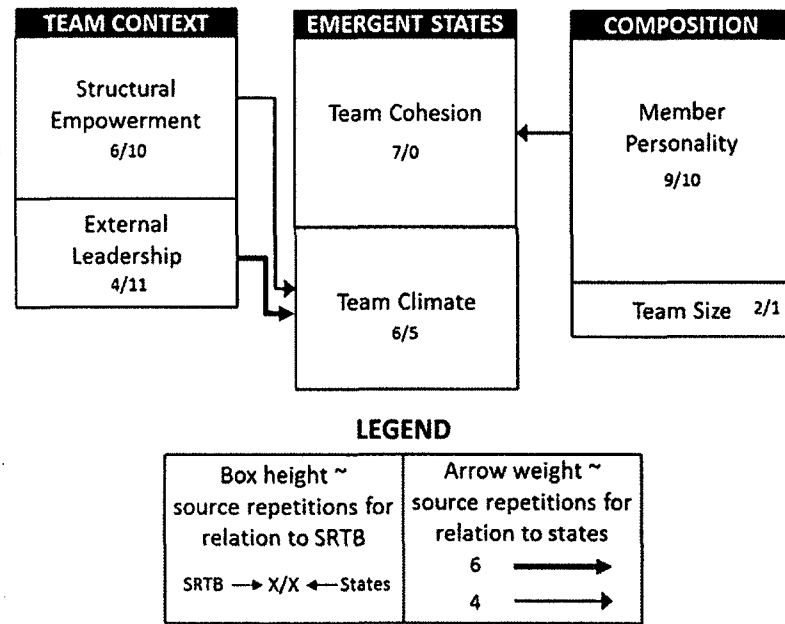
Figure 9. Example Section of a Causal Network Map

In the causal network map, the height of each box is proportional to the total number of source repetitions for that factor's relation to SRTB. The two numbers associated with each box indicate the number of source repetitions found to relate that factor to SRTB and emergent states respectively. The arrow weights are proportional to the number of source repetitions found between a factor and an emergent state. To simplify a cross-case causal network map, arrows are only drawn for the more significant links. The causal network map does not communicate "quantitative data" per se. It does however provide a measure of the influence and interactions of factors affecting SRTB.

Data analysis for the research had two main components, within and cross-case analysis. Referring to the central research question, a causal network map highlights the key factors and links influencing SRTB for the case study under consideration. The rich detail of context and history in the data was used to perform within-case analysis and explain why those relationships should exist for the work group. Aggregating the data and comparing and contrasting features of the cases in a cross-case analysis was used to explain why those relationships should exist for the LVHC production work group setting. Cross-case analysis serves as a form of replication (Yin, 2009) and it extends

knowledge beyond explanation into understanding why phenomena occur (Pagell & LePine, 2002).

Two common tactics for cross-case analysis were used (Barratt el al., 2011; Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2009). The first tactic was to look for within-group similarities and inter-group differences when cases were categorized by the work group's degree of engagement in SRTB (i.e. categories of literal and theoretical cases). The second tactic was to examine pairs of cases, identifying the similarities and differences between them. These analysis strategies are commonly applied in work team and operations management research involving multiple case studies (Bourgeois & Eisenhardt, 1988; Edmondson, Bohmer, & Pisano, 2001; Pagell & LePine, 2002; Pais, 2010; Yin, 2003).

3.7 Validity, Reliability, and Trustworthiness

An often cited concern of using the case study design for empirical research is the validity and reliability of its findings. However, the process of building theory from exploratory case studies should not be constrained by these issues (Handfield & Melnyk, 1998; Yin, 2009). The concepts of validity and reliability as defined in quantitative terms are inadequate for qualitative social research using the naturalistic approach (Golafshani, 2003). Nonetheless, to promote the usefulness of case study research it should be conducted in a manner that assures that the results are trustworthy, regardless of the research purpose (McCutcheon & Meredith, 1993; Patton, 2002).

In quantitative social research validity refers to whether the research truly measures that which it was intended to measure and operational definitions of the concepts being studied are used in an instrument (e.g. surveys) to ensure that they accurately reflect all of the concepts' observable effects, describe only the concepts under consideration, and appropriately correlate with the operational measures used to assess other related concepts (Nunnally, 1978). However, the instruments used in naturalistic inquiry are not confined to operational measures of concepts (Lincoln & Guba, 1985).

Reliability in quantitative social research refers to the extent to which findings are consistent over time and they accurately represent the total population under study,

normally addressed by the robustness of the instrument being used (Golafshani, 2003). Reliability can be considered high when a different researcher could reach the same conclusions if they performed the same research again using the same instrument. In naturalistic inquiry such as this research, a variety of instruments may be used to gather data but the primary instrument is the researcher (Erlandson, et al., 1993). In naturalistic inquiry, *trustworthiness* is central to issues conventionally discussed as validity and reliability and it is established from the research's credibility, transferability, dependability, and confirmability (Erlandson et al., 1993; Golafshani, 2003; Lincoln & Guba, 1985).

Credibility from the viewpoint of the information sources (participants involved in the research) is a major trustworthiness criterion concerning the truth value of the findings. Credibility can be obtained from prolonged engagement with the research participants, persistent observation, relying on triangulation of data from different sources and different methods, peer debriefing, and member checking (cross-checking with those from whom data was collected) (Lincoln & Guba, 1985). Each of the three case studies performed for this research involved extensive time spent between the researcher and the participants to discuss and observe matters of importance related to SRTB. Case studies of the three work teams included multiple data sources, including direct observation, supervisor interviews, member interviews, and the gathering of data from physical artifacts. The process of code-checking (Saldana, 2013) was accomplished over many meetings with a fellow LSS group member, who was familiar with each work team involved in the research, to review and edit the codes assigned to the case study data. Finally, the research participants were provided with the written transcripts from their interviews and requested that they be reviewed to ensure that they accurately reflected their responses.

Transferability refers to the degree to which the results of qualitative research can be generalized to other contexts or settings. It can be enhanced from purposive sampling of the cases to be studied and by providing a thorough description of the case study context (Lincoln & Guba, 1985). The work teams involved in this research were strategically selected to obtain a range of compositional and contextual features that are

expected to be present in other LVHC production contexts. In addition, each case study was separately documented in thick detail to capture the unique characteristics of the team's composition, context, and history.

Similar to reliability in the quantitative research paradigm, the objective of dependability is to minimize errors from the activities of data collection and analysis of each case study. Dependability should be implied with credibility, but following an established research protocol and using a case study database are among the measures that can be taken by a researcher to ensure this criterion of trustworthiness is met (Lincoln & Guba, 1985; Yin, 2009). As was described in Section 3.5 Data Collection, an established research protocol for observation and interviews was used to collect data that was transferred into a case study database.

The concept of confirmability concerns the objectivity of the qualitative investigation and the degree to which the findings represent the experiences and ideas of the research participants, absent of the researcher's bias, motivation, or interest. The role of triangulation promotes confirmability, as does avoiding research of social groups with which a researcher is closely involved (Lincoln & Guba, 1985). To reduce the potential for researcher bias in the selection and analysis of cases in this research, the researcher had not been directly involved with the work teams within the past eight years. The method of using source repetition for data triangulation also addressed the confirmability of the research findings. If a source (including observation from the researcher) reported an influence from a factor it was counted as a single effect in the causal network analysis, regardless of how many times the same source may have reported it. Using the source repetition method precludes source bias from affecting the data analysis.

3.8 Ethical Considerations

A Non-Disclosure Agreement (NDA) between the participating company and Old Dominion University (ODU) regarding proprietary information related to this research was completed and is on file at both locations. It is necessary that the dissertation be reviewed for competition-sensitive content prior to submission to the University. The site's Senior Director of Operations and Senior Director of Contracts will serve as the

reviewers. Necessary care has been taken not to disclose information related to the identity, products, technical processes, programs, or customers of the company. The case studies have been described in this dissertation so as to avoid disclosing the identity of the work teams and any proprietary information related to their taskwork.

This research was conducted under the highest ethical standards for the protection of human subjects. The researcher has completed the Collaborative Institutional Training Initiative (CITI) Social and Behavioral Responsible Conduct of Research Curriculum required by the University for graduate research involving human subjects.

Prior to the start of the research activities, the site assembled a review board for human subjects protection and both the research proposal and protocol were reviewed and approved for submission to the University's College Committee. An application was filed with the University to classify the research as exempt from Internal Review Board (IRB) process according to Federal Regulation 45CFR46.101(b) Section 6.2. The research involves the use of interview procedures and observation of public behavior that was conducted and reported in a manner such that the human subjects cannot be identified, directly or through identifiers linked to the subjects.

Research involving the study and reporting of a contemporary social phenomenon in its real-life context necessitates that specific measures be taken to protect the rights of all individuals that agree to participate. The following measures were used to protect the rights of all research participants:

- Verbal informed consent was obtained from all persons who were involved in the research prior to their voluntary participation. An informed consent form that would be signed by the participants was removed from the protocol of the research at the request of the ODU College Committee for Research on Human Subjects. The reasoning for that was that a formal signed consent form would make it necessary for the researcher to deal with participant names which could lead to disclosure.

- A Research Participant Information and Consent Document (not signed by the participants) was used to inform participants of the nature of the research, to request their voluntary participation through verbal consent, to describe their involvement,

and to instruct them on how they may withdraw their participation at any time. A copy of that document was also provided during the participants' interviews.

- Unanimous consent from all team members and the team's supervisor was required for a team to be selected for the research; participants could choose to withdraw their participation during or following the observation period but the interview process continued with members that chose to continue their participation.

- All interviews were conducted in a one-on-one private setting in the site's facility with the research. Neither audio nor video recording was used during the interviews.

- Participant's names were not recorded on the interview records or typed transcripts; only the date of the interview was recorded on those documents.

- Participants were provided a copy of the interview transcripts and requested they review their documented responses for accuracy.

- The identity of each work team remained confidential through the use of a coded identifier on all research records.

- All electronic documents used for the collection and analysis of research data were stored in password protected files on the researcher's computer.

- The dissertation does not include a means to identify the research participants. Because of the small group sizes, the singular form of *they* was often used to refer to a single person in the case study descriptions.

- Upon completion of the research, all data other than the dissertation will be transferred into the intellectual property management system of the participating company to be destroyed after five years.

CHAPTER 4

TEAM JUN CASE STUDY

This chapter contains the findings from the first case study conducted for the research. Separate sections in this chapter describe the work team and case study process, report the findings, and present the within-case analysis of the data.

4.1 Description of Case Study

This section describes the work team involved in the first case study, details how the case was conducted, and provides an assessment of the team's engagement in SRTB based on direct observation.

4.1.1 Introduction to Team Jun

The team involved in the first case study, called Team Jun, was responsible for the fabrication of a group of one of the more complex products the site manufactures. The team was composed of nine members (equally mixed gender) all working the same shift. Seven of the members were hourly-paid production personnel belonging to an organized labor union and reporting to the same supervisor. The supervisor of the team had 34 direct reports at the time of the case study. Two members were salary-paid technicians that reported to the same production manager (different from the supervisor). The salary technicians were highly trained personnel assigned to operate or oversee the use of specialized equipment used in the taskwork of the team. Three hourly members had relatively short tenure with the team; three weeks, four months, and six months. The remainder had been working together for up to five years.

In late 2011, lean practices were introduced into the team's work at the direction of the site's program management to improve cost and delivery performance. Facilitated by two individuals of the site's LSS group (not the researcher), the lean intervention included introducing a 5S system for workplace organization, reconfiguring the area layout, establishing point-of-use storage for materials, creating a kanban pull system for select materials, conducting a total productive maintenance event on a critical piece of equipment, and implementing a visual scheduling system for work flow. At the time of

the lean interventions, the work group was composed of 19 members working on two shifts. Six of the nine members participating in this case study were also involved in the lean interventions occurring in 2011. Since that time, the work group size was reduced and all operations reduced to the same shift. The supervisor was assigned to the work group just prior to the lean interventions.

The production demand of the work team has been stable since the beginning of 2012, averaging seven products per month. At this rate of production while working one shift, the takt time for the product is three days. This means that for every three working days, a product must be completed in order to meet the delivery schedule. Thus, three working days is the fundamental work cycle that the team experiences in their work activities.

The taskwork and teaming arrangement was split between two major technical processes. The team was wholly collocated while working in separate but adjacent rooms. Cross-work between the rooms by some of the team's members was frequent. The team had a formally designated hourly lead receiving higher work compensation than the other hourly members. The team also had an informally recognized salary-paid leader.

4.1.2 Case Study Process for Team Jun

Team Jun was purposefully selected for the first case study because they were highly regarded by the site's top management group and described as requiring little to no direction from their supervisor. Most members were involved in the work group when it was significantly larger, thought to be less effective by management, and recognized as requiring close supervisor control. Discussions with the site's top management group led to identifying this work team as a preference for a literal replicate.

Once identified as the potential first case study, the researcher met with the team as a group (including the supervisor) in a conference room to inform them of the research and to request their participation. The purpose and process of the research was explained to the group (without specifying why their team was chosen) and the participant information and consent document was read aloud after having been given to each individual. Each person was requested to notify the researcher within a week if they

would participate. Within a couple days of the group meeting, unanimous verbal consent was obtained from all participants. Six of the nine team members communicated their consent to participate on the same phone call (passing off the phone to each other). The others provided their consent to participate individually.

Once unanimous consent was obtained, the case study data collection was initiated with a one-hour supervisor interview. Observation of the team's work activities began the week following the supervisor's interview. The observation lasted for 10 complete working days, spending time with each member in the two work rooms.

Member interviews began the week following the observation period. All but one member was interviewed for the case study. The member that was not interviewed expressed anxiety over the formality of the interview and suggested that we just *"talk more out here on the floor like we have been"*. Each member interview lasted about one hour and they were accomplished on separate days. Following the research protocol, each member was given a copy of the interview transcript and requested to review their responses for accuracy. No changes to the interview transcripts were requested. During the timeframe of conducting the member interviews, lasting four weeks, coding of the data was initiated and then entered into the case study database.

4.1.3 Self-Regulating Teamwork Behaviors and Effectiveness of Team Jun

During the observation period the supervisor was seen among the team members on just a handful of occasions. In all cases each encounter was brief, several of which the researcher was included and therefore aware of the discussion topic. There were occasions when different members of the team, particularly the co-leads, would go to the supervisor's office located adjacent to the work rooms. Based on the observation and analysis of interview data, management's assessment of Team Jun's current engagement in SRTB is corroborated. However, a high degree of reliance on coaching from the salary lead may indicate they are still in the process of developing those behaviors. In other words, the behaviors are there but the coach is still on the field.

Appendix D is a work flow dependency diagram for Team Jun, showing a snapshot of the work in process (WIP) and taskwork role interdependencies on a

particular day. On each day of the observation there were six to seven different products (units) active in the work flow. The arrows in the work flow dependency diagram indicate the flow of the units and the primary interdependency pattern of the team's taskwork. The work flow revolved around the EXCHANGE PROCESS circle, where the product was transferred between the work rooms every three days. The lead hourly technician primarily led activities on the left of the exchange (upstream) and lead salary technician primarily led those on the right of the exchange (downstream). The nine members of the team, noted in italics on the dependency network, are shown in their *home* positions where they spent most of their time. However, the activities of some members spanned across their *home room* and across both rooms for certain steps. The interdependency between members working in the FAB CELL and on ESys1 (equipment system #1) is highest and reciprocal in nature. After the exchange, task interdependency is sequential and the products leave and return to the work team toward the end of the process.

For the most part, the daily goals and plans of the team were driven by the co-leads. The taskwork required much coordination within and between the work rooms to meet schedule goals. Task-related information was exchanged frequently between the members. A high degree of cooperation on taskwork was observed and in most cases a task required it. Several instances of performance monitoring, backup behaviors, and collaborative problem solving were observed. Most adjustments were observed to accommodate the reciprocal interdependency between the FAB CELL and ESys1, deal with technical problems around ESys2 (equipment system #2), or to account for absenteeism.

Over the observation period, the team met their goal of completing a product every three working days through each operation, although there was some give and take. No overtime was utilized during the observation period, but some member's work schedules were adjusted over the 10 days. There were several instances of absenteeism in the team throughout the observation (entire or partial shifts) but it did not seem to negatively affect their outcomes. Instead, the team appeared to be adequately staffed and cross-trained to account for those absences. Some members did appear to have negative

attitudes toward having a formal hourly-paid lead among them, but in general they held their coworkers, their supervisor, and the site's management in high regard. Based on the generally recognized criteria for a team's effectiveness (performance, member attitudes, and outcome behaviors), the information gathered from the observation and interviews supports management's valuation of their effectiveness.

4.2 Findings from Context

This section reports the major findings from the Team Jun case study for the influence of context on SRTB. Team context and organizational context respectively accounted for 38% and 8% of the entire dual-coded data set as an independent factor.

The team context category includes external leadership, structural empowerment, team task design, and coaching. Team task design was considered a multi-dimensional factor encompassing task interdependence, task routineness, task variety, task autonomy, task significance, task identity, and task feedback (Cohen et al., 1996; Hackman, 1987; Hackman & Oldham, 1980; Harvey, & Burns, 2005; Rousseau et al., 2006; Rousseau & Aube, 2010). Coaching was also considered multi-dimensional and included functions for motivation, consultation, and education (Hackman & Wageman, 2005; Rousseau et al., 2013). According to source repetitions, team context appeared to heavily influence SRTB in Team Jun.

The organizational context category includes work support systems, information systems, reward systems, and education systems. Information systems was reported (by source repetition) to be the most influential organizational context factor on Team Jun's SRTB.

4.2.1 External Leadership

This section describes the influence of external leadership on SRTB from the Team Jun case study. In addition, substantial relations to the emergent states team climate and team integration were found and are reported in separate subsections. External leadership accounted for 27% of the dual-coded data from team context.

"The bottom line of all of this is a good supervisor, believe it or not." This phrase, offered up by a team member during their interview, summarizes the affect that other members communicated regarding their supervisor. Continuing with why they thought that way, *"I've been here for 15 years and have worked for several supervisors. Their attitude toward me affected my performance. Our supervisor is a great one, ... treats me with respect and I go above and beyond to make my supervisor look good."* Team Jun has worked for a few different supervisors during their development and the introduction of their current one was often cited as a main reason for their engagement in SRTB. Regarding how their SRTB for work preparation started, the lead hourly technician said *"I think it started happening when our current supervisor first started... It was choppy at first."* Most of the team members had worked together on this job with several other individuals that are no longer part of their group. Referring to the difference between then and now for their collaborative behaviors, one member said *"I think the biggest reason between the way it was then and the way it is now is the personalities of the people and the different supervisor."* Several comments demonstrating this team's regard for their supervisor's influence were shared in the member interviews such as *"Each person is fitted right in the team's jobs to their personality. That probably falls back to the supervisor too, taking the time to get to know the employees and where they would thrive in the team."*

Team Jun was thought to exercise a high degree of group autonomy, thus one of the reasons they were selected as a literal replicate for the research. During the observation period the supervisor was seen on just a few occasions among the team members, most often to check work status on something called an *IOP board* or to drop by the members to see how things were going for them. However, the frequency of contact is not indicative of the quality of the interface that was occurring. The supervisor's office is located nearby the work team and several members, in particular the co-leads, would go to the supervisor's office at unscheduled times for brief and informal discussions about what was going on. The supervisor also spoke of receiving phone calls or texts from different members of the team, during or after work and regarding the work or *"more important things"*. It was evident from the observation and discussions with the

members that they perceived their supervisor as doing more than just supervising them. The supervisor was working to shape the climate and integrate the members into an effective team.

4.2.1.1 Influence of External Leadership on Team Climate

When Team Jun's supervisor was asked why they thought the team was engaging in SRTB, they simply responded *"Because that's my expectation."* Based on the members' interview data, the team overwhelming concurred with that notion. One member told me *"I might see our supervisor a couple times a day, but very little. They'll drop in to check on our work status, see if we need anything, crack jokes, etc. I really don't know our supervisor that well yet but I remember when I started on this job they explained their expectations and what they absolutely will not tolerate. They took me to the IOP board and explained it. It seems that our supervisor gives you what you need in advance, something for your tool belt to prepare you."* Likewise, another member explained that *"When you have a boss that treats you right you don't mind working for them. Our supervisor also doesn't take any crap. They have a job to do and they want to do it right... They'll cut up, but '*nickname*' wants it done!"*

Team Jun's supervisor seemed to be influencing the team's climate, foremost a shared concern for *excellence of task performance* (Anderson & West, 1998). At times the environment in a work room will go out of spec, lights will go out, or computers used for the fabrication will go down. When that happens the supervisor said *"No one goes home."* The supervisor's expectation is that *"...the members inside that room will first clean and then go to the other work room to help other members. The team has never seen someone needing help and not helped them."* The observation provided a firsthand account that Team Jun was in fact doing that. However, undivided accounts were given of how it wasn't always that way. Coming from the supervisor, *"There were some people now not on the team that weren't being team players so I worked to have them removed. My expectation is that if you're going to be on this team you're going to be a team player."*

The supervisor's expectations seemed to be reflected in the members' perceptions of *"the way things are around here"*. For example, a member was working in the room they're not normally assigned to and helping other members accomplish their tasks. When asked what prompted that behavior the member said *"I didn't have anything to do in the other room because I was waiting on work from EqSys1. But there's always something to do out here. HPUs has a lot to do with it, trying to keep them down."* This member was not directed by anyone to go to the other work area to provide help.

To learn and develop the skills to manage and improve the process themselves requires a *climate of participative safety* (Anderson & West, 1998). "People tend to act in ways that inhibit learning when they face the potential for threat or embarrassment (Edmondson, 1999, p. 88)." Several members gave accounts of *"the way it used to be."* Referring to the generation of their current collaborative behaviors, *"The change happened when one member was laid off. We downsized a non-team player. You have got to have a team that can communicate and work together. For example, that member had a tool box that I constantly felt like I was bothering to borrow and put back their tools. I couldn't do anything to innovate to improve my job; to them it was always nope, nope, nope. You've got to want to make things happen!"* Note in that member's comment the reference to the removal of a non-team player as something *"we"* did.

Apparently tool boxes were not the only things that were off-limits at one time for Team Jun. The supervisor said that when first assigned to this team the norm was that the hourly members did not use the restrooms and refrigerator located in the management office area, both of which are located closer to their work area than the ones they had been using. According to the supervisor, that was changed by *"...making them feel welcome to use both and by demonstrating trust."* The supervisor's interview answer to how the team's current work assessment behaviors came to be was puzzling at first, *"I made the team understand that I'm no better than they are, and thanked them. I showed the team respect."* But from the following observation and forthright conversations with each member, it appeared that the supervisor's demonstration of trust and respect (another expectation of the supervisor for the team's interactions) had influenced the members to feel safe to be involved in SRTB. The member's accounts of their team

interactions portrayed a sense of confidence that they would not be embarrassed, rejected, or punished for speaking up. That confidence stems from mutual respect and trust among team members (Edmondson, 1999).

Acquiring the skills to self-regulate performance requires that individuals learn and adopt new ways of thinking and behaving (Frese & Zapf, 1994). The supervisor of Team Jun also seemed to play a role in developing a *climate of support for innovation* (Anderson & West, 1998). Within just a few months of being assigned to Team Jun, two members of the site's LSS group helped the supervisor facilitate an extensive lean event occurring over a period of several weeks. The details of what was accomplished in the lean intervention were described in Section 4.1.1 Introduction to Team Jun. Referring to a part of that event, the supervisor said *"A particular rack move had a domino effect. When members saw their opinions mattered, their ideas mattered, they became engaged. Once one work room saw what was going on in the other room, they also became engaged. Ideas just kept coming. We rarely put ideas into the EIP system now, they just get done."*

The supervisor talked about previous team members that were strong resistors to both the lean intervention and participating in collaborative teamwork behaviors. The supervisor said they eventually worked out transferring those individuals to other areas, after *"...trying to bring them on board with 'the team' for quite some time."* As for the others, *"There was some kickback at first but I just asked them 'why not?'"*

The influence of external leadership on establishing a climate of support for innovation is evidenced from the attitudes and behaviors of the Team Jun members. As one member put it, *"We had a 5S event a little after that* [after current supervisor started] *and it made a big difference. Some people might think that the 5S thing is a big joke, but if I have to walk 20 feet to get my tools and materials it's not good for us. They let us take the bull by the horn and we did it."* Note in that member's comment the reference to having to walk fart to get tools as something that not good for *"us"*. This comment and the one before it are both intended to communicate a sense of team identity that was uniformly expressed by the Team Jun members. Here too, the influence of external leadership is notably apparent in the process of integrating the members into a *team*.

4.2.1.2 Influence of External Leadership on Team Integration

When asked why collaborative behaviors were occurring in the team as they are, Team Jun's supervisor succinctly said, *"We come together as a team."* Recalling their introduction to this assignment, *"At first it wasn't easy. I had an inside and an outside group and they weren't working together well. We were also in here 10 hours a day and 7 days a week. I sat down with them and together we figured out how to help each other get out of here!"*

According to one of the members, a mandate for integration was actually given by management prior to their current supervisor's efforts to bring the team together. Referring to the generation of their collaborative behaviors, *"...but then we began to be evaluated as a team by management, not as two groups. Our operations manager starting posting our team metrics, but I think what I'll call the 'team building' started with a previous supervisor. We began to be told by management not to think of being two groups but to think of ourselves as a team."*

It appeared that for Team Jun's supervisor the forming of a team identity went beyond doing so to improve performance. One member said *"Sometimes on a whim we'll eat together on Fridays. Our supervisor just creates a great atmosphere to work in and their attitude is awesome."* The team reported that the supervisor would on occasion cook and bring in breakfast for members who would have to work on a Saturday and that *donut day* and *pizza day* were common events, now most often led by one of the team members instead of the supervisor.

Regarding the team's work, from the case study observation it appears at this point that the supervisor has "left the kitchen" and is leaving the cooking up to the team. As one member said, *"Yes I think we are effective at collaborating to get our job done, very much so. Part of it might be because our supervisor isn't directly involved in our day to day activities. I've been on other teams here with other supervisors and I think that when you have a supervisor with you on the floor a lot of time that it tends to cause tension between the employees. That tension might come about if the supervisor doesn't treat everyone equally, or if some people just see it that way."* When asked how they thought the team's collaboration could be improved or worsened a member responded,

"What could make it worse is personal conflict, when the 'I' gets in the way of the 'team' or when individual recognition occurs more than team recognition. For example, singling out members of the team by giving 'at-a-boys' or rewards of different kinds, or showing favoritism by the supervisor or other management. I think what might be driving some of the conflict we have now is the relationship between the supervisor and the lead hourly tech; there may be some jealousy going on."

4.2.2 Structural Empowerment and Information Systems

This section describes from the Team Jun case study the influence of structural empowerment and information systems on SRTB. An important relation was also found between structural empowerment and team climate. Combined, structural empowerment and information systems accounted for 22% of the dual-coded data from independent factors in organization and team context.

4.2.2.1 Structural Empowerment

According to Team Jun's supervisor, *"The lead salary tech is my right hand and the lead hourly tech is my left hand."* As documented in a formal arrangement between the site and the labor union, an hourly lead is responsible for assisting the supervisor by providing instructions to employees, making work assignments of employees, and performing a variety of assigned duties including performing production work in whole or in part. Lead selection is to be based on technical knowledge of the taskwork and ability to assign work, teach others, and other leadership qualities. Team Jun did not have an hourly lead when the lean intervention occurred but a member of the team, LHTech, was assigned to that position shortly afterwards by the current supervisor. Recalling how their work preparation behaviors began, LHTech said *"Most of the previous team members wouldn't take direction unless it was from the supervisor, but some had been coming to me for direction for quite some time. They would say stuff like 'you're the lead' even though I really wasn't."* LHTech stated that *"Once it was made official and some difficult members left, it felt like I could actually lead and it started working out."*

The leadership status of one of Team Jun's salary technicians, LSTech, is informal. While LHTech had actual taskwork responsibilities, LSTech did not. The role of LSTech seemed to be dedicated to providing coaching and boundary spanning for the team. In the words of LSTech, *"The team takes direction from me without any problem. At any given time, I can look at the work in process and know exactly what position someone is in. That helps with backing up and knowing what to provide coaching for."* A member explained that one of the reasons for their current work preparation behaviors is that *"LSTech is always out on the floor finding out what's going on and making sure there's something to do."* As another member stated *"LSTech is the bridge for us to the downstream operations and to our management group, letting us know what's going on outside our team and if there are things we need to do better to support other groups."*

The roles of internal leadership for Team Jun seemed to be shared, but as one of the members stated when talking about the team's work preparation behaviors, *"I think LSTech can be considered more of the actual lead for both work rooms, being more of the 'go to person'."* That sentiment appeared to be shared among the members. When asked about how their shared leadership roles developed, LHTech said *"I think when we were experiencing quality problems it actually helped to get us working together to solve them. I started working with LSTech to solve some of the problems we were having and it grew from there."*

Having salary technicians and hourly technicians integrated in a production work team appeared to be a structural empowerment feature that influenced the team climate. According to the team's supervisor, *"In my opinion, we need to have more salary people working in with the hourly people for the kind of leadership this team gets from LSTech."* The arrangement between Team Jun's supervisor and LSTech was simple according to LSTech, *"The supervisor takes care of the people side and I take care of the technical side."* The hourly members all agreed that the salary technicians were valuable members of their team. As one member said, *"Working with salary technicians on the same job was different at first but it works well."*

The co-lead LSTech did not actually have a job to perform on Team Jun in the production sense but the other salary technician was responsible for operating ESys1,

being the only member fully trained to do so. During the observation, that member would sometimes get a late start in the mornings or not be seen during the day running ESys1. Having an office area located beyond the work areas, that member would sometimes spend time there or would have to attend management meetings at various times during the week. Several comments revolving around keeping that member *"working in the room"* were made by the supervisor, LSTech, and LHTech in reference to affecting the climate of the team and their performance.

Another issue related to having hourly and salary technicians integrated in the work group involved the relationship with the labor union. One of the team members was also a union official for the department and according to the supervisor has *"...actually filed one grievance against LSTech for doing work that the hourly should do, but they work very well together regardless."* LSTech said it was *"...a couple of grievances."* It was apparent that LSTech had introduced much technical innovation into the processes for cost and time improvements and several reports from the members indicate their appreciation for the salary co-lead on the team. Like one member said, *"I've told LSTech that it's ok when they do things* [perform hands-on work], *especially to show me an easier way. I want to know how to do it right and LSTech likes to be involved, so it works out well. The way I see it, let the union people handle it if they think LSTech is working too much."*

LSTech acknowledged that as a salary technician performing hands-on work can cause some conflict in the team but *"I know LHTech pretty well, and we joke around a lot. But it depends on who I'm helping. This team has a lot of ties to the labor union so it's pretty hard for me to get by with too much! It's not like they're out to get me, and they especially don't want to burn any bridges with me. I just like to be involved in the work"*. LSTech also said *"If they're working overtime they don't seem to have as much trouble with me getting my hands dirty. I've learned where my limits are; I know when to be cautious and I know that there are some tasks they actually want me to do. The way I see it, we can get along or not"*.

4.2.2.2 Information Systems

Information systems was defined for this research as the practices of an organization used to provide employees with information to plan their work and manage their performance (Hackman, 1987; Morgeson et al, 2006). A particular practice appearing to influence Team Jun's engagement in SRTB was the introduction and use of something they called the *IOP board*. Replaced weekly, the IOP board was an oversized schedule in the work area showing the planned dates for major operations with blanks to record actual completion dates. It was introduced during the lean intervention to help the team monitor and manage schedule performance. During the observation, photographs of the IOP board were taken at the end of each day to compare how it was being used and what actually occurred on that day. Those artifacts indicated it was not being used as originally intended.

As the supervisor explained the purpose of the IOP board for the team's work preparation and work assessment, *"To plan the team's work we first tried the magnet charts but they didn't work because they were too complicated. Then I hung up the IOP board showing the dates for each unit through the different processes and the team took off with it."* When asked about what it was that enabled the team to take on responsibility for planning their work activities a member said *"Visual cues. There was a build plan (IOP board) that was introduced during a lean event. Using that, we know what steps to do and where everyone is in their work because we mark off our progress as we go."*

The supervisor communicated that all team members use the IOP board as if it were a team norm. *"Using the IOP board, they know how many days they have to complete each step in the process to meet their goals and they write down their progress on it."* However, the team actually seemed to be split on the usefulness of the IOP board for planning and monitoring their work activities.

Some members, those directed by LHTech with work centered around ESys1, held the IOP board in high regard. Referring to the generation of their work preparation behaviors, one of those members said *"The IOP board is what I attribute that to. I go to the IOP board and can see what I need to do."* Another said *"The IOP board really comes in handy... I think what goes a long way is people just being able to see what needs*

to be done." In fact, within this group of members the IOP board was stated as a reason that would justify altering a feature of their structural empowerment. *"If people can see what the goals are for the team, then I don't see the need for an hourly lead. We check the IOP board every morning to find out what to do, really without having to have anybody tell us what to do."*

Members in the other room seemed to think the IOP board had little utility to support their SRTB. Starting with *"It's a little confusing, but to tell you the truth nobody has taken me to the board to show me how it should work. Anyway, I don't think it's the best way to know what to do because too many things interrupt the process. If I always just paid attention to what was up next on the IOP board I might do the wrong thing."* Another member said *"I don't write down dates on that thing, but I can tell them when they happen if they ask."* In fact, that member did write down and color-code milestone events (such as absences) and task completions on a calendar at their work station.

According to LSTech, the division in Team Jun's respect for and attention to the IOP board may be due to a difference in the routineness of the taskwork between the two rooms. The members in favor of the IOP board work ahead of the exchange process in the fabrication sequence where *"...as long as everyone is here everything goes according to plan."* The taskwork of members not using the board occurs after the exchange, where the routineness becomes lower. As LSTech explained it, *"As a goal, we look at completing two units every week. As far as following the IOP board goes, we often have to make adjustments in the ESys2 work room due to technical problems. So I don't pay too much attention to the IOP board, I just keep everyone multi-tasking."*

4.2.3 Team Task Design

This section includes findings from the Team Jun case study related to the influence of team task design on SRTB. Team task design accounted for 25% of the dual-coded data from team context. Table 5 shows the counts of source repetitions reporting an influence from team task design on the separate phases of SRTB, categorized by the most frequently reported task design features.

Table 5. Team Jun Task Design Relations to SRTB

TASK DESIGN	SRTB			
	Prep	Collab	Assess	Adjust
Interdependency		2	1	1
Autonomy		1	2	2
Feedback	1			1
Routineness	4		1	6

4.2.3.1 Task Interdependency

From an overall perspective, the team's supervisor explained the fundamental task interdependency shared by the team members, *"The members in the ESys2 room have to have their work completed by the time the members in the ESys1 room are ready for the exchange"*. The work flow diagram for Team Jun (see Appendix D) shows that relationship. Observation revealed that much coordination of the work activities within each room was necessary to ensure the exchange occurred as planned.

The exchange process itself requires no less than three members work on it at the same time, often involving members from both work rooms. In fact, within both work rooms cooperation is necessary on most tasks and not possible on just a few. Several instances of cooperation were observed to present opportunities for performance monitoring (including constructive feedback on task performance) and collaborative problem solving. A notable and humorous example of performance monitoring facilitated through cooperation involved two members working together on the ESys2 pre-step. During this cooperative task one member noticed that a feature of the taskwork created in the prep cell wasn't correct and jokingly said (referring to the other member who had performed that task earlier) *"If that &%!# [sic] that does these would do it right we wouldn't have to fix 'em every time, oh that's _____!"* They laughed about it and the member receiving the "feedback" apparently took it well.

In addition to influencing collaboration and work assessment behaviors, task interdependency also appeared to initiate team adjustment behaviors. The level of

interdependency between ESys1 and the fab cell is reciprocal and both were observed to adjust their work tasks to accommodate the other. One member, not involved in that loop but working in the same room, pointed out how it was influencing team adjustment behaviors. *"I'm not sure about the sequence but I know there are a lot of times when they have to switch things around at ESys1 in order to keep everything moving and meet our schedule. It takes planning and we do it on our own."*

4.2.3.2 Task Routineness

Task routineness, the extent to which team members accomplish their work in a consistent or repetitive manner, was found to be limiting but also providing opportunities to generate SRTB in Team Jun. Among the limiting evidence, a newer member of Team Jun explained that *"I haven't worked anywhere else in the plant like this; in here the production is different. It seems like as long as the work is steady there aren't any problems to have to deal with."* Another member stated that *"A lot of the work in my room is based on keeping the momentum going on what we're already working on or just starting what's next in line on the IOP board when we're done."* Still yet another member spoke about their taskwork as *"It's easy when you know exactly what you have to do next. We have very few delays, things usually fall in place. Sometimes people get ahead or behind, usually causing some bitching and moaning [said jokingly] but it seems that everything is tuned. We're in the sweet spot."* Those members worked in the same room, where the high task routineness didn't appear to create as many opportunities for team adjustment behaviors.

In the other room, the task routineness was considerably lower. Primarily working in the prep cell, one member said about their taskwork *"This is a complex job; you never work on the same thing eight hours a day. It takes a while for it to set in, it's very technical."* The observation revealed that the taskwork around ESys2 frequently had surprises and setbacks from technical problems. When those events happened, it prompted the team to adjust their work activities and sometimes go back to the drawing board for their plans. Under the guidance of LSTech, several occasions of collaborative problem solving were observed between the members to counteract those effects.

Team Jun's supervisor identified the quality characteristics of one of the materials used in the process as a problem impacting the flow through ESys2. As the supervisor described it, *"When the member working on ESys2, who's a real go-getter, is faced with a having to deal with those problems they just feel whooped"*. That member worked through a predetermined but complex sequence established by LSTech to try and solve the problems but that process might cause other problems as well. Like the supervisor said, *"When they can't fix the problem by themselves, they'll get LSTech or another member and they'll figure it out together."* According to LSTech much of the team's work preparation behaviors result from the unreliable nature of the taskwork involving ESys2. When asked what could improve their preparation behaviors LSTech stated that *"...it would definitely be better if we could solve our problems with the material, it's our weakest link. Whenever that occurs it causes us to have to stop and change our plans, but when we have good material everything runs smooth according to plan."*

It was apparent from the observation and interviews that the low task routineness surrounding ESys2 was providing opportunities for the team to engage in SRTB. However, a reliance on LSTech for arriving at solutions for problems and innovating taskwork was also evident. As one member put it, *"I think it's important for solving the complex technical issues that we have leadership from one member of the team, even at this point in our maturity. That's the main role of LSTech whereas LHTech is doing more of a scheduling and training role which isn't as important now as it once was. If the team matures further and we don't have turnover, we might be able to do it without LSTech but the technology and current problems are so complex that I don't think it would be a good idea to do that."*

4.2.3.3 Task Autonomy and Task Feedback

As an illustration of how task autonomy provided an opportunity for work assessment behaviors, a member said *"From a quality standpoint, at one time there were a lot of sub assembly installations that were incorrect. To verify their placement, the corrective action started out with an inspector coming to check them. Then that responsibility was moved to the salary technicians. Now it's up to them [the fab cell*

members]. *That gave them ownership; they feel accountable and they do it.* " Another example of how task autonomy influenced performance monitoring came from observing the work at ESys2. A member was checking process results from prior units before beginning another one. When asked why they did that the member responded *"To know what to expect on this one. It's up to me to make sure that the process goes like it should. LSTech doesn't look over my shoulder as much anymore."*

Several sources of task feedback appeared to enable planning for work preparation and assessment behaviors. Prior to introducing lean methods for visual workplace and pull systems for WIP and materials, LHTech said that it was *"...difficult to know what we were doing good and what we were doing bad. I also had trouble giving direction to the other members because it was hard to tell what needed to be worked on."* Now according to one of the members, *"Everyone works at a good comfortable pace, not too fast or too slow, and we can see the work in progress. For example, at the sub assembly station you can plainly see what's been completed and what needs to be done because of the visual cues."*

Task feedback was also cited as necessary to provide knowledge of task results so that problems could be solved collaboratively. When asked what might improve their team adjustment behaviors, a member responded *"I think getting more feedback on defects that are not discovered until downstream from our team could improve it."* In fact, during the case study the co-leads and members of Team Jun were working together to counteract a troublesome defect that is being created from their taskwork.

4.2.3.3 Task Variety, Task Identity, and Task Significance

Other less cited task design features appeared to have some influence over Team Jun's adoption of SRTB, including task variety, task identity, and task significance. An example of influence from task variety on cooperative behaviors was discovered during the observation when one of the members was found assisting LHTech and another member with the exchange process. That member's taskwork actually took place in a separate area from the exchange and it required a relatively narrower set of taskwork skills. When that member was asked what prompted the cooperation they said *"Actually,*

I just got bored with what I was doing and walked out to see what was going on. When I saw they were starting an exchange and needed one more person I just started helping. "

While talking about how taskwork knowledge was shared among the team members, one of the members offered an opinion that was thought to reflect an influence from task identity on the team's mental model. *"You know what helps? You know how some of our programs here have one group prepping the work, then handing it off to another group to do the fab, then sending it on to another group to do whatever else, that doesn't work. What works better is to have all of the work done by the same group like we do."*

Another example of how task design can influence an emergent state (in this case team cohesion) came from a member's comment regarding the significance of their taskwork. *"If you're working in a machine shop making some minor part embedded in an engine or something no one sees it. But people see a product like ours and we know it's important. The people on this team are proud to be a part of making it happen."*

4.2.4 Coaching

This section describes findings from the Team Jun case study related to the influence of coaching on SRTB, accounting for 24% of the dual-coded relationships from team context. Team coaching is an act of leadership with three commonly recognized functions (motivation, consultation, and education) that were used as categories to examine the case study data (Hackman & Wagemen, 2005; Rico et al., 2011; Rousseau et al., 2013). For each datum with coaching assigned as the independent factor, it was determined whether the influence was on the generation or further development of SRTB. Table 6 shows the counts of source repetitions reporting an influence of coaching on the separate phases of SRTB, categorized by coaching function. The motivational function was found to influence the generation of SRTB while the consultative and educational functions were found to influence its continued development.

Table 6. Team Jun Coaching Relations to SRTB

	Coaching	Team Jun SRTB			
		Prep	Collab	Assess	Adjust
Gen	Motivational	5	7		
Dev	Consultative Educational		3	2	5

4.2.4.1 Generative Influence of Coaching

At the beginning of a day during the observation, one of the members was approached and asked when they planned to continue working on a unit that was run on the prior day in ESys2. The member said it was last on the list and they first planned to get a different unit into step 2 and then another unit into step 1. After that, and if they had time, the member said they would continue working on the unit from the prior day. When asked how they came up with that plan for the day the member said *"LSTech did"*. On each day of observation, it seemed that most work plans for the ESys2 room were driven by LSTech. There were times however when LSTech was absent and momentum seemed to carry the work activities due to the long cycle times.

Team Jun's supervisor expressed that *"LSTech is a real 'goal setter' for the team, setting the team's goals a little higher than the management goals but the team has no issues with that."* One of the members who does not work in the ESys2 area thought that LSTech was effective at providing leadership for the team's work preparation due to their drive and determination and *"...because of the time LSTech's spent on this job."* In the other work room, LSTech appeared to influence the higher level goals and work plans (at times contrary to the sequence on the IOP board) but the details were left up to the team members under the guidance of LHTech. As one member put it, *"Yes, I think LHTech is good at helping us make work plans. LHTech is right on top of it, ... knows the schedule and isn't bossy, it's more like suggesting what we should do."*

Members in the two work rooms appear to have generated SRTB for work preparation in different manners. In the work room associated with ESys1 and LHTech,

the members were taking on more self-planning. Frequently citing the IOP board as enabling their work preparation behaviors, some members in that group questioned the need for an hourly lead among them. In contrast, the members in the work room associated with ESys2 appeared to rely on motivational coaching from LSTech for work preparation behaviors.

Motivational coaching was also observed and reported to influence task-related collaborative behaviors for Team Jun. A need for motivational coaching was suggested by LHTech who said, *"I can say that our team has gotten off track when I'm not here."* Referring to LSTech as *"the straw that stirs the drink so we keep moving,"* one of the team members recognized LSTech as the driving force behind the team's collaborative efforts. *"LSTech is a hands-on, roll-up the sleeves kind of person who's not afraid to get involved in any issues or problems. LSTech has an easy-going personality and sets the pace or the pulse of our work."* This impression was echoed by other member's comments and even confirmed by LSTech saying *"This is a pretty good bunch as far as keeping a good pace goes, but sometimes I have to push them."* Another member, laughing about their own *"pusher"* comment said *"LSTech's driven to turn out quality work and to keep moving things as fast as they can be. ...sort of a persistent pusher."* Referring to members outside their work room, another said *"Some people need pushing and LSTech does well with that."*

4.2.4.2 Developmental Influence of Coaching

Team coaching used to address performance strategy (consultative) and members' knowledge and skills (educational) appeared to be impacting the development of SRTB in Team Jun for collaboration, work assessment, and team adjustment. Like LHTech said during their interview, *"Some are still learning; there's a lot to learn on this job and we need everyone to step up and do their part. For example, I saw one of our newer members just watching as someone else was training them on a task so I told the member that was providing the training '...there are two wrenches, you need to make sure they use one too.'"* A kidding but seemingly serious comment related to educational coaching came up when one of the members was providing backup for another to complete a

hardware assembly needed at ESys2. LSTech provided instruction to this member because they had not previously performed the task. Responding to a comment that the assembly was completed quickly, one of the members stated, *"It had to be, LSTech held their hand the whole time!"*

Regarding consultative coaching, the supervisor said *"The co-leads make sure the members check on each other's progress for getting an exchange ready."* According to one member *"LSTech's hardly ever seen inside the room but ... knows what's going on and communicates back and forth. LSTech does well with keeping both sides informed and in flow."* When asked what helped to provide coaching for performance monitoring, LSTech said *"I've proven that I can do this job too. I've done all of these jobs, so I know how long it should take and how much effort it takes."*

The observation revealed that the team received coaching to make adjustments when problems came up. Several instances of backup behavior were observed within and between work rooms but like the supervisor stated, *"The backup between rooms is usually initiated by the co-leads."* As one member put it, *"If something ever comes up that throws a wrench in our routine, then LSTech always has a backup plan."* Another member referred to LSTech as the driver for solving the team's technical problems. *"In general, LSTech handles most of the technical problems, either on their own or with other team members."* According to LSTech, going into the other work room is usually prompted by *"...trying to work out a problem with LHTech. We'll look at a part to see the problem and sometimes gather more of the team to work on solving it. We do this as a team effort because others may see something that we don't."*

4.3 Findings from Composition

This section presents the findings from Team Jun for how team composition influences SRTB. Team composition accounted for 25% of the entire dual-coded data set as an independent factor. The team composition category includes member personality, member taskwork skills, member teamwork skills, team flexibility, team stability, and team size. Member personality dominated this category but teamwork skills and team flexibility were also reported to influence SRTB with high source repetition.

4.3.1 Member Personality

Reports of the influence of member personality on Team Jun's participation in SRTB were categorized by the five-factor model. The five-factor model, or Big Five, is the most widely accepted model for describing personality trait structure (McCrae & Costa, 2008). It includes the dimensions openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (or emotional stability). Table 7 shows the counts of source repetitions reporting an influence of member personality on SRTB and the team emergent states climate, integration, and cohesion. The traits are listed by the acronym OCEAN, corresponding to the first letter of their name.

Table 7. Team Jun Personality Relations to SRTB and Emergent States

	PERSONALITY TRAITS				
	O	C	E	A	N
SRTB	1	7	2	7	
Team Climate	1			2	
Team Integration				2	2
Team Cohesion		1	1	3	
Totals	2	8	3	14	2

Conscientiousness and agreeableness were the traits most often cited to influence the generation of SRTB in Team Jun. When asked about the difference between their current state and the way it used to be, all members and the supervisor made reference to some previous members as being *"difficult to work with."* From LSTech, *"In the past, there were some team members that were difficult to work with, but now they're gone. There was a change of personnel with positive attitudes, people that were willing to work together."*

The other members shared similar comments. One said *"One of the difficult members transferred out and another was laid off."* Another said *"Previously, there were some difficult people on this team to work with. I've also worked with them on other jobs and it was the same way. There were two in particular. I know that one of those members was like that on other teams too."* During the observation a story was shared about a

small box that had been put in place during the lean event to store a cutting tool used in the work area. Every day a member's day-shift coworker (no longer on the team) would move the box because they did not want to use it. Every night the second-shift workers would move it back. Finally, the second-shift members bonded and bolted the box to the table it was sitting on and *"...that took care of knowing where the box was but my coworker still wouldn't use it to store the knife. They did whatever they could to not get on board with the rest of us. "*

The team attributed an abundance of agreeableness among the current members for enabling them to begin working together effectively. One of the members said *"I think it's the chemistry of the team. We have the view that the other person would help them if they needed help, so we are always ready to help out. "* In response to what happens when someone gets behind in their work, another said *"I've seen many examples of the people on this team backing each other up to help out whenever that happens. I think it's just the personalities. You could put five or six other people in these same jobs and I don't think they could do it like we do. "* In response to whether monitoring the performance of other team members causes conflict one of them said *"I don't see it. We jump in and help each other. They'll say stuff to me like, 'you know we're going to need what you're working on finished by tomorrow, right? If you aren't going to be ready just holler and we'll jump in and help you. '"*

The conscientiousness trait was also broadly cited by the members to influence SRTB. In response to a question about what was driving the team's adjustment behaviors, LSTech said *"This team is made up from what I call 'A' players. They're quality-minded and they like to be efficient to keep our HPUs down. They don't just look at the router standards for how much time is allotted and work to that. "* LHTech said not only the members but the co-leads were conscientious about the team's work. *"Our team is made up of very conscientious people. In fact, one thing about me and LSTech is that we're both Virgos, we're very conscientious about doing things right. "*

From a member's comment about having their work checked, *"I don't mind that. I'm the kind of person that would rather have my work checked than do something wrong. "* When another member was asked about what they thought was helping their

team collaborate they said *"In all honesty I think it has to do with the group of people you have together. There are a lot of driven people on this team. They want job security, they want to do a good job, and they will bend over backwards to help each other out. Yes there's some bickering, but that's everywhere. Some people you just can't put together and get good team performance."*

4.3.2 Member Teamwork Skills and Team Flexibility

Member skills for teamwork were reported to influence SRTB. The supervisor said, *"For the most part the team is in the same room and talking; if someone's not moving quick enough they talk. The members in one room don't just do their job and expect the other room to work, they check on them and they communicate. Both groups work to fix problems on their own before they get help if they need to. If they know they are behind, or if a problem comes up like something happening to the equipment, they bring it to my attention with alternate plans."*

Some examples of how teamwork skills influenced their SRTB came from the members. While some members reported others to need better teamwork skills, one said they have favorite members to work with because *"...we like to figure out a system that will make our job quicker."* LHTech said *"Some people are better at some things than others, so we have to find out what they're good at and go from there."*

Team flexibility, or the ability of members to perform tasks interchangeably, was also stated by the co-leads as important. According to LHTech, collaboration between the two work rooms began when *"... there would be some days when nothing was going on inside my work room so I would go to the other room because they always have something to do. I got more familiar with that work, and was then able to provide training to new members."* Referring to how their adjustment behaviors could be improved, *"Everyone getting to know all the different parts of the job helps."* According to LSTech, *"Bad apples can draw everybody else down, but now all the members can perform just about any task. We try to put ourselves in each other's shoes. Most everyone is cross-trained, so we know how to help the other guy out. When you know more of the*

whole process to build the part, it helps to see how what you might do in one step can affect another step that the team works on."

The other team members agreed that team flexibility is important to continue developing SRTB. As one said, *"We're going to have people out but most everyone on our team has been cross-trained and we can fill their shoes."* Still yet, an increase in the team's flexibility was cited by several other members as what could improve their SRTB. *"We could probably have some more cross-training. I'm the only person that does my job, except for on a rare occasion someone else might have to do a small part of it." "An example where it might get worse is not having enough cross-trained skills or no one to back you up." "We seem to work so well together but it would help to have a backup for a particular member; that would help our HPUs too."*

4.4 Within-Case Analysis for Team Jun

The coded data set from the Team Jun case study contained a total of 309 items. As explained in Section 3.6.3 Ordered Displays, a factor matrix was first created for the within-case analysis to record counts of the different sources reporting dual-coded relationships. Table 8 is the factor matrix for the Team Jun data.

Table 8. Team Jun Factor Matrix

Dual-Coded Source Repetition Count (max 10)	TEAM COMPOSITION — Team Size	Member Personality	Skills - Task Work	Skills - Teamwork	Team Flexibility	Team Stability	ORG CONTEXT — Work Systems	Information Systems	Reward Systems	Educational Systems	TEAM CONTEXT — Empower Structure	External Leadership	Team Task Design	Coaching	EMERGENT STATES — Team Integration	Team Climate	Team Cohesion	Team Empowerment	Team Mental Models	SRTB	Sum
TEAM COMPOSITION Team Size	■																		1	2	3
Member Personality		■													2	2	4	1	1	9	19
Skills - Taskwork			■								1				1					1	3
Skills - Teamwork				■							1		2							6	9
Team Flexibility					■													1	2	8	11
Team Stability						■														3	3
ORG CONTEXT Work Systems							■								3		2			3	8
Information Systems								■									1			6	7
Reward Systems									■						2	1					3
Educational Systems				1						■									1		2
TEAM CONTEXT Empower Structure											■	1			2	4		1	3	6	17
External Leadership												■			3	6	1		1	4	15
Team Task Design											1		■				2		3	8	14
Coaching				1										■	1	2		1		10	15
EMERGENT STATES Team Integration															■	1	4		1	10	16
Team Climate																■	2		3	6	11
Team Cohesion																	■			7	7
Team Empowerment																		■		9	9
Team Mental Models											1								■	8	9

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The matrix groups factors into composition, context, and emergent state categories. The numbers in the matrix indicate how many different sources reported an influence from an independent factor (rows) on a dependent factor (columns). The Team Jun case study involved observation and nine interviews, thus ten was the maximum number of source repetitions that could occur for a factor relationship. The count of source repetitions was used as a basis to determine the relative importance of factors and relationships in the analysis. As explained in Section 3.7 Validity, Reliability, and Trustworthiness, the method of using source repetition for data triangulation enhances the confirmability of the research findings.

A causal waterfall display was then created, where source repetitions were used to separately show the significance and relationships of the independent factors. Figure 10 is the causal waterfall display for the Team Jun data.

TEAM COMPOSITION

19	
9	MBR-PERS
	4 COHESION
	2 INTEGRATION
	2 CLIMATE
	1 MENTAL MODEL
	1 TEAM EMPWR

11	
8	FLEXIBILITY
	2 MENTAL MODEL
	1 TEAM EMPWR

9	
6	SKILLS-TEAM
	2 COHESION
	1 INTEGRATION

3	
1	SKILLS-TASK
	1 STRUCT EMPWR
	1 INTEGRATION

3	
2	SIZE
	1 MENTAL MODEL

3	
3	STABILITY

ORG CONTEXT

8	
3	WORK SYS
	3 CLIMATE
	2 TEAM EMPWR

7	
6	INFO SYS
	1 TEAM EMPWR

3	
0	REWARD SYS
	2 INTEGRATION
	1 CLIMATE

2	
0	EDUC SYS
	1 FLEXIBILITY
	1 MENTAL MODEL

TEAM CONTEXT

17	
6	STRUCT EMPWR
	4 CLIMATE
	3 MENTAL MODEL
	2 INTEGRATION
	1 TASK DSN
	1 TEAM EMPWR

15	
4	EXT LEADER
	6 CLIMATE
	3 INTEGRATION
	1 COHESION
	1 MENTAL MODEL

15	
10	COACH
	2 COHESION
	1 CLIMATE
	1 MENTAL MODEL
	1 FLEXIBILITY

14	
8	TASK DSN
	3 MENTAL MODEL
	2 COHESION
	1 STRUCT EMPWR

EMERGENT STATES

16	
10	INTEGRATION
	4 COHESION
	1 CLIMATE
	1 MENTAL MODEL

11	
6	CLIMATE
	3 MENTAL MODEL
	2 COHESION

9	
8	MENTAL MODEL
	1 STRUCT EMPWR

9	
9	TEAM EMPWR

7	
7	COHESION

LEGEND

Source repetitions as independent factor

Source links to SRTB →

Source links to → dependent factors

11	
6	CLIMATE
	3 MENTAL MODEL
	2 COHESION

Figure 10. Team Jun Causal Waterfall Display

The number appearing at the top of the sub-table for each independent factor in the causal waterfall display is the total repetition count of its relations to both SRTB and emergent states. The dependent factors in each sub-table are listed below the independent factor in decreasing order of source repetitions.

The next step in analyzing the Team Jun case study data involved integrating the factors and their relationships into a causal network map shown in Figure 11. The height

of each box is proportional to the number of source repetitions for that factor's relation to SRTB. The two numbers associated with each box indicate the number of source repetitions found to relate that factor to SRTB and emergent states respectively. The arrow weights are proportional to the number of source repetitions found between a factor and an emergent state. To simplify the Team Jun causal network map, relations having fewer than four source repetitions are not shown.
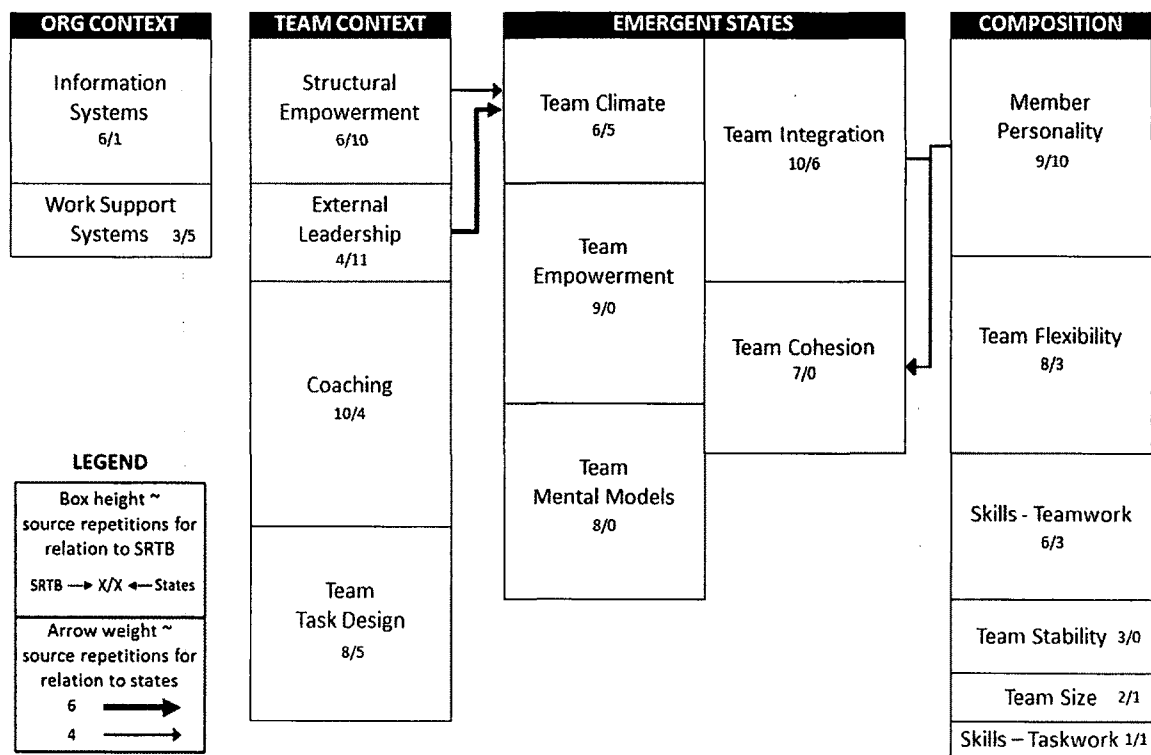
Figure 11. Team Jun Causal Network Map

The causal network map illustrates the relative influence of factors on Team Jun's SRTB as expressed from source repetition, ranging from member personality with the highest to taskwork skills with the least. Referring to the central research question, the causal network map makes clear the key factors and links influencing SRTB for Team Jun. The key factors for Team Jun are:

- Member personality, with a link to team cohesion
- External leadership and structural empowerment, both linked to team climate

- Team integration, with a link to team cohesion

Why should member personality be a key factor for SRTB in Team Jun and be linked to cohesion? Referring to how their current collaboration behaviors developed, a member of Team Jun said *"I think the biggest reason for the difference between the way it was then and the way it is now is the personalities of the people."* Prior research has established that a team's personality composition affects performance, but the mechanisms for the effect are not well understood (Anderson, 2009; Morgeson et al., 2005; O'Connell et al., 2001).

Agreeableness was the personality trait of members most frequently cited to influence SRTB and the emergent states of Team Jun. The relationship between member personality and team cohesion shown in the causal network map is also due to this personality trait. Agreeableness refers to individual characteristics such as selflessness, cooperativeness, helpfulness, tolerance, flexibility, generosity, sympathy, and courtesy (Witt, Burke, Barrick, & Mount, 2002). Barrick et al. (1998) proposed that social cohesion was an important mechanism for the relationship between member personality and team cohesion and suggested that team conflict was a potential mediator. Their research found that higher average and minimum levels of agreeableness in a team's composition correlated negatively with team conflict.

From the case study data it appears that changes made to the composition of Team Jun altered the group's personality characteristics, resulting in reduced task and relationship conflict. Example comments from the different members provide evidence for this claim. *"Sometimes you could go inside the work room and you couldn't cut the tension with a chain saw." "At that time there were a few members, not on the team now, that were very difficult to work with." "There was a change of personnel with positive attitudes, people that were willing to work together." "It got better when the trouble makers were gone."* The within-case analysis for Team Jun suggests that SRTB was generated under a condition of reduced task and relationship conflict between members, arising from a team composition of members with high levels of the agreeableness personality trait.

Why should external leadership and structural empowerment be key factors for SRTB in Team Jun and be linked to team climate? The majority of Team Jun had been together for nearly five years when the case study was performed yet engagement in SRTB was reported to have occurred only within the past 18 months or so. Around that time two important aspects in the context changed: a different supervisor was assigned to the team and a single hourly lead position was formally established by that supervisor. According to the long-standing members' accounts of the team's history, other factors in the team context such as the integration of salary technicians and the design of their taskwork were relatively constant throughout the team's existence. The within-case analysis suggests that the generation of SRTB in Team Jun was influenced by changes in team climate, resulting from a combination of external leadership and structural empowerment.

According to the supervisor of Team Jun, the lead salary technician was their *"right hand"* and the lead hourly technician was their *"left hand"*. Each member of Team Jun, including the co-leads, seemed to share a clear understanding of the roles and expectations of all members on the team. In addition, most all members expressed that prior compositions of the team were associated with task and relationship conflict that interfered with their effectiveness. The case study data suggest that addressing both of these issues were some first steps taken by the supervisor to facilitate teamwork behaviors. The early behavior of Team Jun's supervisor is called *initiating structure* in the research literature (Burke, Stagl, Klein, Goodwin, Salas, & Halpin, 2006), a task-focused style of leadership that emphasizes the minimization of role ambiguity and conflict within a team. Prior research has found that the task-focused leadership behavior of initiating structure is a predictor of member's perceptions of team effectiveness and leadership outcomes (Burke et al., 2006; Judge & Piccolo, 2004).

Team climate has been described as the norms, attitudes, and expectations members perceive in the context of working on their team (Anderson & West, 1998; Edmondson, 1999; Eisenbeiss et al., 2008; Loo & Loewen, 2002; Mathieu et al., 2008; Rico et al., 2011). Kozlowski and Ilgen (2006) concluded in their review of the research literature that team climate is a key emergent state that shapes a team's processes and

behaviors for goal accomplishment. Managers' leadership styles have long been recognized by researchers as a determinant of team climate which in turn drives motivation and behavior (Likert, 1967; McGregor, 1960). Kozlowski and Doherty (1989) proposed that the interpretation of climate by team members is shaped by their relationship with their leader. In particular, a person-focused leadership style has been proposed to predict teamwork behaviors through the management of team climate (Smith, Salas, & Brannick, 1994). The person-focused leadership style is subsumed to be composed of four behavioral dimensions: transformational, consideration, empowerment, and motivational (Burke et al., 2006). Example comments from different members of Team Jun indicate that their supervisor used a person-focused style of leadership to generate SRTB.

Transformational leadership involves meaningful exchanges between a leader and their subordinates to bring out vision-driven change by moving followers beyond immediate self-interest. *"The bottom line of all of this is a good supervisor, believe it or not. I've been here for 15 years and have worked for several supervisors. Their attitude toward me affected my performance. Our supervisor now is a great one, ... treats me with respect and I go above and beyond to make my supervisor look good."*

Consideration is a dimension of person-focused leadership behavior that emphasizes satisfying employee needs and maintaining close social relationships and group cohesion. *"If I were to use one word to describe our supervisor it would be caring, that's a big one. Our supervisor cares about people."* And from the supervisor, *"One thing I learned from a class I took one time was that as a supervisor I need to know something personal about each person. When I talk with the team members, it's not just about work stuff."*

Empowerment leadership behaviors refer to actions that focus on generating and developing the self-management skills of subordinates. As one of the newer members said, *"I might see our supervisor a couple times a day, but very little. They'll drop in to check on our work status, see if we need anything, crack jokes, etc. I really don't know our supervisor that well yet but I remember when I started on this job they explained their expectations and what they absolutely will not tolerate. They took me to the IOP*

board and explained it. It seems that our supervisor gives you what you need in advance, something for your tool belt to prepare you."

Motivational behaviors are used to promote the exertion of continued effort from team members. *"Our supervisor also doesn't take any crap. They have a job to do and they want to do it right... They'll cut up, but 'nickname' wants it done!"* And from the supervisor, referring to why current team adjustment behaviors were enacted as they were, *"Because that's my expectations. Sometimes the environment in a work room will go out of spec, lights will go out, or computers used for the fabrication will go down. When that happens the members inside the room clean first and then go outside to work with the other members. No one goes home."*

The within-case analysis for Team Jun suggests that SRTB was generated from two distinct leadership behaviors that influenced the team's climate: initiating structure which minimized role ambiguity and conflict followed by a person-focused style of leadership that brought about the behavioral interactions, cognitive structures, and attitudes necessary for the members to work effectively as a team.

Why should the emergent state team integration be a key factor for SRTB in Team Jun and be linked to team cohesion? Team integration was defined for this research as the integration of members through psychological bonds of trust and respect to create an internalized *team* (Cronin & Weingart, 2005; Mayer et al., 1995; Millward et al., 2010; Rico et al., 2011; Weingart et al., 2005). Team integration is composed of the following elements: the extent members are willing to rely on one another in the absence of monitoring (interpersonal trust), the extent members value each other for their character, abilities, and contributions (mutual respect), and the degree members internalize the team as part of their self-definition, resulting in their thinking, feeling, and behaving representing and protecting the integrity of the team's interests (team identity). Team cohesion was defined as the strength of the social and motivational forces that bond members together and it contains the following elements: the extent members share a liking for other members in the group (interpersonal attraction), the extent members share a commitment to the group's taskwork and goals (task commitment), and the extent members share an importance of the group (group pride) (Aube & Rousseau, 2005; Beal

et al., 2003; LePine et al., 2008; Millward et al., 2010). Even though they are closely related constructs, team integration can be thought of as the *state of coming together as a team* while team cohesion can be considered the *state of the strength of togetherness*.

Although much of the Team Jun data for integration as an independent factor referred to interpersonal trust and mutual respect, the link to team cohesion in the causal network map is entirely due to reports of team identity. Campion et al. (1996) found that relationships between certain team characteristics (such as self-management, workload sharing, and communication/cooperation within the team) and effectiveness are stronger and more positive in work groups with higher team identity. Jehn et al. (2008) propose that the team identity of a work group can be disrupted by relationship conflict resulting in members not feeling as connected to each other (i.e., cohesive as a group).

As evidenced by comments from different sources in the Team Jun data, changes to the work group's composition altered its personality characteristics and skills for teamwork which reduced conflict and enabled SRTB:

"There were a couple of members that didn't fit in, mostly conflict between some of our female members. But we did it anyway." "In the past, there were some team members that were difficult to work with, but now they're gone." "One of the reasons we help each other out is because we often give things to each other, like food (said jokingly). We're kind of like family away from home. I feel like I'm part of a team." "I'm proud to be a part of it. I finally landed on a program where I feel like I'm part of it." "New people are accepted into the group, just like family. Do you have brothers or sisters? It's just like that. We can say something bad about each other but nobody else can."

The within-case analysis for Team Jun suggests that SRTB is heavily influenced by team integration and team cohesion. These team emergent states appear to mediate the influence of member personality and member teamwork skills on generating and developing SRTB respectively.

CHAPTER 5

TEAM SEP CASE STUDY

This chapter contains the findings from the second case study conducted for the research. Separate sections in this chapter describe the work team and case study process, report the findings, and present the within-case case analysis of the data.

5.1 Description of Case Study

This section describes the work team involved in the second case study, details how the case was conducted, and provides an assessment of the team's engagement in SRTB based on direct observation.

5.1.1 Introduction to Team Sep

The team involved in the second case study, called Team Sep, was responsible for the assembly of a complex product set for the site. The team was composed of three hourly-paid employees (mixed gender) working the same shift, reporting to the same supervisor, and belonging to an organized labor union. The supervisor of the team had 21 direct reports at the time of the case study. Long-standing membership existed in the team; each member had at least 10 years. Despite the longevity of membership, the team reported that concerted efforts to engage in SRTB did not occur until sometime in 2011.

Between 2009 and 2011 lean practices were introduced into the team's work at the direction of the site's program management to improve cost and delivery performance. Facilitated by two individuals of the site's LSS group (not the researcher), the lean intervention included introducing a 5S system for workplace organization, establishing point-of-use storage for materials, creating a kanban pull system for all productive materials, and implementing a visual scheduling system for work flow. At the time of the lean intervention, the work group was composed of five members working on the same shift. Up to seven members working on two separate shifts had previously been assigned to the work. All of the current Team Sep members were involved in the lean intervention. The supervisor had been assigned to the team since 2009 at the beginning of the lean interventions.

The production demand of Team Sep had been stable since 2012, averaging two assemblies per month. At this rate of production while working one shift, the takt time for the product is ten days. This means that for every ten working days, a product must be completed in order to meet the delivery schedule. Thus, ten working days is the fundamental work cycle that the team experiences in their work activities.

The taskwork associated with Team Sep was entirely manual assembly; no specialized equipment was used. The assembly process was extensive, involving up to 300 tasks per product (many tasks also contained multiple steps). The team was collocated in an open work area. Each member worked primarily on the same tasks from unit to unit unless another member was absent. Two members were hourly-leads but one of those was informally recognized by the other members, the supervisor, and the organization as the team's internal leader (LATech).

5.1.2 Case Study Process for Team Sep

Team Sep was purposefully selected for the second case study because they were highly regarded by the site's top management group and described as requiring little to no direction from their supervisor. All of the members were involved in the fabrication of the product when the group was significantly larger, thought to be less effective by management, and recognized as requiring close supervisor control. Discussions with the site's top management group led to identifying this work team as a preference for a literal replicate.

Once identified as the potential second case study, the researcher met with the team as a group (including the supervisor) in a conference room to inform them of the research and to request their participation. The purpose and process of the research was briefly explained to the group (without specifying why their team was chosen) and the participant information and consent document was read aloud after having been given to each individual. Each person was requested to notify the researcher within a week if they would participate. Immediately following the consent meeting, unanimous verbal consent was obtained from all participants.

Once unanimous consent was obtained, the case study data collection was initiated with a one-hour supervisor interview. Observation of the team's work activities began the week following the supervisor's interview. The observation period included ten complete working days followed by five partial days.

Interviewing the members was delayed six weeks after the observation was complete due to the researcher's availability. All three members were interviewed for the case study, each lasting about one hour and accomplished on separate but consecutive days. Following the research protocol, each member was given a copy of the interview transcript and requested to review their responses for accuracy. No changes to the interview transcripts were requested. Coding of the data was initiated after all interviews were completed and then entered into the case study database.

5.1.3 Self-Regulating Teamwork Behaviors and Effectiveness of Team Sep

During the observation period the supervisor was seen among the team members on a rare and brief basis. Even though the supervisor's office is located adjacent to the work area, none of the members were observed to go to the supervisor's office. Based on the observation and analysis of interview data, management's assessment of Team Sep's use of SRTB was confirmed.

Appendix E is a work flow dependency diagram for Team Sep, showing a snapshot of the work in process (WIP) and taskwork interdependencies between the seven major operations. On each day of the observation there were three to five different units active in the work flow. The arrows in the work flow dependency diagram indicate the flow of the units and the primary interdependency pattern of the team's taskwork. The pattern of flow for the products created both sequential and pooled interdependency. To avoid delay at the UNIT ASSY operation, located in the center of the work flow dependency diagram, separate sub-assembled details were required to arrive at the same time (pooled interdependency). Up to that point, the interdependency was sequential but each product left and returned to the work team twice to perform an external process. After that point, the interdependency was sequential but each product left and returned to the work team once to perform another external process. The three members of the team

(noted in italics) are shown at multiple locations on the work flow dependency diagram corresponding to the operations they performed during the observation.

The daily goals and plans for Team Sep primarily resulted from a concerted effort by the members. The taskwork appeared to require much coordination to meet schedule goals. Task-related information was exchanged frequently between the members. Task cooperation was observed, usually involving just a few minutes but on some occasions lasting for a couple of hours. Many instances of performance monitoring, backup behaviors, and collaborative problem solving were observed. Most team adjustments were observed to counteract material shortages or absenteeism.

Over the observation period, the team met their goal of a completing a product every ten working days through each operation, although several adjustments to task sequencing had to be made. Overtime was utilized on a regular basis by some of the members in order to meet the production schedule. Very few instances of absenteeism occurred throughout the observation, usually only for a partial shift. The attitudes of the team members were very positive; they held their fellow team members, their supervisor, and the site's management in high regard. Based on the generally recognized criteria for team effectiveness (performance, member attitudes, and outcome behaviors), the information gather from the Team Sep case study supports management's valuation of their effectiveness.

5.2 Findings from Context

This section details the major findings from the Team Sep case study for the influence of context on SRTB. Team context and organizational context respectively accounted for 21% and 15% of the entire dual-coded data set as an independent factor.

The team context category includes external leadership, structural empowerment, team task design, and coaching. Team task design was considered a multi-dimensional factor encompassing task interdependence, task routineness, task variety, task autonomy, task significance, task identity, and task feedback (Cohen et al., 1996; Hackman, 1987; Hackman & Oldham, 1980; Harvey, & Burns, 2005; Rousseau et al., 2006; Rousseau & Aube, 2010). Coaching was also considered multi-dimensional and included functions for

motivation, consultation, and education. The Team Sep case study data indicated that external leadership and team task design significantly influenced the generation of SRTB. Based on source repetitions, less influence from structural empowerment and coaching was reported.

The organizational context category includes work support systems, information systems, reward systems, and education systems. Work support systems and information systems were reported (by source repetition) to be the most influential organizational context factors on Team Sep's SRTB.

5.2.1 External Leadership and Coaching

This section describes the influence of external leadership and coaching on SRTB from the Team Sep case study. Combined, external leadership and coaching accounted for 35% of the Team Sep data in team context. For comparison, 53% of the team context data for Team Jun came from external leadership and coaching.

Most of the information obtained from both the supervisor and the team members regarding external leadership involved *"letting go"* of control by the supervisor replaced by a role of boundary-spanning. The supervisor had been associated on and off with the assembly work team assigned to this product since the early 1990's but was assigned to this team continuously since 2009. In the supervisor's own words *"I don't really tell them what to do, I just give them the same schedule that I get and they give me updates on their progress each day. I just try to make sure they have everything they need to keep working."* The supervisor reported to interface with the team at least 5-6 times a day (which was verified by observation) to ask *"How are you doing, do you have everything you need, and what are you going to get done today?"* The supervisor uses that information to meet the team's needs and also uses it to relay production status in management meetings.

When a problem comes up that interferes with the team's work, the supervisor asks them what can be done and then will do whatever it takes to help get it done. This was echoed by LATech, saying *"Over the last 3 years I've seen a change in the trust from our supervisor. Our supervisor now asks us 'What do you want to do?'"*

Responding to a question about how they started making work goals and plans themselves, LATech said *"I think it started when our supervisor just started leaving it up to us, not taking as much effort to supervise us. When our supervisor got less involved we just worked out our own plans. When they saw that our plans worked out, they got even less involved and trusted us more."* Adding that their supervisor was still performing an important role for the team, *"The supervisor would still chase parts for us if we needed them and work with the resources outside our team to make sure we were going to get what we needed when we needed it. Our supervisor did for us the things we couldn't do because we didn't have any authority over other work groups and ... also had an overall view of the process that we didn't have."*

The leadership behavior of the supervisor that seemed to most influence SRTB in Team Sep was boundary-spanning. During the observation period, the supervisor's interaction with the team was primarily to ensure that a supply of parts was available to continue working. An uncharacteristic feature of the empowerment structure for this team is that their supervisor was also responsible for many of the processes and employees working upstream from Team Sep's assembly work, resulting in the boundary spanning role possessing formal authority.

During the observation period no coaching from the team's supervisor was observed and the members did not mention it ever having occurred during their interviews. Team coaching is defined as direct interaction with a team by an individual intended to help members make coordinated and task-appropriate use of their collective resources to accomplish their work (Hackman & Wageman, 2005). In the other literal case study (Team Jun), some coaching was reported to have been provided by that team's supervisor to generate SRTB (motivational and consultative). For Team Sep however, coaching appears to been entirely internal (provided by LATech). Most instances of coaching were observed to be from LATech toward ATech1, or from ATech1 toward ATech2. The instances of coaching between the team members, from what was observed and mentioned during conversations, appeared to be accomplishing consultative and educational functions.

5.2.2 Structural Empowerment and Organizational Context

This section describes from the Team Sep case study the influence of structural empowerment and the organizational context on SRTB. Structural empowerment accounted for only 5% of the dual-coded data from team context, compared to 20% for the other literal case replicate (Team Jun).

The structure and roles of both the team and its support personnel appeared to influence SRTB for Team Sep. First of all, according to one of the members *"You've got to have a 'head honcho' on the team and that person needs to be respected by all the other team members."* Indicating that the responsibility for leadership doesn't just belong with the lead, another member added *"Other members, besides the lead, can help train other members. I think having a chain or link between the lead to all the members is also important. The lead might not be as good at working with some members whereas someone else on the team might do that better. For example, I think I can work better with one of the other members than our lead can."*

Responding to how their team adjustment behaviors might be improved, the team's lead said *"I really think they could only go South like with other things. Keep the same people on the team, the same QE, same ME, the same supervisor and we can make those adjustments effectively when we have to. Keeping the same support people in place is probably more important to making adjustments than it is for the normal work because we need people that will allow us to do what we think needs to be done without questioning us so much. There's probably a chain that needs to stay in place; starting with our team, then our supervisor, then our ME, then our QE, then our PC person, and on down the line for whoever has to help us work out the problem."*

Aside from the supervisor, another source of management support was reported to have affected the team's engagement in SRTB. Two of the members said that their experience with a change in the engineering support for the team had enabled them to accomplish many more process changes they had suggested. A transition in primary engineering support had occurred during 2011 resulting in what they said was a favorable rewrite of their work instructions and a significant boost in support for implementing their process improvement ideas. As the lead put it, *"The new manufacturing engineer*

would take our ideas and run with them. Sometimes so fast that our quality engineer would have to slow him down!"

The site also has an idea submittal system to encourage and assist employee involvement in continuous improvement (called EIP idea system). The members of Team Sep were heavily engaged in the EIP idea system to drive improvement of their work tasks and the processes of the site. In 2012, a high percentage of all ideas entered into the EIP idea system came from members of Team Sep. When asked why they used the idea system and what it meant to them, LATech said that it started out with just a couple of ideas they *"threw out there"* to see what would happen. Those first ideas were not necessarily related to their taskwork but they were things they thought important to the success of the site. *"To be honest, at first we really didn't know what kind of ideas the company wanted from us."* According to one of the members, when they saw their ideas getting attention and being implemented they *"...realized we had the power and support to improve our jobs and the company through the EIP idea system. You can have an idea and tell someone in management about it and they might or might not do something about it. But when it's put out there for everyone to see, something's going to be done about; it either gets done or reasons for why it can't have to be spelled out. We rely on the EIP idea system for the things we can't do ourselves."*

The site also used a formal recognition system to reward employees for exceptional performance. Through the company-funded recognition system, individuals and teams could be monetarily rewarded for their impact on the business. Members of Team Sep had recently received several of those awards for their involvement in continuous improvement. Talking about the awards they had received, *"It's nice to get recognized for what you do, for what we do. But we get a reward every week, a paycheck, for doing what we're supposed to do. We're not just supposed to do our job, were supposed to keep getting better at it."*

Several lean tools and systems have been introduced at the site to manage production performance, including Team Sep's work. Responding to how the goals and work plans for the team were being made the supervisor said, *"...we've 'leaned' the process down, completed a 5S, and put in a bin-system to manage the materials. We also*

have takt schedules posted for the major operations that lay out all the steps and time requirements." Adding more to the response about the takt schedules, *"But the team doesn't really use those anymore because they're not right. They weren't changed when the team size got smaller, from five to three. We're at the end of a contract now so there's no use in changing them; when we start back up we'll have to go to a shorter takt anyway and more people will be required. Right now, they aren't really used for goals or planning, that just comes from the team."* Like one of the members said about this issue, *"I don't know how our work preparation could be improved...the takt boards, they're just hanging there. In my opinion they didn't really help that much to start with anyway. They just gave you an idea of how long a job should take but ever since they cut us back to three we can't do it the way it says to anyway."*

According to LATech, they have recently had to communicate more frequently with external groups because the pull system put in place during the lean intervention had *"...fallen apart for the most part. We spend more time now chasing parts than we ever had to when it was working the way it's supposed to."* When asked about why the pull system had degraded, two members said it was because the current contract was coming to a close and management did not provide the necessary resources in the upstream operations. As a result, the material bin system began to *"dry up"*. Like LATech put it, *"At first we had a two-bin system, then you could gradually see it turning into a one-bin system, and now we have a no-bin system for most parts. We work hand to mouth."*

5.2.3 Team Task Design

This section describes findings from the Team Sep case study related to the influence of team task design on SRTB. This factor accounted for 59% of the dual-coded data from team context. Table 9 shows the counts of source repetitions (a maximum of five for Team Sep) reporting an influence of team task design on the separate phases of SRTB, categorized by the most frequently reported task design features.

Table 9. Team Sep Task Design Relations to SRTB

TASK DESIGN	SRTB			
	Prep	Collab	Assess	Adjust
Interdependency		2		
Task Autonomy	1			1
Task Feedback	1		2	
Task Routineness				2

5.2.3.1 Task Interdependency

As shown in the work flow dependency diagram for Team Sep (see Appendix E), task interdependency for this work team is sequential and pooled but the long cycle time makes it *"difficult to feel it"* according to conversations with the team's lead during the observation period. As LATech stated, *"This is a complex process that takes a lot of time to complete. Unless you talk a lot, it could take a long time to get feedback on something somebody else is providing for you."*

From observation, it was evident that the members shared information related to the task frequently (all members work within talking distance). For example, one of the members was heard to just say to another *"I'm ready"* and the other member knew what was needed without further explanation. Most of the task-related information exchange appeared to occur within the team but some communication was also necessary with external work groups to ensure the team's activities were coordinated.

Task interdependency arising from the need to work cooperatively on tasks was less than it was for the other literal replicate (Team Jun). Some cooperation was necessary on certain tasks but it was usually brief, such as when loading large parts into fixtures and providing backside assistance for fastener installations. Other tasks did not require cooperation but the members said that with the reduced team size it is now often used. For example, the bond operation was originally accomplished by one member when the team was larger. Now it is often performed by two members simultaneously because *"We had to learn that process because we'd never done it before. We knew in general*

how it was done but we didn't know the details. So LATech and I took it on together to figure out the process and we discovered new ways of doing it that saved a lot of time. Sometimes we still do it together because it seems like we can improve it better when we work together on it."

5.2.3.2 Task Routineness

According to the team's supervisor, the most important thing affecting the team's coordination is that the supply of parts provided by the upstream operations must be ready when needed. The supervisor also said that not having hardware ready when needed was one of the biggest problems facing the team right now. *"They can do some assembly out of sequence if they have to, from not having a part ready, but it causes them to come up with work-arounds or start the next unit before it needs to be started."* During their interview, one of the members spoke of an example of coaching behavior provided by the other members one day. *"They reminded me about checking on whether or not a part was going to be ready for me when I needed it. The supermarket* (lean system used to supply parts) *no longer working has caused us problems like that."*

Ironically, the low routineness caused by material shortages seems to have been beneficial to the team's generation of SRTB. LATech said *"Something that probably made us get better as a team was not having some parts available to work with. It causes us to work out plans and do things we don't normally do. Sometimes we'll work on the same task together when we don't have parts so we can keep our HPUs down. We also talk more when we're doing work-arounds. Don't get me wrong, we don't like to run out of parts; we like to have them but it might have made us better at working together."* Adding to that opinion, *"Material shortages forced us to work out problems, but there's no doubt that having parts when we need them gives better HPU performance."*

5.2.3.3 Task Autonomy and Task Feedback

Team Sep's self-managed work preparation behaviors were reported to be enabled when their sense of ownership and responsibility (task autonomy) increased due to their supervisor *"backing out"*, as LATech said it. *"I can't remember the last time we received*

direction from our supervisor about what to do, unless it was to work on another job. Our Supervisor comes by to see where we are in getting our work done but ... knows we're going to take care of it."

According to the team's supervisor, *"They don't look to me to solve their problems because they know they're the experts."* When asked how the team started to engage in adjustment behaviors without guidance from their supervisor, one of the members said *"We have to have responsibility and we have to make decisions. Unless it's a real big one, we should have the answer. We're comfortable enough about the job to do that. After all, who knows it better? A lot of it is just common sense. But we have to have authority to do it."* That member also added *"...it makes it easier for the supervisor because they can trust us. It makes it easier on us because the supervisor trusts us to make those adjustments when we have to. I think some supervisors cause work teams to not take on those behaviors because they're always checking, always directing. Some supervisors just won't trust them to handle things on their own."*

The feedback feature of team task design was found to primarily influence work assessment behaviors for Team Sep. During the observation, LATech showed posted graphs for labor hours on the bond operation to demonstrate performance monitoring from a long-term perspective. Those graphs were printed and posted every day by the supervisor, but according to LATech *"...they're no longer as useful as they once were because we've improved our performance so much."*

LATech also showed similar graphs displaying the overall labor performance of the team. *"I think the labor charts were important in getting us to start monitoring our performance. I actually like those charts because when you're working on an operation that takes 80 hours to complete it's easy to lose track of where we are."* LATech also said *"...not meeting the goals was also important to begin monitoring our performance, but we couldn't really do anything about it because there were too many people on the job back then. I think you sort of have to be pushed a little bit; we work hard but the push motivates us to keep going."* *"We sort of live off of taking 340 labor hours out of the job; that makes us feel good. It gives us more drive to do good on the next one we build."*

5.2.3.3 Task Variety and Task Identity

A recent increase in the variety and identity for the team's taskwork also appeared to influence SRTB. For example, two of the members didn't perform the bond operation until early in 2013 after a previous member left the team. The increase in task variety prompted them come up with new ways of performing their taskwork. When asked how they felt about standardized work, a lean method used to reduce variation in the outcomes of a process, the members working the bond operation said *"Actually, we've never completed a bond operation the same way twice; we're always introducing gradual improvements. We never got to work on this process before, so we didn't really know how it could be improved."*

The team's lead explained how an increase in the scope of their tasks prompted SRTB. *"When the team was larger each person just had one job, even I had just one job. That kept us from having to work together as much as we do now and it also kept us from knowing all the different parts of the job. Now we're better prepared to tackle problems when they come up because we know how what we do affects other parts of the job."* Although the actual scope of the team's work had not changed, their perception of it did.

5.3 Findings from Composition

This section presents the findings from Team Sep for how team composition influences SRTB. Team composition accounted for 38% of the entire dual-coded data set as an independent factor. Among the team composition factors, member personality was cited as a large influence on the generation of SRTB as well as on the emergent states team integration and team climate. In addition, taskwork skills seemed to be equally important based on the count of source repetitions. Team size was also reported to influence SRTB more than what was found from other literal case study (Team Jun).

5.3.1 Member Personality

Reports of the influence of member personality on SRTB and emergent states were analyzed by categorizing dual-coded data according to the five-factor model of personality traits (McCrae & Costa, 2008). Table 10 shows the counts of source

repetitions reporting an influence of member personality on SRTB and the team emergent states climate, integration, and cohesion. The traits are listed as the common acronym OCEAN, corresponding to the first letter of their name.

Table 10. Team Sep Personality Relations to SRTB and Emergent States

	PERSONALITY TRAITS				
	O	C	E	A	N
SRTB		4		5	
Team Climate		2	1	1	
Team Integration		3		2	
Team Cohesion					
Totals	0	9	1	8	0

Conscientiousness and agreeableness were the traits most frequently cited to influence SRTB in Team Sep. A statement from the team's supervisor provided a figurative summary of the influence conscientiousness has on generating SRTB. "*Some workers are good, some are worse and some just don't give a $#!^* [sic]. *Those are the worst to have on a team like this, they just come in for eight hours and go home. The team and the supervisor can't do a thing about it.*"

Data from the Team Sep case study showed the influence of conscientiousness to "cover the bases" of the phases of SRTB. Referring to SRTB for preparation, "*Whether or not team members keep up with each other is important. If they don't, it makes it harder to set goals and make plans because you can't count on them. They might not keep up because of their skills or they might not keep up because of their work ethic.*" Referring to SRTB for collaboration, "*I think we're probably good at working together to meet our goals because we all like to stay real busy. Each one of us gives at least 100% every day. It's just the way we are, the chemistry of our team matches up.*" Referring to SRTB for work assessment, "*You can give constructive feedback to anyone willing to learn and willing to do the job right.*" Referring to SRTB for adjustment, "*We do that because we're always trying to make the job better. If we're down here for some reason, go over there. We're not children and don't have to ask for help.*"

Conscientiousness was also reported to influence team emergent states. As an example of influence on the team's climate for excellence in taskwork, one of the members said *"I've always had to work. I've worked at places harder than this, and I enjoy working. I want to work until I can't anymore and the company's got to make it for that to happen. I'm sure not going to sit around and watch others work! When I come in here to work, it's with a purpose."* And from another member, *"In my opinion, I think management should put the best on a new job so they can set the standard. When other team members come on you've got to tell them 'you'd better keep up', don't baby them."*

The case study data also showed that the personality trait agreeableness spanned the phases of SRTB. Referring to how work preparation behaviors can get started, one member said *"Team members can't get insulted when they're given direction from someone else on the team, like our lead."* Talking about why the team cooperates on tasks like they do, LATech said *"We've got people on this team that don't want to do 'just their job.' and not work with others when it's needed. We all help each other, absolutely."* A different member said in response to what helps them monitor each other's performance, *"If you're wrong about something you did and you're told you're wrong, you can't get offended. That was one of the issues we had with a former team member."* Both the supervisor and members expressed similar reasons for what enables their team adjustment behaviors. *"One of the team members is a 'doer', a follower, and it works out good."* *"Every team is made up of planners and doers. The planners can figure out what to do when we run into problems and our lead is good at that. Our team has that mix; our personalities have a lot to do with it."*

Members' agreeableness was also found to influence team emergent states. Affecting team integration, one member said that having team members that are willing to work with members of the opposite sex is also important for generating SRTB. *"Whenever a new member was added to our team, I would always ask them first if they were willing to work, then I would ask them if they were willing to work with (the opposite sex)."* Echoing that statement, another member stated *"The first thing another member asked me when I started working this job was if I was willing to work with (the opposite sex) and if I was willing to work. And they were serious about it too!"* When

asked what it was about the team that made them effective in working together, a member's interview response pointed to how members' agreeableness can affect a climate of participative safety. *"Relationship. What I mean by that is not being afraid to ask the other members for something. None of them is ever grouchy! Sure, everybody has a bad day but we don't let it get in the way. Me and another member carry on something terrible and joke around but we're serious about getting done what we need to get done."*

5.3.2 Taskwork Skills

Member's skills for taskwork were found to influence SRTB for Team Sep as well as their team climate and integration. According to the team's supervisor, *"You can show a person how something should be done but a lot of it is an individual thing. Some just can't or won't get it. This team has very good work skills."* Apparently though, the work group was not always that way. During the observation they spoke about how difficult it was to *"make everything click"* when there was more people on the job (up to seven) and especially if members were lacking on taskwork skills. They said it was even harder to accomplish their goals when a second shift was in place because as one member said *"We spent most of our time fixing someone else's work from another shift."*

The supervisor highly regarded the lead's technical skills saying, *"LATech is definitely recognized, by the other team members and the organization, as the leader of this team ... a very good mechanic and has the team's respect."* However, one of the members said that the taskwork skills of the team need to be broad. *"LATech can sit down with a print or a traveler and go through it with great detail and understand it better than we can. But the lead needs to have the right team members that they can go to and give direction. They have to be willing to take direction from the lead and they have to have the skills to pull it off."*

It was apparent that the members of this team valued each other for their character, abilities, and contributions. When questioned about what influences the team to make their own work plans, a member said *"I've worked for many years and I can honestly say that our lead is the smartest person I've worked with. ... can figure it out, that's what makes our lead good at it."* Apparently, previous teaming arrangements

didn't possess the same levels of trust and respect; not just for shortcomings in taskwork skills but for character as well. *"There was a previous member that was real bad at being sloppy and if they messed up they wouldn't be honest about it. They were disrespecting our lead's intelligence. I wanted to say, 'just stop!' Static in the team hinders getting the job done. You want to say to people like that 'move on Jack'!'*

According to all interviewed sources, some prior members didn't have the taskwork skills necessary to keep up (too slow) with the team's demand, causing conflict to arise from performance. Speaking of a prior member, *"We got along really well together and we like him, but he was just always uncertain about his work and took too long because he was always checking and rechecking. We hated to see him go, tried as much as we could to help him out, but he had to leave to improve our performance."* As a member said, *"Not all people that make A-pay are on the same skill level; all have different skills and abilities. If someone on the team is smarter, better, or faster* [referring to a team's lead or best member for taskwork] *don't use it against the team but use it as a tool to get it going. You've got to find the nitch that each person has that can help the team. Sometimes though, it just doesn't work out."*

5.3.3 Other Composition Factors

Team size, member teamwork skills, and team stability also received support from the Team Sep case study for being factors that influence SRTB. Responding to how their collaborative behaviors got started, LATech said *"We're very conscientious about our performance and I think when the group got smaller we had more influence on it."* Stating that the team's size had contributed to their HPUs being higher than they are now, *"With the larger group, if someone was ahead they just slowed down instead of doing something else because they only knew that one job."*

Similarly, one of the members said *"I think the group getting smaller helped us get better at coordinating our tasks and working together."* But that member also pointed out how team size can also influence the team's climate. *"I think there also needs to be some playfulness, it really helps to get along well together. I think you can have that in small groups but not in larger groups because of competition and conflict."*

The skills to self-manage performance was evident among the Team Sep members. LATech was observed to cite the time that each task or operation should take, without having to refer to documentation. LATech also easily stated what the plans were for each day, who would be working on what and when they should be complete, even about when someone would need some help from another member. The lead explained that the work content is *"pretty closely balanced"* between the three of them but *"maybe a little heavier for me and another member."*

During the observation, the team members were often heard discussing plans for the remainder of a day's work just before they took their breaks. They were also observed discussing plans for the next day's work at the end of shifts. *"We know what we want to do and we know what needs to be done. For us, we need to look at the overall work load and assign each other work to make the job go well in a cycle. Some might have more work to do than others at times but the work load has to allow us to be there to help."* Explaining how milestones were used to measure daily performance, a member said *"When I'm doing something like drilling, I sort of put myself where I need to be by break time and somewhere at dinner time. Sometimes I get it and sometimes I don't. When I get behind, another team member helps me and they help me plan out my work too."*

Team stability was reported by all three members to be something necessary to enable them to continue developing their SRTB. Responding to a question about what is important to develop SRTB for planning, the team's lead said *"Probably just keeping the team together is what is now important to get better at making plans for our work because we're so trained on what we're doing and we know what everybody on the team is good at. Even a change in who's our supervisor could make a difference with that."* Another member said, *"To keep it going, I guess it should just be left like it is and don't add any more people unless you absolutely have to because of the work load. I think we can do more by ourselves now than with someone helping us."* And the third member said, *"If we had team members added right now, we wouldn't have the time to do the training that would need to be done. It would depend on the rate needed, but we might have a hard time fitting in someone else."*

5.4 Within-Case Analysis for Team Sep

The coded data set from the Team Sep case study contained a total of 177 items. As explained in Section 3.6.3 Ordered Displays, a factor matrix was first created for the within-case analysis to record counts of the different sources reporting dual-coded relationships. Table 11 is the factor matrix for the Team Sep data.

Table 11. Team Sep Factor Matrix

Dual-Coded Source Repetition Count (max 5)	Team Size	Member Personality	Skills - Task Work	Skills - Teamwork	Team Flexibility	Team Stability	Work Systems	Information Systems	Reward Systems	Educational Systems	Empower Structure	External Leadership	Team Task Design	Coaching	Team Integration	Team Climate	Team Cohesion	Team Empowerment	Team Mental Models	SRTB	Sum
TEAM COMPOSITION Team Size	■												1		1		1			4	7
Member Personality		■													3	3				5	11
Skills - Taskwork			■												3	3			1	4	11
Skills - Teamwork				■											1				1	4	6
Team Flexibility					■															4	4
Team Stability						■														4	4
ORG CONTEXT Work Systems							■								1		1			4	6
Information Systems								■												3	3
Reward Systems									■						1						1
Educational Systems										■					1						1
TEAM CONTEXT Empower Structure											■									1	1
External Leadership												■			1		1			3	5
Team Task Design													■					1	1	4	6
Coaching			1	1										■	1					2	5
EMERGENT STATES Team Integration															■	1	3	1		4	9
Team Climate																■	2	1		5	8
Team Cohesion																	■			3	3
Team Empowerment																		■		3	3
Team Mental Models																			■	4	4

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The matrix groups factors into composition, context, and emergent state categories. The numbers in the matrix indicate how many different sources reported an influence from an independent factor (rows) on a dependent factor (columns). The Team Sep case study involved observation and four interviews, thus five was the maximum number of source repetitions that could occur for a factor relationship. The count of

source repetitions was used as a basis to determine the relative importance of factors and relationships in the analysis. As explained in Section 3.7 Validity, Reliability, and Trustworthiness, the method of using source repetition for data triangulation enhances the confirmability of the research findings.

A causal waterfall display was then created, where source repetitions were used to separately show the significance and relationships of the independent factors. Figure 12 is the causal waterfall display for the Team Sep data. The number appearing at the top of the sub-table for each independent factor is the total repetition count of its relations to SRTB and the emergent states. The dependent factors in each sub-table are listed below the independent factor in decreasing order of source repetitions.
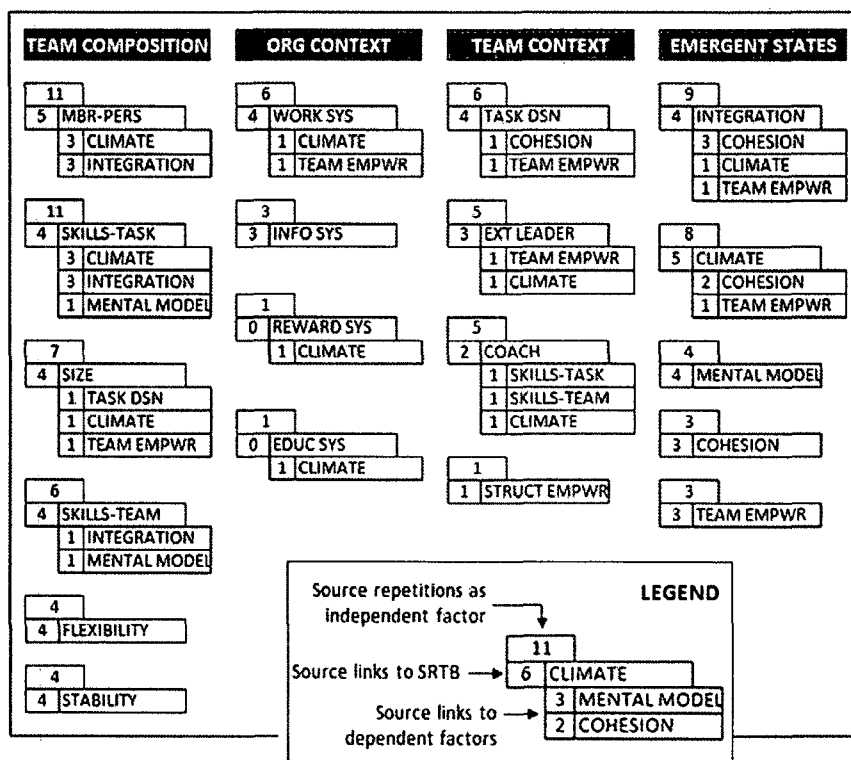
Figure 12. Team Sep Causal Waterfall Display

The next step in analyzing the Team Sep case study data involved integrating the factors and their relationships into a causal network map shown in Figure 13. The height of each box is proportional to the number of source repetitions for that factor's relation to

SRTB. The two numbers associated with each box indicate the number of source repetitions found to relate that factor to SRTB and emergent states respectively. The arrow weights are proportional to the number of source repetitions found between a factor and an emergent state. To simplify the Team Sep causal network map, only relationships that had at least three of the five possible source repetitions are shown.

ORG CONTEXT	TEAM CONTEXT	EMERGENT STATES	COMPOSITION
Work Support Systems 4/2	Team Task Design 4/2	Team Climate 5/3	Member Personality 5/6
Information Systems 3/0	External Leadership 3/2	Team Integration 4/5	Skills – Taskwork 4/7
	Coaching 2/1	Team Cohesion 3/0	Team Size 4/2
	Struct Empower 1/0	Team Mental Models 4/0	Skills – Teamwork 4/2
		Team Empowerment 3/0	Team Flexibility 4/0
			Team Stability 4/0

LEGEND

Box height ~ source repetitions for relation to SRTB	Arrow weight ~ source repetitions for relation to states
SRTB ---▶ X/X ◄--- States	3 ━━▶

Figure 13. Team Sep Causal Network Map

The causal network map illustrates the relative influence of factors on Team Sep's SRTB as expressed from source repetition, ranging from member personality and taskwork skills with the highest to structural empowerment with the least. Referring to the central research question, the causal network map makes clear the key factors and links influencing SRTB for Team Sep. The key factors for Team Sep are:

- Member personality, with links to team integration and team climate

- Skills-taskwork, with links to team integration and team climate

- Team integration, with a link to team cohesion

Why should member personality and member taskwork skills be key factors for SRTB in Team Sep and both be linked to team integration and team climate? An apparent theme in Team Sep involving the influence of member personality and taskwork skills was members *"keeping up"* with the rest of the team, as example statements from the different members point out: *"Whether or not team members keep up with each other is important too. If they don't, it makes it harder to set goals and make plans because you can't count on them. They might not keep up because of their skills or they might not keep up because of their work ethic." "There's no conflict in our team now due to performance but there was earlier. Some of it came from members making errors and some of it came from members being too slow." "There used to be*[conflict from performance]. *There was a previous member that did good work and we got along together with him, but he just wasn't fast enough."*

When the interdependency of a work group includes conjunctive tasks, as it does in Team Sep, the group's performance is a function of the least competent or capable member. Conjunctive tasks require that all group members contribute to the end product in order for it to be completed (Steiner, 1972). Thus, the group must pace itself at a speed which can be achieved by all group members or they must wait for the slowest member to complete their tasks. Under this type of task interdependency, ineffective member coordination is damaging to the group's performance and this is observed more often in larger groups because they have more linkages and more variation in members' work motivation and taskwork skills (Campion et al., 1993; Campion et al., 1996; Hackman, 1987; LePine et al., 2008; Steiner, 1972; Sundstrom et al., 1990).

Empirical research on work groups has widely found that group size negatively relates to team cohesion, team performance, and member attitudes (Campion et al., 1996; Frank & Anderson, 1971; Hackman & Vidmar, 1970; Langfred, 2000; LePine et al., 2008; O'Connell & Doverspike, 2002; Wageman, 2001). Example comments from different Team Sep members point toward a reduction in group size positively influencing their SRTB and emergent states: *"I think the group getting smaller is what helped us to start getting good at coordinating our tasks and working together." "We're very conscientious about our performance and I think that when the team got smaller we*

had more influence on it." "I think there also needs to be some playfulness, it really helps to get along well together. I think you can have that in small groups (3 or 4) but not in larger groups (7 or 8) because of competition and conflict."

All three members of Team Sep had been working together for many years but despite their permanence SRTB did not occur until lately. Significant changes occurred in the team's composition since its inception, most importantly the size of the work group had gradually been reduced from seven to three with the most recent reduction (one member) occurring just nine months prior to the case study. As the group size decreased, it impacted other aspects of team composition such as member personality and member taskwork skills. As the group's personality profile and collection of taskwork skills changed the emergent states team integration and team climate also changed, resulting in states that were more conducive to SRTB. The within-case analysis for Team Sep suggests that SRTB is heavily influenced by team climate and team integration. For Team Sep, those emergent states appeared to mediate the influence of member personality and member taskwork skills on generating SRTB.

Why should the emergent state team integration be a key factor for SRTB in Team Sep and be linked to team cohesion? When the lead for Team Sep was asked if it felt like they were on a team, LATech responded *"Oh yeah, we can do anything together."* Not only becoming a team but becoming a team *with a respected internal leader* appeared to be a theme for Team Sep as example statements from the other members point out: *"You've got to have a 'head honcho' on the team and that person needs to be respected by all the other team members." "Our lead's changed a lot too over the years that I've worked with them. There was a previous member on our team that never did get along with our lead. That person wanted to be the top dog, and maybe it offended our lead and ... doesn't get over it. Our lead's the kind of person that won't fool with you if you won't work hard and don't respect the team and what we need to do." "It's not always been as good as it is now. When I started on this job there were more people on it than there is now. It got better when some people left the group, especially the one that was causing problems with our lead. When that person left, it was*

like our lead was a different person ... seemed happier, talked with us all more, and we
started working together better."

The majority of the Team Sep data for team integration as an independent factor referred to interpersonal trust and mutual respect, including the link to team cohesion in the causal network map. Team Sep had a history of prior task and relationship conflict occurring between members as well as issues of trust and respect for members' taskwork skills. Those concerns were removed as the composition changed from member reduction, promoting integration of the team and firmly establishing internal leadership.

According to social identity theory (Tyler, 1999), individuals feel recognized in their group and seek to be involved in it when their personal contributions to the group's functioning are valued by other members. An individual's feeling of social identity with a team and their desire to contribute to achieving the team's goals may be influenced by their perception of respect and consideration from other members (Aube & Rousseau, 2011; de Cremer, 2002). Aube & Rousseau (2011) proposed that interpersonal aggressive behaviors can be perceived by members as a lack of respect and consideration and their research found that team goal commitment mediates the effect of those detrimental behaviors on team performance and viability. Team goal commitment, along with interpersonal attraction, are two commonly recognized components of team cohesion (Aube & Rousseau, 2005; Beal et al., 2003; LePine et al., 2008; Millward et al., 2010; Weldon & Weingard, 1993).

The within-case analysis for Team Sep suggests that SRTB is heavily influenced by team integration and team cohesion. In the Team Sep data, team integration appeared to mediate the influence of member personality and member taskwork skills on generating SRTB. Team cohesion, in particular task commitment, appeared to be a mechanism for the team's integration nature to further develop those behaviors.

CHAPTER 6

TEAM FEB CASE STUDY

This chapter contains the findings from the third case study conducted for the research. Separate sections in this chapter describe the work team and case study process, report the findings, and present the analysis of the case study data.

6.1 Description of Case Study

This section describes the team involved in the third case study, details how the case was conducted, and provides an assessment of the team's engagement in SRTB based on direct observation.

6.1.1 Introduction to Team Feb

The team involved in the third case study, called Team Feb, was composed of nine hourly-paid employees (mixed gender) working on two different shifts. The team reported to the same supervisor, who had 29 direct reports at the time of the case study. The majority of the members had worked together in this group for up to two years but one member was added approximately three months earlier. Three of the nine members were formally recognized with hourly-lead status. Unlike in the literal case replicates (Team Feb & Team Sep), this team was not responsible for the entire fabrication of a product. Instead, they were provided with sub-assemblies to perform additional manual assembly tasks and then their products were passed on to downstream groups that completed the assembly into an identifiable unit.

Similar to what was accomplished for the work teams involved in the literal replicate case studies, lean practices were introduced into the work of this team during 2012 at the direction of the site's top management group to improve cost and delivery performance. As with the prior case studies, the lean intervention was facilitated by members of the site's LSS group (not the researcher). The lean intervention included reconfiguring the area layout, establishing point-of-use storage for materials, creating a kanban pull system for the products, and implementing a visual scheduling system for work flow. Six of the nine members were active with the team during the lean

intervention. The team experienced several supervisor changes over the past couple of years, with their current supervisor being assigned approximately three months prior to the case study.

The production demand of the work team was relatively stable since 2012 with a takt time of two days. Thus, the fundamental work cycle for this team was similar but shorter than that of Team Jun (three days). The taskwork of Team Feb was entirely manual assembly. Other than occasional use of overhead lifting devices, no specialized equipment was used. The work of the team was arranged into separate lines (collocated within a large and open area) with products dedicated to specific lines. With little exception, the members were assigned to work only on specific lines. The task complexity and work content of the different lines varied, but the scope and complexity of the taskwork was less than that observed in both Team Jun and Team Sep.

6.1.2 Case Study Process for Team Feb

Team Feb was purposefully selected for the third case study to serve as a theoretical replicate for the research. As described in Section 3.4 Case Selection, case study replicates can be of a literal nature where similar results are predicted or of a theoretical nature where dissimilar results are predicted but from reasons based on theory. The literal replicates of this research were predicted to provide similar results (regarding how context and composition influence their engagement in SRTB) because both were considered by the site's management to be highly effective while demonstrating some degree of SRTB. Dissimilar results were expected from this case study because they were not considered by the site's management to be as effective in general and their teamwork was described as being *"disjointed"* with little evidence of STRB.

Once identified as the potential third case study, the researcher met with the team as a group (including the supervisor) in a conference room to inform them of the research and to request their participation. The purpose and process of the research was briefly explained to the group (without specifying why their team was chosen) and the participant information and consent document was read aloud after having been given to each individual. Each person was requested to notify the research within a week if they

would participate. Similar to the Team Jun case study, five of the nine team members communicated their consent to participate on the same phone call (passing off the phone to each other) about an hour following the consent meeting. The rest individually provided their consent to participate (in person) over the next few days.

The case study data collection was initiated with a one-hour supervisor interview. Observation of the team's work activities began on the day following the supervisor's interview. The observation period included nine complete and consecutive working days.

Following the observation period, each member was individually requested to participate in a one-on-one interview and one member declined. One interview was conducted with two members simultaneously at their request. The member interviews each lasted one hour and they were accomplished over a period of seven working days after the observation. Following the research protocol, each member was given a copy of the interview transcript and requested to review their responses for accuracy. No changes to the interview transcripts were requested but one member withdrew their participation from the study after being provided their interview transcript. As such, none of that member's comments that were recorded from the observation and their interview have been stated in this dissertation. Coding of the data was initiated after all interviews had been completed and an ordered display was created for the case's analysis.

6.1.3 Self-Regulating Teamwork Behaviors and Effectiveness of Team Feb

During the observation period the supervisor was seen among the team members only occasionally and the encounters were brief. The supervisor's office is located adjacent to the work area, but none of the members were seen to go to the office during the nine-day observation. One member did report that they went to the supervisor's office once during the observation period to find out when a raw material was supposed to be received. Based on the observation and analysis of interview data, management's assessment that Team Feb engages in little SRTB as a whole was confirmed. However, several self-regulating teamwork behaviors were observed to be occurring in sub-groups of two or three members.

Appendix F is the work flow dependency diagram for Team Feb, showing the flow of the products and task dependencies between members. Due to the nature of this case study, member identification codes were not specified on the work flow dependency diagram as an added measure of confidentiality. In addition, the work was completed on separate shifts but the number of members working each shift is not disclosed. The work flow proceeds across discrete sequences of tables (identified as SEQ in the work flow dependency diagram), with members of the team assigned to work a particular sequence. None of the hourly-leads worked in the same sequence. On each day of the observation there was active WIP in each sequence. In addition, product was observed in queue for each sequence and except for one day each sequence had completed product ready for the next downstream operation to consume (one sequence did not have completed product due to a material shortage on that day). The arrows between members in the work flow dependency diagram indicate the flow of taskwork and therefore the interdependencies in each sequence. On the whole, the primary interdependency pattern for the work team was pooled but within sequences the interdependency varied between none, sequential, and reciprocal. To avoid delay at the downstream assembly operation, separate completed products were required to be supplied within a two-day period matching the sequence of consumption.

When recognized during the observation, collective behaviors to establish daily goals and plans for work accomplishment were isolated to members within the different sequences of the work flow. Compared to Team Jun and Team Sep, much less taskwork coordination was required for the team to meet its schedule goals. Task-related information was rarely exchanged between members working on different sequences. Cooperation on tasks was observed to be brief (lasting only a few minutes), primarily to maneuver products. Very few instances of performance monitoring, backup behaviors, and collaborative problem solving were observed. In most all cases, those behaviors were isolated to a product sequence.

During the observation period, the team met their collective goal of supplying product at the required rate with the exception of one day due to a material shortage. The material shortage caused a one-day delay for the downstream operation, even though self-

managed adjustments had been made by the members working the sequence where the material shortage occurred. Overtime was utilized on a regular basis in some of the sequences in order to meet production schedule. No instances of unplanned absenteeism occurred throughout the observation. The members' attitudes seemed generally negative toward their work group, but exceptionally so toward the site's management. Based on the generally recognized criteria for team effectiveness (performance, member attitudes, and outcome behaviors), the information gather from the Team Feb case study supports management's valuation of their effectiveness.

6.2 Findings from Context

This section details the findings from Team Feb for the influence of organizational and team context on SRTB. The influence of organizational context on Team Feb appeared considerably more pronounced than was reported from the prior two case studies. Organizational context, categorized in this research as work support systems, information systems, reward systems, and education systems (Hackman, 1987; Morgeson et al., 2006; Rico et al., 2007) accounted for 32% of the entire dual-coded data set as an independent factor (compared to Team Jun and Team Sep at 8% and 15% respectively). Only two of the organizational context factors, work support systems and information systems, are presented due to their prominence in the case study data.

6.2.1 Work Support Systems

The Team Feb case study data indicated that work support systems, defined as the practices of an organization used to accomplish work and to provide employees with resources and support for taskwork (Rico et al., 2007), appeared to be the dominant factor directly inhibiting the generation of SRTB as well as negatively impacting the emergent states team climate, team empowerment, and team integration. As one member of Team Feb summarized their impression of the site's management, *"Have you figured out yet that the management here couldn't run a hot dog stand?"* That seemed to be a shared sentiment among the members of Team Feb.

An inadequate and inefficient supply of material resources was observed to negatively impact the group's ability to plan and coordinate their tasks effectively and it was reported to be a commonly occurring problem across the different work sequences. During the observation period, a material shortage occurred in one of the work sequences that impacted meeting their schedule goal (resulting in a one-day slip). According to a team member working that sequence, they were told the order for that material had been placed a couple of months earlier. They said they had notified their production control contact during the previous week that they would be running out of the material and had been routinely asking their supervisor when to expect it. When it did show up, after being expedited by sending one of the site's employees on a special trip to pick it up, members on that product sequence decided on their own to work through their afternoon break and then on overtime into the evening to complete their tasks and minimize damage to their schedule goal. Responding to an interview question about whether or not they thought their team's work preparation behaviors were effective for meeting their schedule goal, one member said *"I think everybody is working toward the goal and when everybody has what they need then yes, we are effective."*

In addition to the supply of productive materials, the availability and reliability of hand tools required to accomplish the taskwork was also cited and observed to negatively impact the group's ability to coordinate their activities and cooperate on tasks. Several specialized hand tools were shared among the members, preventing the same task from being accomplished on multiple sequences simultaneously and also preventing cooperation on some tasks in the same sequence. The reason for not having duplicate hand tools was reported to be because *"they say it costs too much money"* and it has resulted in the group being very protective of what they do have. The specialized hand tools are locked up because *"... if you leave them laying around they grow legs and walk off. We've got to have them to do our job, and most of them we've modified ourselves to suit our needs."*

The practice of using two-bin material supply systems (supermarkets) was established for the work group during the lean intervention of 2012. It was evident from the observation and member interviews that the system was not being controlled as

originally designed. The hourly-leads of the team were responsible for performing audits on the 2-bin systems and they reported they would often find missing kanban cards, materials not stocked in their correct bins, and materials dropped off in the floor instead of being stocked away by the stockroom personnel. As one team member said, *"We're left with fixing it. It takes time away from our jobs to do what someone else's job is supposed to be. We shouldn't have to put those materials away, or grab something just to take it back to our work station and then find out it's not the right part because it was in the wrong bin."* Another member said *"It takes away from our value-added work. Nobody seems to know anymore who's supposed to do what for those supermarkets. The roles and responsibilities for the supermarkets are not clearly defined and no one in management is working to explain what they are."* Stated by another member, *"We get hopeful whenever there's some kind of change going on like the lean implementation, we begin to think that things will actually get better and we like to be involved in those things. But then the same old thing happens, it falls apart because management doesn't support it."*

Another feature of the work support system involving the boundaries of the team was stated by several members as negatively impacting their ability to coordinate their taskwork effectively. *"We don't have a balanced flow because the different supervisors from our upstream and downstream departments aren't working together. They're all doing things to benefit their own concerns and it ends up making us look bad. They've got to have teamwork before they should expect us to."* As another member said, *"I think that the people working in our downstream process should have the same supervisor as we do to match up our work patterns and overtime. It feels like we're always playing 'tug of war' with them."* Stated by another member in their interview, *"I think things would work better for teamwork if our downstream process had the same supervisor as us. It seems like we're not part of them and they're not part of us but they're right there with us. There's only two of them, it seems like we could help each other better if we were all on the same team."*

Work support systems were also found to be negatively influencing emergent states of the team, which in turn seemed to influence their motivation to engage in SRTB.

The team's climate of excellence for taskwork was reported to be influenced by management's approach of using workers outside their group to make adjustments to meet schedule goals. The team's climate of support for innovation was reported to be influenced by how management handled their ideas and concerns for improvement.

While talking with a member at the overtime posting board, he said *"Management has lost all respect from the workers here. They've let the workers run all over them. The workers are the ones that are actually running the place. They'll let people that miss work during the week sign up for work in other departments on a Sunday for just four hours and pay them double time to do work that should have already been done."* When asked if the performance of their group or individual members ever causes conflict and if so how it's handled, one member said *"Yes it can cause conflict, sometimes. It's usually about someone not getting done what's needed to get done in time. They get help and the hours go up. They'll complain to the supervisor that they need help and the supervisor will send someone from outside our group to work on it with them or for them."*

Following an all-hands meeting during the observation period that included all production employees and support personnel assigned to the product types that Team Feb was responsible for, one of the group members commented *"So, if we see a problem that's getting in the way of our performance they said we should raise our hand, as if they're actually going to help us. To tell you the truth, I'm tired of raising my hand. Every time you do they always come up with some reason to blow off your concern."* Members of Team Feb have submitted some ideas in the site's EIP idea system that have either been turned down or in their words *"neglected"*. Some of the ideas would have required a change to the design of the product, which they said would have required customer approval. According to one of the hourly-leads *"We've given them* (management) *ideas that would help us with the job and save money but they were turned down because they would have to be approved by the customer and we don't have anyone here in management anymore that could sell the ideas to them. We have new people in management that don't know the customer like the people we used to have."* Team Feb's supervisor also recognized the lack of support for innovation and how it affected the team's climate, *"The big thing for us right now is trying to reduce cycle times, cutting*

HPUs, but a lot of the reason for HPUs being high is because it's just built into the process. The people in the group see that. They've suggested ways to cut it down but they get aggravated because no one wants to change it."

Team empowerment was another emergent state reported to be negatively influenced by the site's work support systems. In particular, management's approach of using workers from outside their group to make up for lost time toward schedule goals was affecting the team's belief that they have the authority, responsibility, and efficacy to control their work environment and their team's functioning.

Referring to the issue of whether members trust each other regarding work performance, *"Yeah I think they do. Like when another member comes over to help on a part I know they'll do a good job. But it stops there with our group, it can't just be anyone. Someone else outside our group will be put on one of our jobs by management and they'll be there for two hours but do fifteen minutes of work and it runs up our hours. But then when it comes down to it management talks to us about the hours not being where they need to be, not to them. How can we control it if they let other people work on it?"* Some members were observed to work on sequences they were not normally assigned to if they could not work on their own for various reasons. *"Doing that is something that drives our hours down. But when other people from outside our group come in to 'get the overtime' it actually drives the hours back up because they don't know the work like we do and they don't care about the performance like we do. They aren't as efficient and they'll often make mistakes we end up having to fix anyway."* Referring to employees outside their work group, another member said *"They* [management] *watch some people loaf all week and then give them a chance to work overtime on the weekend. We work hard all week and don't particularly want to live in here on the weekends. So what do they do, they let them work in our area and we can't do anything about it. Everything we try to do during the week gets messed up."* Still another member stated *"To me, all supervisors are supposed to be supportive and not hurting one group just to make their own work group look good. When they interfere by pulling out someone from our group to work in another area or when they bring in someone to our group who doesn't want to work it causes chaos."*

One of Team Feb's hourly-leads said *"The basic stuff we're being taught in the Lean 101 workshop isn't being followed by management."* The lead went on to provide an example of how their work flow was being affected by management's approach of running upstream and downstream processes at different rates because of a lack of coordination between the different supervisors. *"All week they've run the downstream process at a faster rate than what we're setup to do and they're also working them this weekend but not us. Now when we come in on Monday, we'll be dried up. So what management will do is bring in unskilled workers to our area on the next weekend to catch up on it and then we'll have to fix their work. It's very discouraging, we can't do it like it's supposed to be done."*

The work support systems were also found to influence another emergent state, team integration, by negatively impacting the team's identity, trust, and respect. Referring to how supervision provides unequal treatment to workers in their group, *"Have you seen the babying that goes on yet?"* I asked one of the members why another had received external backup support during the day and they said *"I have my suspicion but I'm not gonna say"*. Comments made by a couple other members indicated a lower level of respect for some member's abilities and contributions. *"They'll whine to the supervisor that they can't do everything they're supposed to do and then get babied by getting extra help whenever they ask for it."*

Management's approach of bringing in workers from outside the team on the weekends also appears to negatively influence the team's identity and trust. Referring to whether work performance causes conflict in the group, *"Only overtime causes conflict. Management will let other people come in to work overtime on the weekend and we have to fix their screw ups. What's worse is that it's the same people that keep doing it, and management keeps letting them do it. They'll pay double time for someone to come in here to screw something up and then pay straight time for us to fix it."* Another member said, *"I don't want to sign off on a product when people outside our group have worked on it because I don't know it was done right. I know that because it's happened."*

6.2.2 Information Systems

The Team Feb case study data indicated that another organizational context factor, information systems, inhibited the generation of SRTB and negatively affected the team's emergent states. Information systems was defined for this research as the practices of an organization used to provide employees with information to plan their work and manage their performance (Hackman, 1987; Morgeson et al, 2006).

As one member summed it up, *"If we knew more often what the hours* (HPUs) *were on the products that we've just completed, or were still working on, I think we could strive to keep the hours where they need to be. We can't do that ourselves, management needs to give us that information. We have to jump back and forth between products and some of them are worked on by second shift or even other people outside our group on the weekends so we can't really tell how much labor time is being put into them."* When asked if they thought their work group was effective at setting goals and making plans to meet their cost goals another member said *"To cut the hours, no I don't think we're effective at that because we don't have the information we need to do it. It's not until the HPU charts come out that we know how we've done on previous parts and we only get that information about every quarter. So we're not finding out how we're doing until after we've made about another thirty of them."*

The site's management uses time-series run charts (commonly referred to as HPU charts by the members) to display the hours spent on processes for previously completed products over the span of twelve months with a five-unit running average. The HPU goal is shown on the charts as a straight horizontal line. The charts for Tem Feb's processes all show historical HPU performance significantly above the goals even though some improvement had been made toward the goals. For Team Feb, management's practice has been to recalculate and print the charts quarterly for display on boards near the work areas.

During the observation period the HPU charts were refreshed and as a follow up to what had been announced by the production manager in an all-hands meeting the supervisors would be *"getting with the workers to talk to them about the charts"*. On one day of the observation Team Feb's supervisor was seen talking with the members

individually to show them *"their own HPU charts"* since they were primarily assigned to work on sequences that had their own charts and goals. In one of the conversations the supervisor was explaining a chart to two members at the same time, asking questions about time charging variation and pointing out that even though improving they were still above the goal. It did not take long for the conversation to get heated with profanity from a member while the supervisor tried to calm them down saying things like *"I'm just asking questions and trying to talk about it."* The supervisor ended the conversation by telling them that they were doing well and appreciated their work and the members appeared to be left frustrated by the exchange.

From the HPU chart communications observed, it did not appear that the conversations or feedback being received from the information system were effective. According to the supervisor, *"They don't monitor their own performance. They won't even ask me how they're doing. If I ask them anything in particular about how they could do their job better they get offended. That's the way it is with the whole group, they think they're doing the best job but I know they can do things better."* The members pointed out that they didn't really see a benefit from the charts. When asked if management provided more frequent feedback on HPU performance would it help to monitor cost performance, one member said *"I don't know if that would help, looking at charts sometimes doesn't mean a lot to us. Basically, we're assemblers, hands-on people. Sometimes we want to say, let us work, just let us work."* Other comments from different members regarding the HPU charts included *"As for the HPU charts, there might only be three or four people that even look at them."* *"I don't think the supervisor should have to come to the individuals and show them how they're doing. I think if people are interested in it they'll go to the board to see it themselves. The supervisor doesn't have to bring it out. In fact, I think that can have a negative effect because you know you're doing the best you can to meet an unrealistic goal and when they do that it feels like they're just coming down on you and it's frustrating. Like I said, I think most of us are over-achievers anyway and we want to do the best we can."* *"Yes, I think everybody would be receptive to it* [management providing more frequent feedback on HPU performance] *but only if it was done for all groups and not just ours. When you see other groups not working, or*

you see the unbalanced workloads between groups, it wouldn't be motivating to get more feedback for how your group is doing. It would just look like they're putting more pressure on those of us that are already working hard and doing the best we can."

The site's information systems seemed to particularly influence the vision aspect of the emergent state team climate. Vision is the extent members share higher order goals they perceive as clear, attainable, and motivating (Anderson & West, 1998; Loo & Loewen, 2002). Responses to questions about the HPU goals indicated that the members were not clear about what the goals were and were not motivated by them because they thought they could not be attained. When asked what the HPU goal for their work sequence was, an actual number was not given but one member responded *"The way I look at it is every two days I've got to finish a product. I just need to work as hard during that time as I can to get that done."* The operations goal shown on the HPU chart for that member's sequence was 14 hours, while the router standard was 13 hours and a previously completed time study was 16 hours. Another member responded to the same question with *"About 8 hours for each sequence".* The operations goals posted on the HPU charts for the sequences in question were seven hours and six hours. Saying what they thought management wanted from the group regarding HPU performance, *"I know what they want. They want about two hours taken out of the HPUs from each sequence but that's not possible and the time studies showed that. It's not very motivating to have HPU goals always thrown in your face that you know you can't achieve and you know were based on management's mistakes."*

6.2.3 Team Task Design

This section describes findings from the Team Feb case study related to the influence of team task design on SRTB. Team task design accounted for 54% of the dual-coded data from team context in this case study. Table 12 shows the counts of source repetitions reporting an influence from team task design on the separate phases of SRTB, categorized by the most frequently reported task design features.

Table 12. Team Feb Task Design Relations to SRTB

TASK DESIGN	SRTB			
	Prep	Collab	Assess	Adjust
Interdependency	2	5		1
Task Autonomy		1		
Task Feedback				2
Task Routineness	1			1

6.2.3.1 Task Interdependency

The task interdependency of Team Feb, depicted in the work flow dependency diagram (see Appendix F), appeared to influence most all phases of SRTB. Members were assigned to work the same product sequence every day and they only worked other sequences on rare occasions. Some sequences had more than one member assigned (either on the same or separate shifts), thus creating within-sequence interdependency, but on the whole the group's interdependency is pooled.

Informal work preparation behaviors were observed but they were confined to the individual work sequences (not across sequences). Coordination was necessary within sequences having more than one member assigned but not between sequences (other than ensuring that the completion of products from the work group meets the sequence that is required in the downstream assembly). Some cooperation was necessary between sequences to maneuver products but those tasks were brief. Within sequences, cooperation was rarely used and reported to be that way because of a lack of hand tools and because that's how the process was designed. The products are large enough that two people could work on them at the same time without getting in each other's way but it would only be possible if multiple hands tools were available. Task-related information exchange was observed to be common within sequences but rare between sequences. Team adjustment behaviors appeared to be generally absent in the group with the exception of occasional backup behaviors.

The influence of task interdependency on SRTB and team identity was also apparent from the member's various comments. *"The way each one of us is dedicated to work certain sequences every day can make it hard to see yourself as working on a team but I've also never seen someone having problems and someone else in the group not helping them out." "The way we're paired up I think a lot of us see each other as working on a team, but it might be like looking at us as just a bunch of small teams making up our work group and not as a whole team. We're kind of wrapped up in our own work sequences and we have to be." "We're broken into sequences and that makes it a little harder for us all to work together, just because of the way the work is designed." "I'm not sure how we could work together more. That's a hard one because for the most part each person manages their own sequence."*

6.2.3.2 Task Feedback

Task feedback appeared to influence the team's ability to engage in SRTB. On one hand, the proximity of the work group to the downstream assembly process and visual aspects of the products and work area provided feedback that could enable preparation, collaboration, assessment, and adjustment behaviors to self-manage schedule performance. As one of the lead members stated, *"I know where each person working in the group is in getting their work done because I can see their completed products and can tell at what point they are on the one they're working. I can also see where our downstream process is in building the assembly from our products so I've got a good idea of how we're doing as far as schedule goes."*

On the other hand, a lack of task feedback for how much time had been spent working on the products seemed to inhibit self-management of cost performance. As one member responded to a question about what was influencing their ability to meet cost goals, *"Not having the HPU information relayed back to us as soon as it needs to be. We should be finding out once or twice a week where we are, as far as how much work is going into the parts. If we found out sooner, we might be able to do something about it because it would be fresher on our minds."* Another member's response to what might help the group monitor their HPU performance was *"I don't know, maybe getting more*

feedback would help. Every couple of weeks would be good instead of the way it is now. The way it is now, we don't find out how we did on parts until it's too late to remember what happened."

6.3 Findings from Composition

This section presents the findings from Team Feb for how team composition influences SRTB. Team composition accounted for 25% of the entire dual-coded data set as an independent factor. Member personality was the dominant category in team composition reported to be influencing Team Feb.

6.3.1 Member Personality

Reports of the influence of member personality on SRTB and emergent states were analyzed by categorizing dual-coded data according to the five-factor model of personality traits (McCrae & Costa, 2008). Table 13 shows the counts of source repetitions reporting an influence from member personality on SRTB and the team emergent states climate, integration, and cohesion. The traits are listed as the common acronym OCEAN, corresponding to the first letter of their name.

Table 13. Team Feb Personality Relations to SRTB and Emergent States

	PERSONALITY TRAITS				
	O	C	E	A	N
SRTB	1	6		4	
Team Climate	1		1	4	1
Team Integration		2		4	
Team Cohesion		2		1	
Totals	2	10	1	13	1

As with the literal case replicates, agreeableness and conscientiousness were the most commonly recognized personality traits appearing to influence SRTB in Team Feb.

According to the supervisor, *"The biggest problem I see on a daily basis is conflict from the personalities, they let it get in the way of being a team. Each member of*

this group has the skills and abilities to do the work but they aren't willing to cross-train or help their coworkers." Taken from group member comments, agreeableness of the members seemed to influence backup and team innovation behaviors. "*We really do have a lot of team players in our group but also some don't want to give or receive help. That's just the way they are.*" Another member said "*Some people in the group won't support new ways to do their work because they take it as criticism.*" An example during the observation was noted when while talking with one of the members they heard a nearby coworker performing a task and their method was causing an irritating but inconsequential shrieking sound. The member commented that if they would just back off a little it would not happen. When asked what it would take to be able to provide performance feedback to the other member, they stated "*It wouldn't do any good, some people won't take work advice from a member of the opposite sex no matter what your knowledge or skill level is.*" Another member stated in regard to giving and receiving performance feedback in their group, "*People have got to be willing to learn to be taught. Some people think they already know it but they don't.*" Another responded in reference to whether performance of members caused conflict in the group "*It has caused problems in the past, when there's been people in the group that were very competitive and they liked to rub it in other people's faces that they were doing more.*"

The conscientious personality trait was offered by seven of the nine group members as being a significant influence. Referring to what they thought influenced the effectiveness of their group members' to set goals and make plans for schedule performance, one member said "*The individuals on each sequence know what is needed and they don't want their part to be the one that shuts down the next assembly. I think we're that way because we're good workers and we strive to make it work and for the company to do good. I want this job for many more years.*" Another said in reference to the same question, "*I think it's more of a 'type of person' thing, an 'over-achiever' thing, all the way down the sequences. I think all of us are over-achievers. I don't think it's as much the support we get as the people in the group, they're very hard workers. I guess some of that goes to picking the people to work on the team, so I've got to give management some credit for putting the right people together. I think our group is made*

up of conscientious people, all throughout. " Referring to what about the group or their support personnel influenced their effectiveness at working together, *"A lot of that, and you can see it across the different work areas, is that you've got some people that want to work and some people that just come to work. The people working the sequences in our group, they want to work. We always try to make sure that the process keeps moving. In other departments the people try to slow the process down so the overtime will kick in. For them, it's all about that dollar. "* Another member said *"Some days there's friction but in general I think we work well together. All of us are hard workers, so when they put someone in our group that's what I'll call a 'less hard worker', it makes us mad. We have the same work ethics, that's the reason we run to help one another. Also, if one of us got blamed for something but they did it instead they would stand up and say 'no I did it'. Integrity like that is hard to find. "*

6.3.2 Other Composition Factors

Member's skills for teamwork and taskwork were reported with moderately high source repetition to influence SRTB in the Team Feb data. According to the supervisor, *"What could make it better? If the leads would initiate helping each other out between the sequences. Don't chastise, just say something like 'here let me give you a hand'. One of the leads just wants to jump in and boss people around and it pisses them off. I don't like a lead with that much power, I think they should help members but not assign work. That should be my job. The other two leads take the pay and that's about it. "* Referring to whether they thought the group needed more freedom to control how they work together as a whole, one of the hourly-leads said *"I'm going to say no because I think we couldn't all agree on how to do it. I think that should be more of a supervisor's assignment and responsibility. "*

Within the work sequences however, the skills for teamwork appeared to be enabling SRTB. Self-managing teamwork skills are used to help establish team goals and plans, coordinate activities between members, and monitor performance with constructive feedback (Stevens & Campion, 1994). One of the members explained how while they would drive into work they would think about what they'd need to do when

they arrived because *"We've gotten to the point now where I can predict pretty well what my coworker on the previous shift should have accomplished and if they can't get to that point they'll send me a text before I go in to let me know what happened."* Adding to their explanation, *"When I leave my work at the end of the shift, I try to leave it so that when the next shift takes over they'll be able to have a full productive shift too. You've got to get in your head what needs to be done in order to get the goal accomplished for the shift. How hard I have to work depends on them and how hard they have to work depends on me."* Responding to how their group's collaboration could be improved, another member stated *"I don't know about the other sequences but our sequence has a layout where we understand what each other needs to do a good job. I understand what they do or don't like to do so I'll try to do that for them if I can before they come in. They knows parts of the job that I don't like to do, so they'll do that when they can so I won't have to."*

Member skills for taskwork was reported to influence SRTB and team integration. *"There used to be someone assigned to accomplish tasks on our sequence that took too long and didn't have the quality that my coworker currently brings us. Now, it would be hard to find someone that could do those tasks for our sequence better than they do."* During an instance of cooperation on a task, one of the hourly-leads stated *"The last thing you want is someone working with you that doesn't keep up. My coworker can and wants to do that, even though they're still learning."* In response to if they thought there was a shared concern for excellence among the group members for work performance, another hourly-lead said *"Some people work good and some work hard but can't accomplish as much. It just may not be in their capability. Some people may be better suited to work on jobs other than what they're assigned to. But that's a management thing, we shouldn't have to be vulnerable to say to anyone else what they should be doing or how they should do it."* Responding to if members trust each other for work performance, the same hourly-lead said *"Not everyone but some, yes. There are certain jobs that you just don't want someone working on because of their skills or physical abilities. It can cause problems or on some things it's just not safe."*

6.4 Within-Case Analysis for Team Feb

The coded data set from the Team Feb case study contained at total of 230 items. As explained in Section 3.6.3 Ordered Displays, a factor matrix was first created for the within-case analysis to record counts of the different sources reporting dual-coded relationships. Table 14 is the factor matrix for the Team Feb data.

Table 14. Team Feb Factor Matrix

Dual-Coded Source Repetition Count (max 10)	TEAM COMPOSITION						ORG CONTEXT				TEAM CONTEXT				EMERGENT STATES					SRTB	Sum
	Team Size	Member Personality	Skills - Task Work	Skills - Teamwork	Team Flexibility	Team Stability	Work Systems	Information Systems	Reward Systems	Educational Systems	Empower Structure	External Leadership	Team Task Design	Coaching	Team Integration	Team Climate	Team Cohesion	Team Empowerment	Team Mental Models		
Team Size (TEAM COMPOSITION)																		2		1	3
Member Personality			1	1											5	6	3		1	8	25
Skills - Taskwork															1	1				3	5
Skills - Teamwork																1	1	1		5	8
Team Flexibility																				1	1
Team Stability															1			1			2
Work Systems (ORG CONTEXT)		1													6	8		7	1	6	29
Information Systems												1			1	3	3	2		4	14
Reward Systems															4	3					7
Educational Systems															1	1		1			3
Empower Structure (TEAM CONTEXT)																				6	6
External Leadership															2	1		2		1	6
Team Task Design															3			1		6	10
Coaching																		2		2	4
Team Integration (EMERGENT STATES)																2	3			4	9
Team Climate				1											1		2	3		7	14
Team Cohesion															2					6	8
Team Empowerment																1				2	3
Team Mental Models															1					7	8
																					165

The matrix groups factors into composition, context, and emergent state categories. The numbers in the matrix indicate how many different sources reported an influence from an independent factor (rows) on a dependent factor (columns). The Team Feb case study involved observation and nine interviews, thus ten was the maximum

number of source repetitions that could occur for a factor relationship. The count of source repetitions was used as a basis to determine the relative importance of factors and relationships in the analysis. As explained in Section 3.7 Validity, Reliability, and Trustworthiness, the method of using source repetition for data triangulation enhances the confirmability of the research findings.

A causal waterfall display was then created, where source repetitions were used to separately show the significance and relationships of the independent factors. Figure 14 is the causal waterfall display for the Team Feb data.

TEAM COMPOSITION

25
- 8 | MBR-PERS
  - 6 | CLIMATE
  - 5 | INTEGRATION
  - 3 | COHESION
  - 1 | MENTAL MODEL
  - 1 | FLEXIBILITY
  - 1 | SKILLS-TEAM

8
- 5 | SKILLS-TEAM
  - 1 | CLIMATE
  - 1 | COHESION
  - 1 | TEAM EMPWR

5
- 3 | SKILLS-TASK
  - 1 | INTEGRATION
  - 1 | CLIMATE

3
- 1 | SIZE
  - 2 | TEAM EMPWR

2
- 0 | STABILITY
  - 1 | INTEGRATION
  - 1 | MENTAL MODEL

1
- 1 | FLEXIBILITY

ORG CONTEXT

29
- 6 | WORK SYS
  - 8 | CLIMATE
  - 7 | TEAM EMPWR
  - 6 | INTEGRATION
  - 1 | MENTAL MODEL
  - 1 | MBR-PERS

14
- 4 | INFO SYS
  - 3 | CLIMATE
  - 3 | COHESION
  - 2 | TEAM EMPWR
  - 1 | INTEGRATION
  - 1 | TASK DSN

7
- 0 | REWARD SYS
  - 4 | INTEGRATION
  - 3 | CLIMATE

3
- 0 | EDUC SYS
  - 1 | INTEGRATION
  - 1 | CLIMATE
  - 1 | MENTAL MODEL

TEAM CONTEXT

10
- 6 | TASK DSN
  - 3 | INTEGRATION
  - 1 | TEAM EMPWR

6
- 1 | EXT LEADER
  - 2 | INTEGRATION
  - 2 | TEAM EMPWR
  - 1 | CLIMATE

6
- 6 | STRUCT EMPWR

4
- 2 | COACH
  - 2 | MENTAL MODEL

EMERGENT STATES

14
- 7 | CLIMATE
  - 3 | TEAM EMPWR
  - 2 | COHESION
  - 1 | INTEGRATION
  - 1 | FLEXIBILITY

9
- 4 | INTEGRATION
  - 3 | COHESION
  - 2 | CLIMATE

8
- 6 | COHESION
  - 2 | INTEGRATION

8
- 7 | MENTAL MODEL
  - 1 | INTEGRATION

3
- 2 | TEAM EMPWR
  - 1 | CLIMATE

LEGEND

Source repetitions as independent factor

Source links to SRTB →

Source links to dependent factors →
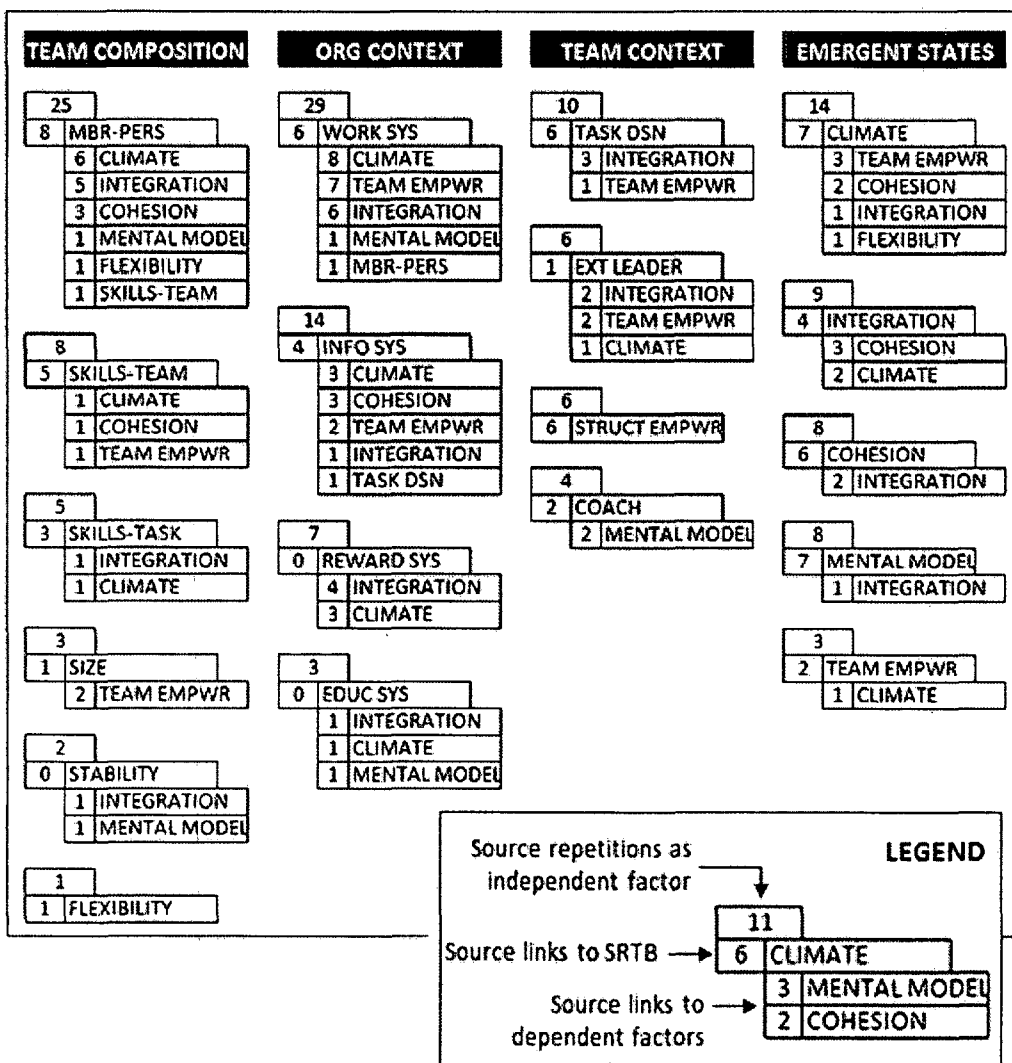
11
- 6 | CLIMATE
- 3 | MENTAL MODEL
- 2 | COHESION

Figure 14. Team Feb Causal Waterfall Display

The number appearing at the top of the sub-table for each independent factor in the causal waterfall display is the total repetition count of its relations to SRTB and the emergent states. The dependent factors in each sub-table are listed below the independent factor in decreasing order of source repetitions.

The next step in analyzing the Team Feb case study data involved integrating the factors and their relationships into a causal network map shown in Figure 15. The height of each box is proportional to the number of source repetitions for that factor's relation to SRTB. The two numbers associated with each box indicate the number of source repetitions found to relate that factor to SRTB and emergent states respectively. The arrow weights are proportional to the number of source repetitions found between a factor and an emergent state. To simplify the Team Feb causal network map, relations having fewer than five source repetitions are not shown.
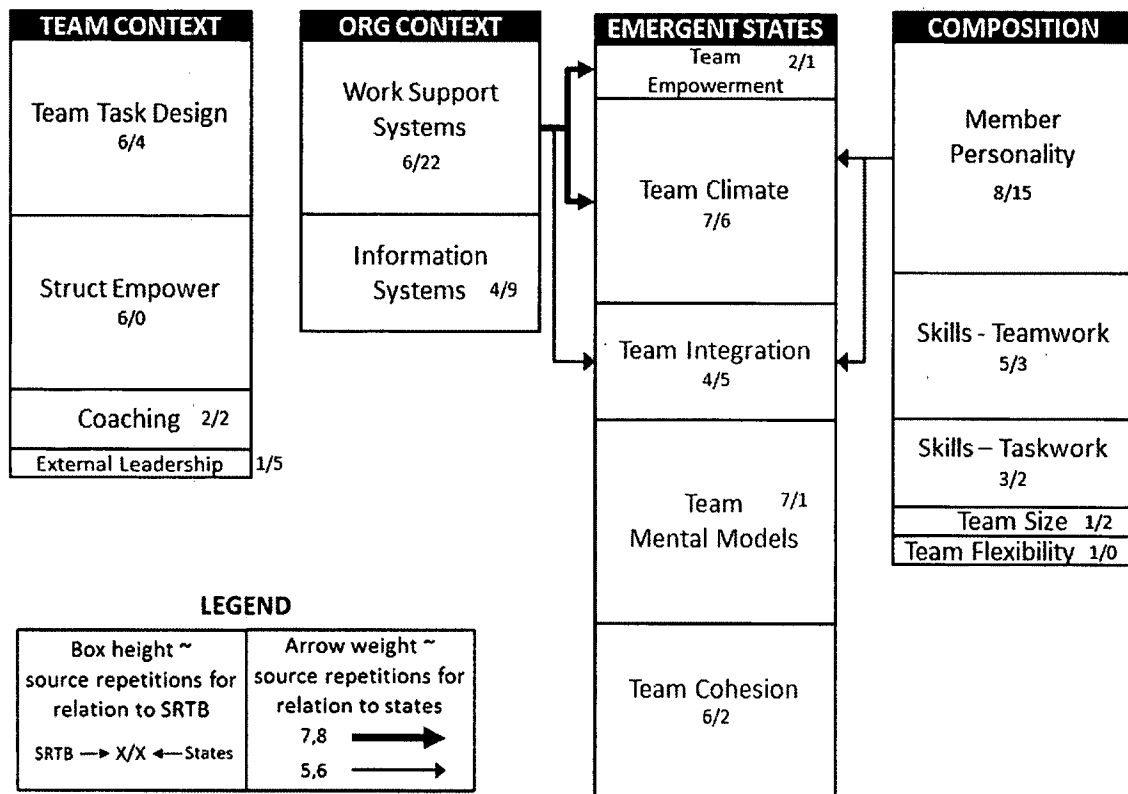

Figure 15. Team Feb Causal Network Map

The causal network map illustrates the relative influence of factors on Team Feb's SRTB as expressed from source repetition, ranging from work support systems and member personality with the highest to team flexibility with the least. Referring to the central research question, the causal network map makes clear the key factors and links influencing SRTB for Team Feb. The key factors for Team Feb are:

- Work support systems, linked to team climate, integration, and empowerment
- Member personality, with links to team climate and team integration

Why should work support systems be a key factor for SRTB in Team Feb and be linked to the emergent states team climate, team integration, and team empowerment? "Too often, researchers of group effectiveness focus on the group itself and neglect the environment in which the group operates" (Hyatt & Ruddy, 1997, p. 577). Work teams are after all, "... embedded in an organizational context that sets boundaries, constrains the team, and influences exchanges with other units in the broader entity" (Kozlowski & Bell, 2003, p. 334). Two themes involving the influence of organizational context on SRTB appeared from the Team Feb case study data; *managerial support* and *team boundary control*. Data from these themes was captured in the factor called work support systems for this research, defined as the practices of an organization used to accomplish work and to provide employees with resources and support for taskwork (Campion et al., 1993; Guzzo & Shea, 1992; Hackman, 1987; Rico et al., 2011; Wageman et al., 2005).

Hyatt and Ruddy (1997) posit that one of the most important characteristics of an effective work group is the support it receives from the organization. Furthermore, their research indicates this may be more important than the cohesiveness of the group. Primary inputs of support for work teams are the material resources and information required to make group functioning possible and these inputs are controlled by management (Shea & Guzzo, 1987). Managerial support, involving the provision of resources and removing barriers to accomplish and improve taskwork, has been found to predict team performance and member satisfaction in work groups (Campion et al., 1993; Campion et al., 1996; Doolen et al., 2003; Tata & Prasad, 2004).

Team boundaries are features that differentiate a work group from others, posing barriers (real or symbolic) that limit access or transfer of information, products, or people while also serving as points of exchange with external sources (Sundstrom et al., 1990). Acting as a sort of filter, Sundstrom et al. (1990) suggest that team boundaries mediate between the organizational context and a team's processes. Team boundary control involves two aspects (Cummings, 1978). The first is that of differentiation, or the extent to which the group can protect their work boundaries from external intrusions. The second is external integration, representing how the team fits into the organization and the extent to which it can influence transactions with its suppliers and customers. According to the socio-technical systems theory for work design, boundary control enhances a work group's self-regulating capacity to control variance from goal attainment which in turn leads to greater performance and member satisfaction (Appelbaum, 1997; Campion et al., 1993; Clegg, 2000; Cummings, 1978). The supervisory role under self-regulating teamwork conditions is suggested to involve two major functions: developing group members and helping the group maintain its boundaries (Cummings, 1978).

The data from the Team Feb case study support the findings of prior research involving the influence of work support systems on SRTB, as evidenced by several repetitions from the case study sources. An inefficient material supply system, material shortages, and a reported lack of knowledge and support from management negatively influences SRTB and the emergent states team climate and team empowerment. Management's practice of using workers external to the group for overtime tasks reduces the team's capacity for self-regulation and boundary control (differentiation), resulting in a negative influence on the emergent states team identity and team empowerment. A lack of coordination between supervisory management impacts the team's boundary control (external integration) by damaging synchronization with its suppliers and customers. This in turn negatively influences team empowerment.

The within-case analysis for Team Feb suggests that the generation of SRTB has been inhibited by a negative influence from work support systems, creating team

emergent states (team climate and team empowerment) that do not motivate members to adopt those behaviors.

Why should member personality be a key factor for SRTB in Team Feb and have links to team climate and team integration? As with the two prior case studies, agreeableness and conscientiousness were the personality traits most frequently cited to influence Team Feb. Two themes regarding the influence of member personality on SRTB and emergent states appeared from the Team Feb case study data. The first was an agreement among the group that its composition included members with a high degree of conscientiousness, positively influencing within-sequence SRTB, a team climate of excellence, and team integration (trust and respect). The second theme involved reports of the team's composition including members with a low degree of agreeableness, negatively influencing between-sequence SRTB, team climate (support for innovation and participative safety), and team integration (respect and team identity). The case study data suggested that member personality was particularly influencing the group's engagement in backup behaviors, an important concern as evidenced by example excerpts from the case study interviews: *"It's disappointing when you can see where someone could help out but they're not taking the initiative to do it." "Each member of this group has the skills and abilities to do the work but they aren't willing to cross-train or help their coworkers." "We don't worry about what they do down there* (referring to other work sequences)*, we just take care of what we have to do up here. I won't go down there and help them out again."*

Prior research has found the personality traits conscientiousness and agreeableness to be significant, albeit weak, predictors of helping behaviors (Organ & Ryan, 1995; Porter, Hollenbeck, Ilgen, Ellis, West, & Moon, 2003). In a first reported study to examine how personality traits might interact to influence helping behaviors in work teams, King, George, and Hebl (1995) proposed that conscientiousness may be a necessary antecedent of helping behaviors but that it may not be sufficient in and of itself. In fact, they suggested that under certain circumstances, individuals high on conscientiousness may actually be very reluctant to engage in helping behaviors because it may interfere with meeting their own role-prescribed goals. However, they also

proposed that to the extent individuals who are high in conscientiousness also possess a high degree of agreeableness, they should be more likely to engage in helping behaviors. The findings of their research supported their propositions, showing conscientiousness to have a strong positive relation with helping behaviors when agreeableness was high and a negative relation with helping behaviors when agreeableness was low.

In Team Feb, the combination of a high degree of conscientiousness among members and a low degree of the agreeableness trait appears to be negatively influencing SRTB and backup behaviors in particular. Furthermore, the role assignment of members to work only certain sequences and their perception of how management views them (as individuals working different sequences instead of as a team) may be intensifying the effect of member personality (conscientiousness) on backup behaviors. Example excerpts from the team member interviews provide evidence to support this view: *"We don't have time to help on other sequences because of the workload we have on our own." "The individuals on each sequence know what is needed and they don't want their part to be the one that shuts down the next assembly. I think we're that way because we're good workers and we strive to make it work and for the company to do good." "I'd say most of us see ourselves as working in a group instead of on a team. There's so much on each of us it's hard to help each other out but like I said I've never seen help denied. I think management sees us as individuals running separate sequences because they don't go to the group to talk about the group's performance, they go to the ones working a particular sequence to talk about performance there."*

CHAPTER 7

CROSS-CASE ANALYSIS

This chapter aggregates the findings from the three case studies conducted for the research. First, a combined causal network map is presented, highlighting the factors and relationships found to most influence SRTB in the LVHC production work groups of the research site. Next, separate sections use existing theory and prior research to explain why certain factors and their relations should be influential on SRTB in LVHC production work groups. Frameworks and propositions for how SRTB can be accomplished in LVHC production settings are presented based on the research findings. Lastly, rival propositions are addressed.

7.1 Cross-Case Causal Network Map

A total of 716 dual-coded items were recorded in the database for the three case studies. Since the case studies were conducted at the same research site, sharing an overall organizational context, aggregating the data into a comprehensive set to search for how and why SRTB can be accomplished in this setting is justified (Miles & Huberman, 1994; Yin, 2009).Where appropriate, this approach lends to a generalization of the findings to other work groups in this setting. A factor matrix was first created for the cross-case analysis to obtain a count of the different sources reporting dual-coded relationships. Table 15 is the factor matrix for the combined case study data.

Table 15. Cross-Case Factor Matrix

Dual-Coded Source Repetition Count (max 25)		Team Size	Member Personality	Skills - Task Work	Skills - Teamwork	Team Flexibility	Team Stability	Work Systems	Information Systems	Reward Systems	Educational Systems	Empower Structure	External Leadership	Team Task Design	Coaching	Team Integration	Team Climate	Team Cohesion	Team Empowerment	Team Mental Models	SRTB	Sum
		TEAM COMPOSITION						ORG CONTEXT				TEAM CONTEXT				EMERGENT STATES						
TEAM COMPOSITION	Team Size	■												1			1		3	1	7	13
	Member Personality		■	1	1											10	11	7	1	2	22	55
	Skills - Taskwork			■								1				5	4			1	8	19
	Skills - Teamwork				■											2	1	3	1	1	15	23
	Team Flexibility					■													1	2	13	16
	Team Stability						■									1				1	7	9
ORG CONTEXT	Work Systems	1						■								6	12		10	1	13	43
	Information Systems								■					1		1	3	3	3		13	24
	Reward Systems									■						6	5					11
	Educational Systems					1					■					1	2			2		6
TEAM CONTEXT	Empower Structure											■	1			2	4		1	3	13	24
	External Leadership												■			5	8	1	3	1	8	26
	Team Task Design											1		■		3		3	2	3	18	30
	Coaching			1	1	1									■	2	2			3	14	24
EMERGENT STATES	Team Integration															■	4	10	1	1	18	34
	Team Climate					1										1	■	6	4	3	18	33
	Team Cohesion															2		■			16	18
	Team Empowerment																	1	■		14	15
	Team Mental Models											1				1				■	19	21
																						444

The matrix groups factors into composition, context, and emergent state categories. Each number in the matrix indicates how many sources reported an influence from the independent factor (rows) on the dependent factor (columns). A maximum of twenty-five source repetitions could occur in a factor relationship, adding the maximum possible number from each of the three cases. The count of source repetitions was used as a basis to determine the relative importance of factors and relationships in the cross-case causal network analysis.

A causal waterfall display was then created, where source repetitions were used to separately show the significance and relationships of the independent factors. Figure 16 is the causal waterfall display for the cross-case data. The number appearing at the top of the sub-table for each independent factor is the total repetition count of its relations to

SRTB and the emergent states. The dependent factors in each sub-table are listed below the independent factor in decreasing order of source repetitions. To simplify the display, *only relations having five or more source repetitions are shown*. Of the thirteen sub-relations shown in the cross-case causal waterfall, nine appeared in all three case studies. One sub-relation in the causal waterfall (Work Support Systems → Team Integration) appeared in only one case study (Team Feb).

TEAM COMPOSITION	ORG CONTEXT	TEAM CONTEXT	EMERGENT STATES
55	**43**	**30**	**34**
22 MBR-PERS	13 WORK SYS	18 TASK DSN	18 INTEGRATION
11 CLIMATE	12 CLIMATE		10 COHESION
10 INTEGRATION	10 TEAM EMPWR	**26**	
7 COHESION	6 INTEGRATION	8 EXT LEADER	**33**
		8 CLIMATE	18 CLIMATE
23	**24**	5 INTEGRATION	6 COHESION
15 SKILLS-TEAM	13 INFO SYS		
		24	**21**
19	**11**	14 COACH	19 MENTAL MODEL
8 SKILLS-TASK	0 REWARD SYS		
5 INTEGRATION	6 INTEGRATION	**24**	**18**
	5 CLIMATE	13 STRUCT EMPWR	16 COHESION
16			
13 FLEXIBILITY	**6**		**15**
	0 EDUC SYS		14 TEAM EMPWR
13			
7 SIZE			

Note: showing only relations with 5 or more source repetitions

LEGEND

Source repetitions as independent factor

Source links to SRTB →

Source links to dependent factors →

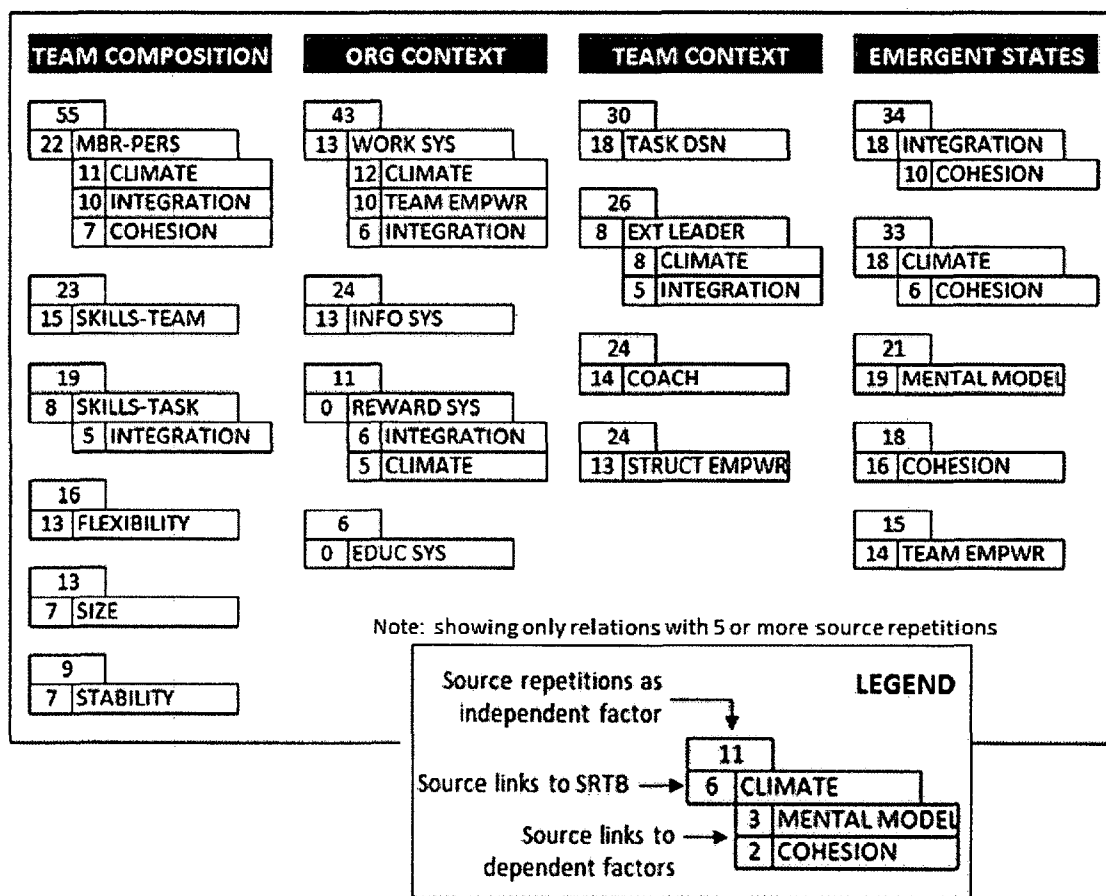| **11**	
6 CLIMATE	
3 MENTAL MODEL	
2 COHESION	

Figure 16. Cross-Case Causal Waterfall Display

The next step in analyzing the combined case study data involved integrating the factors and their relationships into a causal network map shown in Figure 17. The height of each box is proportional to the total number of source repetitions for that factor's relation to SRTB. The two numbers associated with each box indicate the number of

source repetitions found to relate that factor to SRTB and emergent states respectively. The arrow weights are proportional to the number of source repetitions found between a factor and an emergent state. To simplify the cross-case causal network map, *relations having fewer than eight source repetitions are not shown*. All relations shown in the cross-case causal network map were reported by at least one source in each case study.
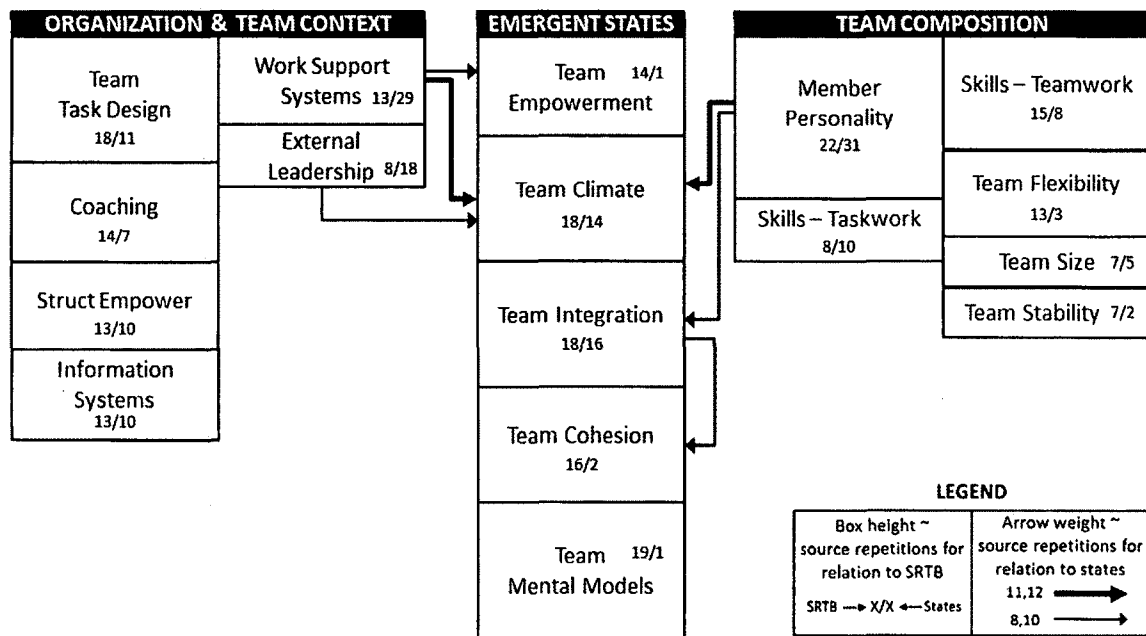

Figure 17. Cross-Case Causal Network Map

The causal network map for the aggregated case study data provides a visual indication of the overall relative influence of factors, ranging from member personality and work support systems with the highest total number of source repetitions to team stability with the least. The organizational context factors reward systems and education systems are not shown in the causal network map due to their low source repetition.

The cross-case causal network map provides a comprehensive view of the influence of factors on SRTB and relationships to emergent states but it does not show how the key factors and relationships compare across the three work teams. This is addressed in the next two figures. Figure 18 shows standardized bar graphs of the direct influence of factors on SRTB, represented by the percent of maximum sources reporting

the influence from each of the three cases (ten for Team Jun, five for Team Sep, ten for Team Feb). The literal case studies are represented as solid bars.
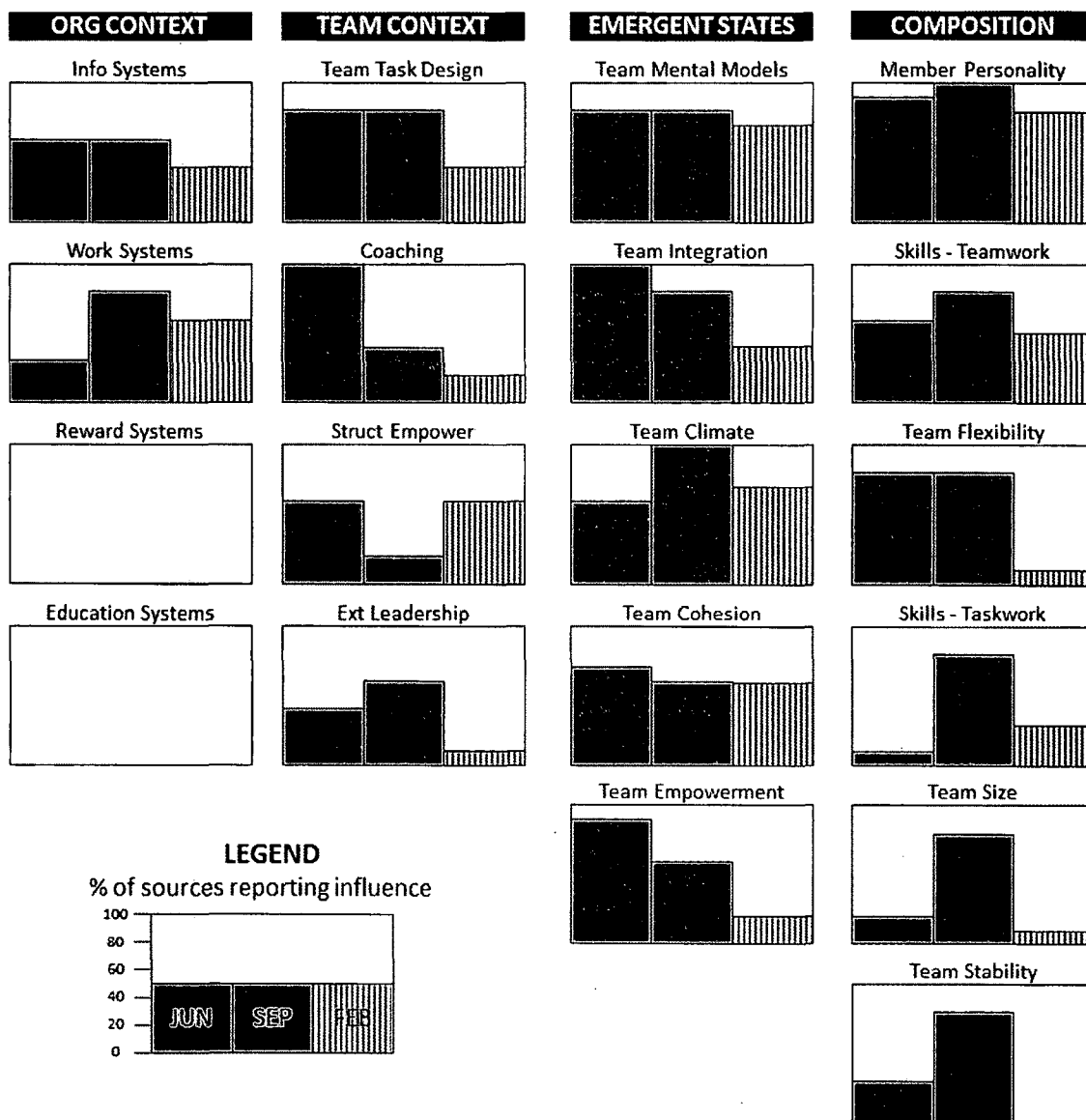

Figure 18. Cross-Case Standardized Bar Graphs for Direct SRTB Influence

Figure 19 similarly shows standardized bar graphs of the influence from factors on the team emergent states, again represented by the percent of maximum sources reporting the influence. In the standardized relations graphs, only relations where at least half of any case study's sources reported the relationship are shown. The standardized bar

graphs shown here bring to light the similarities and differences between the work teams. The reasons for those similarities and differences are discussed in the following Section 7.2 Cross-Case Analysis.
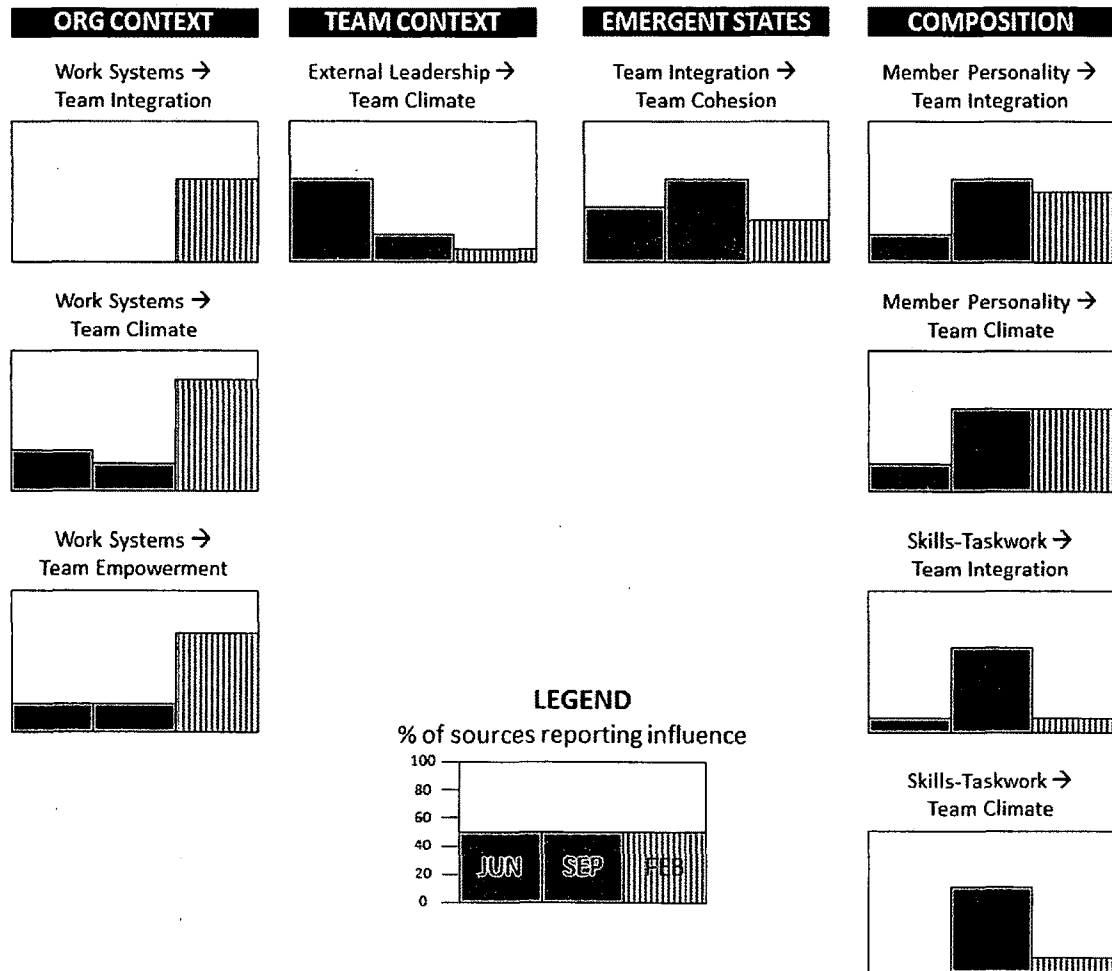

Figure 19. Cross-Case Standardized Bar Graphs for Influence on Emergent States

7.2 Cross-Case Analysis

Overall, the idea behind a cross-case analysis is to force investigators to go beyond the initial impressions imposed from the individual cases (Eisenhardt, 1989). The causal network map for the combined case study data brings to the surface what factors and relations are common among the work groups involved in the research. However, a more complete understanding of why certain factors and relationships influence a

phenomenon (in this case SRTB) may be obtained by examining the data in the light of differences between the context and history of the work groups (Meredith, 1998). The first tactic used for the cross-case analysis was to look for within-group similarities in the literal replicates (Team Jun and Team Sep) and how they were different from the theoretical replicate (Team Feb). The second tactic was to examine pairs of cases, identifying the similarities and differences between them.

Using these tactics along with the causal network maps, the following principal patterns emerged from the cross-case analysis:

1) Among the Team Composition factors, member personality (in particular the traits conscientiousness and agreeableness) appeared to be a very significant influence on generating SRTB in all three work teams. Member personality also appeared to influence team climate and team integration across all three teams.

2) Among the Organizational Context factors, work support systems appeared to influence SRTB in all three work teams but much more significantly in the theoretical case replicate's (Team Feb) generation of those behaviors. Work support systems also appeared to influence team empowerment, team climate, and team integration.

3) Among the Team Context factors, external leadership appeared to influence the generation of SRTB in the literal case replicates (Team Jun & Team Sep) with a link to team empowerment and team climate.

In addition to those principal patterns of influence from context and composition on SRTB, several other important factor relations emerged from the cross-case analysis. The following sections of this chapter explain why the key factors and relationships identified from the cross-case analysis should influence SRTB in LVHC production work teams. As was explained in Section 1.1 Background of the Problem, three distinguishing features are present in the taskwork of a LVHC production work team:

- The fundamental work cycle for taskwork is long, usually measured in days

- The scope and complexity of the taskwork are high

- The pace of taskwork is controlled by people and not technology

The case study work teams are compared to each other with respect to these distinguishing features of LVHC taskwork in Table 16.

Table 16. Case Study Work Teams Compared by LVHC Taskwork Features

	Work Team		
LVHC Taskwork Features	**JUN**	**SEP**	**FEB**
Fundamental work cycle	3 days	10 days	2 days
Taskwork scope/complexity	highest	high	low
Taskwork pace control	coached	individual	individual

7.2.1 Team Composition

This section presents the cross-case analysis for the team composition category of factors. The analysis revealed that member personality, member taskwork skills, and team size should influence the generation of SRTB in LVHC production work teams. In addition, the analysis also suggests that member teamwork skills, team flexibility, and team stability should influence LVHC production work teams to further develop SRTB.

7.2.1.1 Member Personality

Among all factors included in the research, member personality had the highest number of source repetitions citing an influence on SRTB and the emergent states and it appeared to be equally important across all three case studies. Member personality accounted for 14% of the entire combined-case data set as an independent variable with 22 of the possible 25 sources reporting it to influence SRTB. Among the personality traits included in the five-factor model, conscientiousness and agreeableness where overwhelmingly assigned to account for the influence as shown in Table 17.

Table 17. Cross-Case Personality Relations to SRTB and Emergent States

PERSONALITY TRAITS

	O	C	E	A	N
SRTB	3	28	4	28	5
Team Climate	2	4	1	9	1
Team Integration	0	5		10	3
Team Cohesion		5	1	6	
Totals	5	42	6	53	9

Personality determines a team member's level of productivity, manner of behavior, and attitude toward the team and it has been used in conceptual models as a measurable variable to predict team effectiveness (Ross, Jones, & Adams, 2008). The specific personality traits conscientiousness and agreeableness have been shown to predict teamwork behaviors such as SRTB (King et al, 1995; Morgeson et al., 2005; Organ & Ryan, 1995; Porter et al, 2003).

Several mechanisms for the predictive relationship between the personality trait conscientiousness and teamwork behaviors have been proposed. Commonly associated with efficiency, organization, reliability, and thoroughness, conscientiousness is a personality trait that may be an important predictor of teamwork behaviors because it provides the organization and direction necessary to achieve a team's work goals (King et al., 1995). In highly interdependent teams where individual contributions are essential to overall team success, conscientious individuals are likely to be willing to perform multiple roles, perform their roles with a minimum of oversight, avoid social loafing, and engage in greater cooperative behavior (Morgeson et al., 2005).

Referring to the central research question, SRTB can be accomplished in LVHC production work teams by having a composition of members with a high degree of conscientiousness. Because the work cycle for taskwork is long, conscientious members will more likely engage in setting goals, making plans, monitoring performance, and monitoring systems to avoid uncertainty in progress toward reaching their goals. Since the scope of the team's taskwork is large, conscientious members will more likely be willing to expand their skills and perform multiple roles. Given that the pace of taskwork

is not controlled by technology, conscientious members will more likely drive themselves and other team members to *"stay busy"* and avoid having schedule goals creep up on them.

Mechanisms for the predictive relationship between the personality trait agreeableness and teamwork behaviors have also been proposed. Commonly associated with selflessness, cooperativeness, helpfulness, and flexibility (Digman, 1990), agreeable individuals are more likely to work cooperatively (as opposed to competitively), better able to resolve intra-team conflict, and simply be more likable leading to increased team cohesion (Morgeson et al., 2005).

Referring to the central research question, SRTB can be accomplished in LVHC production work teams by having a composition of members with a high degree of agreeableness. Because the scope of the team's taskwork is large, agreeable members will more likely be willing to cooperate on tasks, exchange task-related information with other members, be receptive of performance monitoring from other members, provide backup behaviors, and work collaboratively to solve the team's problems.

7.2.1.2 Other Composition Factors

Other team composition factors also appeared to influence SRTB in each of the case study work teams. Among them, *member skills for teamwork* and *team flexibility* were both reported to influence the development of SRTB in the literal replicates, Team Jun and Team Sep. In Team Feb, member teamwork skills were only reported to influence SRTB among members working in the same sequence, not the entire group. Additionally, only the supervisor from the Team Feb case study reported team flexibility as an influence on SRTB. Therefore, it does not appear that member skills for teamwork and team flexibility are generative mechanisms for SRTB but instead are beneficial for their continued development.

It stands to reason that member personality influences these composition factors, since conscientious and agreeable members will be more likely to develop their teamwork skills and increase the flexibility of the team by accepting multiple roles. Because the scope of a LVHC team's task is large, there is significant opportunity for

members to manage the component and coordinative complexity by adopting SRTB. Thus, SRTB can be further developed in LVHC production work teams by having a task-flexible composition of members that have skills for teamwork. These team features may develop from conscientious and agreeable members.

Member skills for taskwork appeared to influence the generation of SRTB and emergent states in each of the case study teams. In particular, references to the efficiency of members and their quality of work were made regarding the development of a climate of excellence within the team and trust/respect among members for inclusion into the team. As the pace of taskwork is controlled by people in LVHC work teams, members that are trusted and respected for their speed in accomplishing tasks will more likely be accepted among the other members, promoting team integration and subsequently cohesion. Since the complexity of a LVHC team is high, a composition of members that can perform high quality and dependable work will more likely promote a climate of excellence within the team. Therefore, SRTB should be generated in LVHC production work teams having a composition of members that are trusted and respected for their taskwork skills by other members of the team.

Team size had a low source-repetition count for influencing SRTB from each of the case studies. However, in both of the literal cases references were made to a reduction in team size as enabling the generation of SRTB to facilitate planning and coordination. A few members in Team Feb pointed to the need for an additional member to be added to the team in order to have the time to participate in backup behaviors. The large scope of taskwork in LVHC work teams could cause members to think of their team as being too small to engage in adjustment behaviors while taking care of their own roles. On the other hand, the person-controlled pace of taskwork may influence members' perception that the team is too large if they observe social loafing within the team. Therefore, and as prior studies on the effect of team size on team performance and member attitudes have shown, the *right* size is likely what matters to the team for generating SRTB (Campion et al., 1993; Campion et al., 1996; Duimering & Robinson; 2007; Hackman & Vidmar, 1970; Langfred, 2000; LePine et al., 2008; O'Connell et al., 2002; Tata & Prasad, 2004; Wageman, 2001).

Team stability also had a low source-repetition count for influencing SRTB from each of the case studies. Reference to this feature of team composition was essentially nonexistent in the Team Feb case study, suggesting that it was not important for the generation of SRTB in their team. However, evidence from the literal case studies pointed toward *"keeping team members together"* important to further develop SRTB. The stability of team membership influences the development of a team's mental model. Turnover in membership puts a burden on existing members because they have to dedicate time to orient new members to the technical requirements of the job and to the way the team works together, something that may have seemed to occur naturally under prior membership (Cohen, 1993). The scope and complexity in LVHC taskwork is likely to concern members that turnover will negatively impact their productivity. Thus, SRTB can be developed in LVHC production work teams by keeping the membership stable.

7.2.2 Organizational Context

This section presents the cross-case analysis for the organizational context category of factors. The analysis revealed that work support systems and information systems should influence the generation of SRTB in LVHC production work teams. The analysis did not indicate that reward systems or education systems should have a substantial influence on LVHC production work teams adopting SRTB.

7.2.2.1 Work Support Systems

Among all factors included in the research, work support systems had the second highest number of source repetitions citing an influence on SRTB and the emergent states. However, it was not reported equally across the three case studies. The majority of data involving work support systems came from the theoretical replicate, Team Feb. Accounting for 10% of the entire combined-case data set as an independent variable with 13 of the 25 possible sources reporting it to influence SRTB, 6 of those came from the Team Feb case study. Furthermore, the links between work support systems and the emergent states team empowerment and team climate shown in the cross-case causal network map are primarily (though not entirely) due to data from Team Feb.

Additionally, the Team Feb data showed a linked between work support systems and team integration with 6 of a possible 10 source repetitions whereas the literal case studies showed no link.

The reason this organizational context factor appeared to heavily influence Team Feb (theoretical replicate demonstrating little SRTB) and not the other cases may be attributed to their perception that it prevents them from beginning to use SRTB. Team boundary control, a current and major concern for the Team Feb members, did not appear to be a relevant issue for the literal replicates. No external members were reported to ever work in Team Jun or Team Sep and they seemed to have a high degree of differentiation and external integration. The literal case replicates also spoke of managerial support (such as providing material resources) causing problems from a historical context or just as a current and minor issue of annoyance. For example from Team Jun, *"Not having material used to be an issue, but ever since the 5S and supermarket for bags was put in place that's not been a problem."* Or ironically, citing material shortages as something that forced them to work on their self-regulating teamwork skills the lead for Team Sep said, *"Something that probably made us get better at coordinating our work was not having some parts available to work with. It causes us to work out plans and do things we don't normally do."*

The cross-case analysis and evidence from prior research presented in the within-case analysis for Team Feb, points to work support systems as being an influence on the generation of SRTB. Furthermore, a negative influence of work support systems also seems to have the potential to further develop work preparation and team adjustment behaviors in teams already having established SRTB, as long as the team has internal leadership from a conscientious member (the members and supervisor overwhelming reported Team Sep's internal leader as being conscientious). As one of Team Sep's members said, *"Our lead takes care of us. We've never had a problem yet that our lead hasn't helped us solve."*

The influence from work support systems such as managerial support and team boundary control is relevant to LVHC production teams generating work preparation and collaborative behaviors. Because the scope of the team's taskwork is usually large, an

adequate supply of resources provides a sense of confidence that engaging in work preparation behaviors will result in achieving their goals. Simply having material resources will allow them to coordinate and cooperate on their complex work activities. Also due to the scope and complexity of their taskwork, members will feel empowered to engage in work preparation and collaborative behaviors if their team boundaries are well-defined. Thus, work support systems also have a generative effect on team empowerment.

7.2.2.2 Information Systems

Information systems was also found to be a key factor for generating SRTB in Team Feb whereas it seemed to have less importance for the literal replicates. Several members of Team Feb referred to needing more frequent feedback from management on labor performance in order to engage in work assessment and team adjustment behaviors (such as innovation and collaborative problem solving to reduce HPUs). For Team Jun, an information system tool called the IOP board was cited by several members as one of the factors allowing them to begin using self-regulating work preparation and collaborative behaviors. In fact, some members on Team Jun thought that with that tool in place there was no longer a need for an hourly-lead on their team. The members of Team Sep acknowledged an earlier importance of their HPU charts for generating work assessment and team adjustment behaviors because *"When you're working on an operation that takes 80 hours to complete it's easy to lose track of where we are"* but also commented that they were *"no longer useful"* since they had significantly improved their labor performance.

Thus, the cross-case analysis indicates that information systems is a factor in the organizational context that is more generative than developmental for SRTB in LVHC work teams. Because the fundamental work cycle is long in the LVHC context, it is difficult for work teams to have a sense of progress toward meeting their schedule and cost goals. Therefore, LVHC work teams will be more likely to engage in the full range of SRTB when management provides information systems to assist with planning and

managing their performance. As a team becomes more established in self-regulating teamwork behaviors, the original utility of the information systems may decrease.

7.2.3 Team Context

This section presents the cross-case analysis for the team context category of factors. When the case study data were aggregated for the cross-case analysis, the factors included in the team context category appeared to share nearly equal weighting from the viewpoint of source repetitions that cited an influence on SRTB and team emergent states. However, when examining pairs of cases the team context factors did not seem to have an equal importance to the different work teams. The cross-case analysis revealed that the empowerment structure, person-focused external leadership, motivational coaching, and team task design should influence the generation of SRTB in LVHC production work teams. In addition, the analysis also suggests that boundary spanning from external leadership and coaching to perform consultative and educational functions should influence LVHC production work teams to further develop SRTB.

7.2.3.1 External Leadership

External leadership appeared as a very large influence on SRTB and team climate in the Team Jun (literal replicate) case study. The team's current supervisor was assigned to the team at a time when member conflict was occurring and the supervisor was attributed to having influenced the generation of SRTB in the team by managing their composition (e.g. controlling membership) and setting clear and high expectations. In addition, Team Jun members also credited their supervisor for influencing the team's climate (excellence for taskwork, support for innovation, and participative safety) as well as team integration (team identity).

The role of the most recent supervisor as an external leader of Team Jun corresponds to what was called "setting the stage" by Hackman (2002). Setting the stage involves leaders of self-managing teams working to ensure that a team has three essential conditions, that when present, can generate self-managed teamwork behaviors (Wageman, 2001). The first is making sure the team is a *real team*. By that, the leader

must ensure that the team is stable and bounded with clear membership, including preventing the presence of toxic members from undermining other team members. The second essential condition is a *clear and compelling direction* that will motivate the team to work together. The third is an *enabling team structure* that includes such features as being the right size, skill diversity, and task interdependence. Several examples of evidence from the Team Jun case study support that their supervisor behaved in this manner. Thus, the influence of external leadership on Team Jun's SRTB appears to have been generative.

Team Sep, the other literal replicate, reported external leadership to influence their SRTB but in a different manner and to a lesser extent than what Team Jun reported. Many references to external leadership, including those from the supervisor, involved a *"backing out"* by the supervisor that allowed the team to engage in SRTB. *"I think we started making our own work goals and plans when our supervisor just started leaving it up to us, not taking as much effort to supervise us. When our supervisor got less involved we just worked out our own plans. When they saw that our plans worked out, they got even less involved and trusted us more."* This behavior of the supervisor resulted in psychological empowerment of the team, which may have also supported the emergent leadership capacity of the team. Emergent leadership is internal leadership provided by one or more members of a team that emerges from teams as a function of working on and accomplishing shared work. (Day, Gronn, & Salas, 2004). According to Team Sep's supervisor, *"LATech is definitely recognized, by the other team members and the organization, as the leader of this team ... a very good mechanic and has the team's respect."* According to LATech, *"At one time our supervisor did have more input and eyes on, but I can really see our supervisor backing out... trusts us, respects our abilities, and expects us to do it on our own."* The influence of external leadership on Team Sep appears to have generated SRTB through psychological empowerment.

Team Sep's supervisor was also performing a role of *boundary spanning* for the team that was enabling them to further develop SRTB. Thought to be fundamental for success in the role as an external leader of self-managed work teams, boundary spanning is when an external leader takes the position of a link between the team and the

organization to supply the team with resources for support (Druskat & Wheeler, 2003). According to LATech, their supervisor performed this role after they had begun to use SRTB. *"The supervisor would still chase parts for us if we needed them and work with the resources outside our team to make sure we were going to get what we needed when we needed it. Our supervisor did for us the things we couldn't do because we didn't have any authority over other work groups and ... also had an overall view of the process that we didn't have."* Thus, external leadership appears as well to have contributed to further developing SRTB in Team Feb by providing boundary spanning.

From the theoretical case replicate however, reports of influence from external leadership on the ability of Team Feb to engage in SRTB were practically nonexistent (only one of 10 sources reported an influence on SRTB, the researcher's observation). The reason for this paucity may be explained from two facts. Firstly, Team Feb's supervisor had only been with the team for approximately three months prior to the case study. As such, the members may not have had sufficient experience with their current supervisor to suggest external leadership as a factor influencing SRTB. Secondly, Team Feb had experienced several rotations of supervisors over the past two years (five different supervisors including their current one). Similarly, the turnover in supervision may have made it difficult to formulate opinions about the impact of external leadership on SRTB other than as one member said *"Part of the problem is having all the different supervisors over the past couple of years."*

The absence of supervisor stability may also be a reason for Team Feb's substantial reports of factors in the organizational context affecting their engagement in SRTB. First-level management is the critical link between a work team and the wider organization, determining the level of support received from the organization (Cummings, 1978). Based on the evidence from the cross-case analysis, external leadership appears to influence both the generation and development of SRTB in LVHC production work teams.

7.2.3.2 Coaching

The data from the aggregated case studies indicate that the team coaching factor primarily influences SRTB and not emergent states. This finding is consistent with a theory of coaching proposed by Hackman and Wageman (2005), stating three functions of coaching that specifically address a team's processes and behaviors for task performance and not members' interpersonal relationships. Hackman and Wagemen (2005) suggest that team effectiveness is a function of the level of effort group members expend in their taskwork, the performance strategies the group uses to accomplish its work, and the knowledge and skill members have for the taskwork. In line with these performance criteria, they propose that motivational coaching addresses effort, consultative coaching addresses performance strategy, and educational coaching addresses the knowledge and skills of team members.

The largest influence from coaching behaviors among the case studies was reported by Team Jun. The role of the salary technician in the group, LSTech, was even referred to as coaching. *"At any given time, I can look at the work in process and know exactly what position someone is in. That helps with backing up and knowing what to provide coaching for."* The relationship between Team Feb's supervisor and LSTech may have supported the capacity to provide coaching to the team, *"The supervisor takes care of the people side and I take care of the technical side."* As was explained in Section 4.2.4 Coaching, the Team Jun sources primarily cited motivational coaching as supporting the generation of their SRTB and consultative and educational coaching supporting its further development. This finding agrees with that of Hackman and Wageman (2005), in that motivational coaching interventions are more appropriate at the beginning of a work team's life cycle while consultative and educational coaching are more appropriate during the midpoint and ending phases of the cycle.

Why coaching appeared to be a larger influence on Team Jun than the other work teams may be attributed to two of the three distinguishing features of the LVHC context. Firstly, Team Jun's taskwork scope and complexity was larger than that of the other work teams making the consultative and educational coaching functions more relevant.

Secondly, the larger taskwork scope combined with the team members' control over the pace of taskwork made the motivational function of coaching more relevant.

Less influence from coaching was found from the Team Sep case study, in fact no evidence for motivational coaching was discovered. The absence of motivational coaching in Team Sep may be due to the lower level of the team's taskwork scope (compared to Team Jun) or to a high concentration of conscientious members on the team. Thus, the motivational function of coaching for LVHC work teams may be contingent on the team's task design and member personality profile. Alternatively, even though Team Sep reported to begin using SRTB only within the past couple of years, their degree of engagement in SRTB was high and the members had been together for quite some time. Therefore, since they were well beyond the beginning phase of their life cycle at the time of the case study motivational coaching may not have been necessary.

Practically no evidence from coaching was found from the Team Feb case study, except for some observed within-sequence coaching (only consultative and educational) and reports of receiving prior consultative coaching from one of the LSS group members during the lean intervention occurring in 2012. Several of the Team Feb members said there was less frustration with the job when the LSS group was involved in helping them setup their pull system and *"everything seemed to click"*, partially crediting that to the consultative coaching received from one of the LSS group members. As one member put it, *"It was like the cavalry had rode in."*

A lack of coaching in Team Feb may come from different reasons. According to the supervisor, the team has not been receptive to the supervisor's attempts at providing coaching to expand SRTB across the different work sequences, *"I've tried, but it had a lot of negative impact and it hasn't been successful. The culture I walked into is not willing to change. Their mentality toward other members is 'You do your job and I'll do mine.'"* Another could be that even though the team has three hourly-leads, none seemed to acknowledge they have the authority and responsibility to provide coaching to members beyond their assigned position in the work sequences. Still yet, another reason could be that the hourly-leads feel such pressure to manage their own sequence they cannot afford to leave it. Several examples of these reasons were provided by Team Feb's

supervisor and hourly-leads. Regardless of the reason, an absence of motivational coaching to extend teamwork behaviors in Team Feb beyond the individual work sequences appears to have influenced their generation of SRTB.

Results of the cross-case analysis suggest that coaching serves both generative and developmental purposes for SRTB in LVHC work teams. In addition, the motivational function of coaching appears to specifically influence work preparation and task-related collaborative behaviors. Table 18 shows the counts of source repetitions (from the aggregated case study data) reporting an influence of coaching on the phases of SRTB, categorized by coaching function. These data suggest that to first generate SRTB coaching should be motivational and directed specifically toward achieving work preparation and task-related collaborative behaviors. The data also suggest that consultative and educational coaching may be more appropriate to develop the work assessment and team adjustment phases of SRTB.

Table 18. Cross-Case Coaching Relations to SRTB

| | Coaching | Cross-Case SRTB | | | |
		Prep	Collab	Assess	Adjust
Gen	Motivational	5	7		
Dev	Consultative Educational	1	7	4	7

Because the pace of taskwork is controlled by team members and not technology, LVHC teams receiving motivational coaching will more likely generate self-regulating behaviors for task-related collaboration and backup behaviors. Because the work cycle is long and the scope and complexity of taskwork is large, LVHC teams receiving consultative and educational coaching will more likely further develop self-regulating behaviors for task-related collaboration, work assessment, and team adjustment.

7.2.3.3 Structural Empowerment

Structural empowerment involves the organizational practice of delegating authority and responsibility to employees intended to grant a team with the responsibility to self-manage their work assignments, work methods, and scheduling of activities (Cohen et al, 1996; Greasley, 2008; Mathieu et al., 2008). The data from the aggregated case studies indicate that the influence structural empowerment can have on SRTB may depend on the degree of interdependency of the team members and the team size.

The largest influence from structural empowerment on SRTB was found from the Team Jun case study, as it was with coaching, perhaps because the majority of coaching was being provided by a salary technician as part of the structural empowerment strategy. Several other reasons however may be given to why the issue of structural empowerment was more prevalent in the Team Jun case study. Another salary technician was also assigned to the team for the purpose of running specialized equipment. Consequently, Team Feb contained a mix of salary and hourly personnel whereas the other work teams did not. The task interdependency of Team Jun was higher than that of the other work teams, possibly leading members to view a need for structural empowerment as more important. In addition, one of the reasons cited by both the supervisor and members for the generation of SRTB in Team Jun was a formal assignment of one of the hourly members as a lead. Most comments referring to the structural empowerment of Team Jun regarded a generative influence on SRTB.

Compared to Team Jun, Team Feb had a high ratio of hourly-leads to members yet it seemed to have realized the least structural empowerment of all three work teams. Only the Team Feb supervisor made a reference to the ratio of hourly-leads to members being too high. Within the team, there appeared to be ambiguity and mixed expectations regarding the roles for the hourly-leads. Each hourly-lead reported on multiple occasions that they did not have time to fulfill their lead roles because of the responsibility they had in their own work sequence. Out of frustration, one of the hourly-leads said they had recently asked the supervisor to take the *"lead pay"* away from them as they were *"...fed up in dealing with it. When I try to give direction the others will say 'I don't work for you.'"*

Aside from reports of having unclear and conflicting role expectations for the leads, another possible explanation for why there seemed to be less structural empowerment in Team Feb than the other work teams is that they also had the least amount of task interdependency. Having less need to interact in their taskwork, the necessity of an enabling team structure may not have seemed as important to the members as other factors did.

In the Team Sep case study, the matter of structural empowerment seemed to revolve around the absence of competition for the position of *"head honcho"* as one member put it. The team members reported that once that competition disappeared (from reduced team size) it enabled their current hourly-lead to effectively provide direction for generating SRTB. Even though competition for the hourly-lead position may have been a significant issue for the team, among the factors reported to influence their engagement in SRTB structural empowerment was the least emphasized. The factors reported to have the most influence on Team Sep involved member composition. As Team Sep was the smallest team involved in the research, having a clearly defined empowerment structure may not have carried as much weight with the members as other factors did.

Results of the cross-case analysis suggest that structural empowerment can support the generation of SRTB in LVHC work teams, although the effect may depend on the degree of task interdependency and the team size. Due to the scope and complexity of taskwork normally found in LVHC work teams, larger teams with high task interdependency will more likely generate SRTB for work preparation and collaboration when provided with an adequate empowerment structure.

7.2.3.4 Team Task Design

From the aggregated case study data, team task design was among the factors showing the highest source repetitions for a relation to SRTB. In terms of overall influence on SRTB, the relation from team task design was similarly reported by each of the three case studies. However, influence from the different features of team task design was not reported by the work teams equally. Based on source repetition counts, Team Jun reported more influence from task routineness and Team Feb reported more from task

interdependency. Table 19 shows the count of source repetitions (from the aggregated case study data) reporting an influence from team task design on the phases of SRTB, categorized by the most frequently reported task design features. These data suggest that task interdependency is more influential on collaborative behaviors while task routineness more likely influences work preparation and team adjustment behaviors.

Table 19. Cross-Case Task Design Relations to SRTB

TASK DESIGN	SRTB			
	Prep	Collab	Assess	Adjust
Interdependency	2	9	1	2
Task Autonomy	1	2	2	3
Task Feedback	2		2	3
Task Routineness	5		1	9

Task routineness determines the variability of task demands on a work team. Highly routine taskwork involves predictable situations that can be addressed using standardized procedures whereas non-routine taskwork involves frequently changing requirements that bring about more unique actions. Rousseau and Aube (2010) propose that teams working in less routine environments are more likely to adopt SRTB than those that work under more routine circumstances. They reason that because ambiguity exists in how to accomplish non-routine tasks, where several alternative courses of actions may often be present, teams will be motivated to engage in SRTB to successfully complete them. Thus, task routineness may serve as a generative mechanism for SRTB in LVHC work teams since the taskwork normally has a large scope with greater opportunity for non-routine situations.

Routineness was the most frequently cited and observed task design feature influencing the generation of SRTB in Team Jun, both from a limiting and opportunistic perspective. The team was spatially separated and the taskwork in the different areas appeared to differ in routineness. Members involved in the more non-routine taskwork

appeared to be more engaged in SRTB while those that had more routine tasks did not. Problems associated with undependable raw materials, defects caused within the team's taskwork, and unreliable equipment were reported and observed to bring on new self-regulating behaviors directed by the team's co-leads. On the other hand, the task demands on some members did not change very often and seemed to be free of problems that would motivate them to engage in self-regulating teamwork behaviors. The work preparation and team adjustment phases of SRTB were heavily influenced by task routineness.

The task interdependency of Team Jun was the highest of the three teams. Although not receiving as many source repetitions for overall influence on SRTB, interdependency was cited and observed to be the primary task design feature influencing coordination, cooperation, and information exchange among the members of Team Jun. An interesting finding from the Team Jun case study is that members associated with the higher reciprocal task interdependency reported higher routineness of their taskwork. The higher routineness of that group's taskwork could be associated with their early position in the product's value stream. Alternatively, the use of SRTB in this highly interdependent group could impact the task's routineness as their behaviors such as planning, coordination, and information exchange may reduce the variability on their task demands.

Interdependency was the task design feature most often cited and observed to influence the generation of SRTB in Team Feb. As can plainly be seen by comparing the workflow dependency diagrams of Appendices D-F, Team Feb had the lowest task interdependency of the three work teams. Due to the assignments for Team Feb members to work only certain sequences, on the whole the task interdependency was pooled with some sequential interdependency between a few members. According to the team's supervisor, *"Each person is assigned to work a sequence, that's what they want to work and they won't change. I've tried to work on cross-training but they resist that."* Each member of Team Feb cited and was observed to possess a high degree of individual autonomy over their work sequence. Task interdependency is a design feature of teamwork that is a matter of choice; the degree of it can be established and controlled by

the team's external leadership (Cummings, 1978; Hackman, 1987; Shea & Guzzo, 1987; Wageman, 2001). A possible reason for a lack of engagement in SRTB by Team Feb is a reluctance of members to accept an increased level of task interdependence because it would require them to relinquish some of their individual autonomy. According to the research of Langfred (2005), teams with high team-level autonomy but low individual-level autonomy outperform those that have the opposite, as long as the task interdependency is high.

The task routineness for Team Feb was also observed and cited to be high. As their supervisor stated, *"I don't see any real technical problems this group has to deal with, it's a routine job done the same day in and day out."* Thus, the high routineness of taskwork and the low task interdependency are likely key reasons for why SRTB has not been generated in Team Feb as it has been in the other work teams.

Team Sep did not report a particular feature of team task design to be more influential on their SRTB. However, statements from the members and direct observation identified how certain task design features influenced the generation of the different phases of SRTB. Their task autonomy lead them to use work preparation behaviors, their task interdependency pushed them to use collaborative behaviors, their task feedback drove them to use work assessment behaviors, and the task routineness motivated them to use team adjustment behaviors.

The cross-case analysis indicates that team task design is a generative factor for SRTB in LVHC work teams. In particular, higher task interdependency, lower task routineness, higher team-level autonomy (opposed to individual autonomy), and higher task feedback appear to predict a LVHC work team's engagement in SRTB. Since the pace of taskwork is controlled by the members, higher *team-level autonomy* should influence the team to use team-based work preparation behaviors such as goal setting and planning. Because the scope of taskwork is large, higher *task interdependency* should motivate LVHC work teams to engage in task-related collaborative behaviors such as coordination, cooperation, and information exchange. Because the fundamental work cycle is long, receiving *task feedback* should motivate LVHC work teams to adopt work assessment behaviors such as performance monitoring and systems monitoring. Also

because the task scope is large, low *task routineness* is likely to influence LVHC teams to engage in adjustment behaviors such as backing up other members, collaboratively solving problems, and innovating on their team practices.

7.3 Answers to Central Research Question

The central research question was *how can self-regulating teamwork behaviors be accomplished in LVHC production work teams?* Based on the cross-case analysis of the three case studies, SRTB can be accomplished in LVHC production work teams in two stages. The first stage involves generating behaviors for self-regulating teamwork and the second stage involves further developing those behaviors. In order to first generate SRTB, teams relied on certain characteristics of their composition and the influence from their organizational and team context to achieve motivational, attitudinal, and cognitive states that emerged from their experiences of working together. Once teams were able to generate SRTB they were then in the position of reaching a more advanced stage where they continued to develop those behaviors. The development of SRTB during this second stage required a higher level of sophistication in emergent states which were influenced by different factors in the teams' composition and context. Figure 20 shows which factors appear to be primarily involved in the generation and development of SRTB.
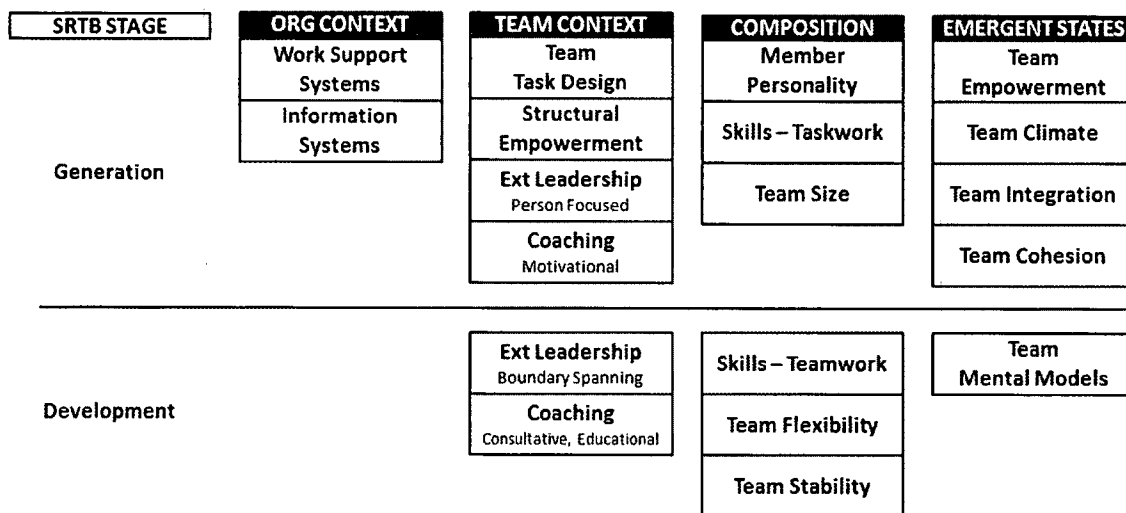
SRTB STAGE	ORG CONTEXT	TEAM CONTEXT	COMPOSITION	EMERGENT STATES
Generation	Work Support Systems	Team Task Design	Member Personality	Team Empowerment
	Information Systems	Structural Empowerment	Skills – Taskwork	Team Climate
		Ext Leadership Person Focused	Team Size	Team Integration
		Coaching Motivational		Team Cohesion
Development		Ext Leadership Boundary Spanning	Skills – Teamwork	Team Mental Models
		Coaching Consultative, Educational	Team Flexibility	
			Team Stability	

Figure 20. Factors Driving SRTB Generation and Development

Organizational context factors were found important in the generation stage but teams did not seem to rely on them as much to further development SRTB. Work support systems and information systems drove teams to adopt SRTB mostly through their influence on the emergent states team empowerment and team climate. No organizational context factors were found to be important drivers of the development stage of SRTB.

A number of team context factors appeared to be instrumental to the generation of SRTB. Those included team task design, structural empowerment, a person-focused style of external leadership, and motivational coaching. External leadership primarily drove teams to adopt SRTB by influencing team empowerment and team climate. The further development of those behaviors relied on different coaching functions (consultative and educational) and also on boundary spanning provided by external leadership.

Certain factors of team composition appeared to influence teams to generate SRTB while others appeared to influence them to continue developing SRTB. During the generative stage, teams relied on the personalities of members, trust and respect for taskwork skills, and their perception of the team being sized appropriately in order to adopt SRTB. Member personality, in a particular the traits conscientiousness and agreeableness, appeared to heavily influenced the teams' climate and integration to begin using SRTB. In order to continue developing SRTB, trust and respect for members' teamwork skills and team stability was necessary to enhance team climate and the integration of members. The degree of team flexibility also influenced SRTB development by maturing team mental models.

Certain emergent states appeared to be antecedent factors for generating SRTB, including team empowerment, team climate, and team integration which subsequently influenced team cohesion. Those states are like a path through which teams achieve the sought for behaviors. Once teams were able to generate SRTB they were in the position of reaching a more mature stage by developing those behaviors. The development of SRTB during this second stage required a higher level of sophistication in the generative emergent states as well as solidifying team mental models.

7.4 Framework and Propositions

Based on the cross-case analysis for this research, separate frameworks for how self-regulating teamwork behaviors can be generated and further developed in LVHC production work teams are proposed. Figure 21 shows the generative model and Figure 22 shows the developmental model. Along with each framework, a set of propositions resulting from the research is also listed. The height of the boxes in each model represents the proportional influence each factor is predicted to have on generating or developing SRTB. The arrows linking factors to emergent states indicate predicted relations that were found to be important from the research. The fact that some factors appear in the generative model but not in the developmental model (and vice versa) does not indicate they are not important for the other stage of SRTB, it just means the research indicated they appear to have more of an influence on the stage of SRTB engagement where they are placed.
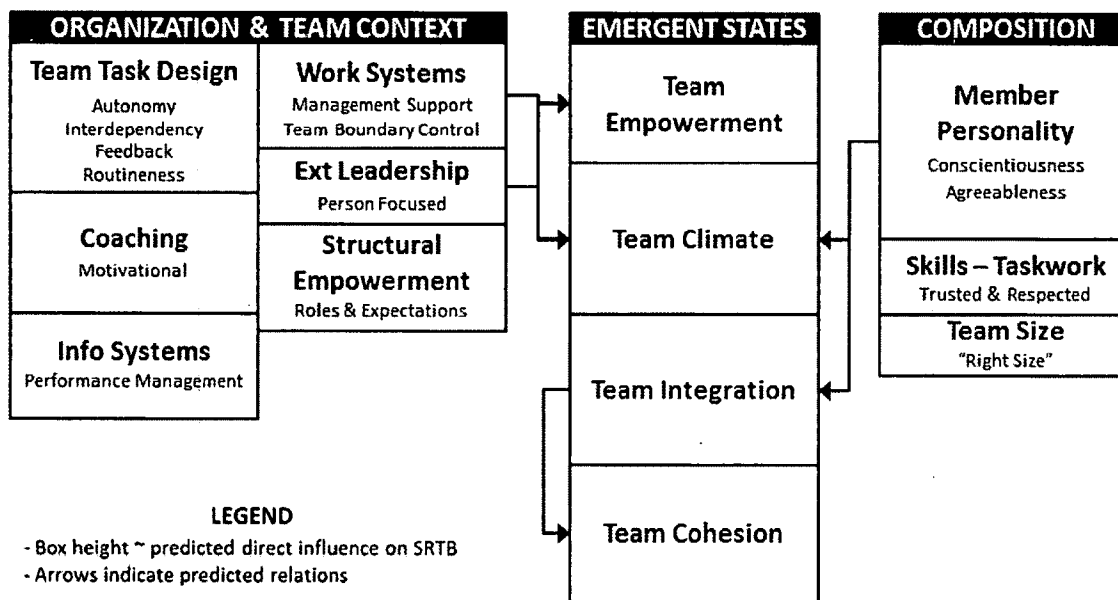

Figure 21. Generative Model for SRTB in LVHC Production Work Teams

The following is a list of propositions for how SRTB can be generated in LVHC production work teams:

1) A team composition of members with high levels of the personality traits conscientiousness and agreeableness should influence LVHC work teams to generate SRTB.

2) A team composition of members with taskwork skills that are trusted and respected by other members should influence LVHC work teams to generate SRTB.

3) A team composition that is perceived as being the right size according to members should influence LVHC work teams to generate SRTB.

4) An organizational context with work support systems that provide satisfactory management support and adequate team boundary control should influence LVHC work teams to generate SRTB.

5) An organizational context with information systems that provide useful performance management tools should influence LVHC work teams to generate SRTB.

6) A team context that provides person-focused external leadership should influence LVHC work teams to generate SRTB.

7) A team context that includes motivational coaching should influence LVHC work teams to generate SRTB.

8) A team context with an appropriate empowerment structure that provides clearly defined member roles and role expectations should influence LVHC work teams to generate SRTB.

9) A team context where the team tasks are designed with high group-level autonomy, high task interdependency, timely task feedback, and low task routineness should influence LVHC work teams to generate SRTB.
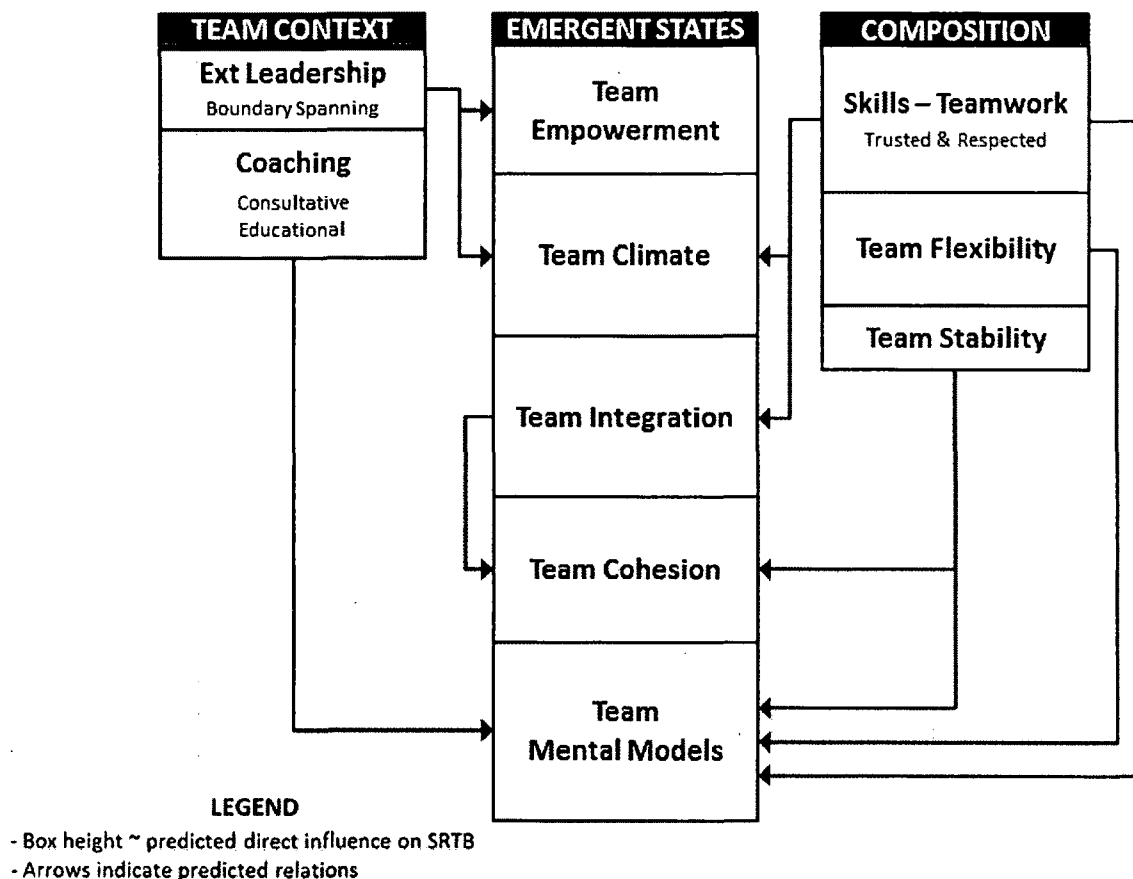
TEAM CONTEXT

Ext Leadership
Boundary Spanning

Coaching
Consultative
Educational

EMERGENT STATES

Team Empowerment

Team Climate

Team Integration

Team Cohesion

Team Mental Models

COMPOSITION

Skills – Teamwork
Trusted & Respected

Team Flexibility

Team Stability

LEGEND
- Box height ~ predicted direct influence on SRTB
- Arrows indicate predicted relations

Figure 22. Developmental Model for SRTB in LVHC Production Work Teams

List of propositions for how SRTB can be developed in LVHC production work teams:

1) A team composition of members with teamwork skills that are trusted and respected by other members should influence LVHC work teams to develop SRTB.

2) A team composition of members flexible in taskwork skills should influence LVHC work teams to develop SRTB.

3) A team composition with stable membership should influence LVHC work teams to develop SRTB.

4) A team context that provides boundary spanning from external leadership should influence LVHC work teams to develop SRTB.

5) A team context that includes consultative and educational coaching should influence LVHC work teams to develop SRTB.

7.5 Rival Propositions

An important strategy for interpreting case study results is to identify and address rival propositions for the findings. In qualitative research, a rival proposition is an alternative explanation for how or why some social phenomenon occurs in its context (Yin, 2009). Regarding this research, a rival proposition is an alternative to those that were presented for how or why SRTB has been accomplished in the literal case replicates (Team Jun and Team Sep) but not in the theoretical case replicate (Team Feb).

The purposeful selection of cases in multiple case study research is the preferred approach for addressing rival propositions because then the findings alone provide evidence to determine their legitimacy (Barratt et al., 2011). Some rival propositions can be refuted due to the purposeful selection of cases in this research. However, other rival propositions that were not addressed by the selection of cases may be credible and should be investigated in future research.

Based on the findings from this research, the following rival propositions do not appear to be plausible:

- A difference in team size caused SRTB to appear in some work teams but not in others. This rival proposition is not plausible because one of the literal replicates and the theoretical replicate had the same team size.

- The gender of team members caused SRTB to appear in some work teams but not in others. This rival proposition is not plausible because all three work teams included a mixed gender.

- The gender of the team's supervisor caused SRTB to appear in some work teams but not in others. This rival proposition is not plausible because the gender of the supervisor for the theoretical replicate was the same as one of the literal replicates.

- A difference in the lean interventions caused SRTB to appear in some work teams but not in others. This rival proposition is not plausible because both the method of facilitation (same LSS group members) and lean practices that were introduced were very similar for all three work teams.

The following rival propositions may be credible and should be investigated in future research:

- The tenure of the team's supervisor caused SRTB to appear in some work teams but not in others. This rival proposition may be plausible because the tenure of the theoretical case replicate (Team Feb) was considerably less than that of the literal case replicates. As one of the hourly-leads for Team Sep pointed out when talking about their ability to further develop SRTB for work preparation, *"Even a change in who's our supervisor could make a difference with that."* The fluidity in supervision experienced by the members of Team Feb may not have presented adequate opportunity for their front-line leadership to influence their structural empowerment and establish supervisor-subordinate relationships to mold a team climate conducive to SRTB. However, as one of the Team Feb members said regarding their supervisor, *"I think our supervisor's really trying, but the older people on our team aren't going to give it a chance because the supervisor's in management, new, and an outsider."* Even though this may be an alternative explanation for why SRTB has not been generated in Team Feb, several other factors supported by source repetition appear to be influential as well.

- The accomplishment of a team's work on different shifts caused SRTB to appear in some work teams but not in others. This rival proposition may be plausible because the work of the theoretical replicate (Team Feb) was accomplished on separate shifts while that of the literal replicates was accomplished on the same shift. One of the members from Team Jun (literal replicate) pointed out how a separate-shift work arrangement can negatively influence team integration (team identity), *"When we had two shifts we didn't communicate. It was like we weren't on the same team."* The members of Team Sep, the other literal replicate, also spoke about how it was more difficult to coordinate their taskwork when a second shift was involved. However several occurrences of SRTB in Team Feb (theoretical replicate), although isolated to the individual work sequences, involved members working on separate shifts.

The previously addressed rival propositions are alternative explanations that arise from features of the actual context or composition of a team. Another type of rival proposition is one that brings to question a bias in the findings from either the participants' input or the researcher's interpretation of their input. One such rival explanation involves a self-serving attribution bias; individuals tend to attribute positive

events to themselves (internal causes) but negative events to external causes (Gioia & Sims, 1985; Mezulis, Abramson, Hyde, & Hankin, 2004). That is, a possible rival explanation for the findings from this research is:

- Members in the literal case replicates erroneously cited internal reasons for their engagement in SRTB (positive event) and members in the theoretical case replicate erroneously cited external reasons for their lack of engagement in SRTB (negative event).

If this were true, then the literal case replicates would have been more likely to cite positive influences from factors in the team composition category of the framework, those factors that are inherent to the team or more under their control. Correspondingly, if this rival explanation was true then the theoretical replicate would have been more likely to cite negative influences from factors in the organizational context or team context.

As explained in their meta-analytic review on attribution error, Mezulis et al. (2004) concluded that the self-serving attributional bias is a robust and amply demonstrated phenomenon in human cognition. However, our understanding of it is largely based on research using an individual-level unit of analysis and additional research is needed to understand how attribution unfolds in complex social systems such as groups and teams (Harvey & Weary, 1984).

The use of data triangulation (sources from observation, physical artifacts, team supervisors, and member interviews) for data collection and the use of source repetition for data analysis promotes the confirmability of the research findings and propositions that have been presented. Furthermore, member interviews were conducted on an individual and private basis (one-on-one with the researcher) and they followed an extensive observation period that provided a first-hand account of each team's activities. Additionally, members of the Team Feb literal replicate provided substantial accounts of how external leadership (their supervisor) positively influenced the generation of their SRTB. However, this rival explanation cannot be solidly refuted by the case study findings and should be explored in future research.

CHAPTER 8

CONCLUSIONS

Prior research has demonstrated that high performance teams use self-regulating teamwork behaviors (SRTB) to prepare for work accomplishment, collaborate on taskwork, assess their performance, and make adjustments to meet their goals. The impact of SRTB on the performance of work teams in the low-volume high-complexity (LVHC) manufacturing context is expected to be significant due to its inherently long work cycles, large scope and complexity of taskwork, and the pace of work being controlled by people not technology, yet there is a lack of understanding for how those behaviors can be accomplished in that context.

Our knowledge of how production operations can be improved through the socio-technical system of work teams can be significantly enhanced by conducting naturalistic empirical research under real-world conditions. The multiple case study method was used for this research in a LVHC manufacturing plant to explore how team composition, team context, and organizational context influence the generation and development of SRTB in production work teams. From this research, the major factors and relationships that drive SRTB of work teams in a LVHC setting were identified and mapped, resulting in the formulation of propositions and a theoretical framework. Although especially relevant to LVHC manufacturers, this research also makes a theoretical and practical contribution to the discipline of engineering management by identifying critical factors and relationships in team composition and context for accomplishing SRTB.

8.1 Practical Applications

The research findings identified some critical factors that are controlled by management and under certain conditions may generate SRTB impulsively due to members' preferences for how to accomplish work coupled with actions required by the work design. From a practical standpoint, knowledge of the appropriate conditions for these factors will provide the management of LVHC producers with the best opportunity requiring the least effort to accomplish SRTB in their production work teams. Those

factors involve selecting team members based on their personalities and taskwork skills and designing the team's taskwork to create opportunities for SRTB.

Because member personality was found to heavily influence direct engagement in the behaviors involved in self-regulating teamwork and the positive growth of team climate and team integration, when management organizes a group of individuals for teamwork in the LVHC setting foremost consideration should be given to establishing a work group that will naturally strive to create and foster synergy. In addition, due to the nature of LVHC taskwork a composition of members with taskwork skills that are trusted and respected by other members should also influence those work teams to adopt SRTB.

Because the work cycle in LVHC production is long, conscientious members will more likely engage in setting goals, making plans, monitoring performance, and monitoring systems to avoid uncertainty in progress toward reaching their goals. Since the scope and complexity of a LVHC work team's taskwork is high, conscientious members will more likely be willing to expand their skills and perform multiple roles and agreeable members will more likely be willing to cooperate on tasks, exchange task-related information, be receptive of performance monitoring, provide backup behaviors, and work collaboratively to solve the team's problems. Also due to the complexity of taskwork, a composition of members that can perform high quality and dependable work will more likely promote a climate of excellence within the team. Given that the pace of taskwork is not controlled by technology, conscientious members will more likely drive themselves and other team members to *"stay busy"* and avoid having schedule goals creep up on them. In addition, members that are trusted and respected for their speed in accomplishing tasks will more likely be accepted among the other members, promoting team integration and subsequently cohesion.

Member composition is a necessary antecedent for SRTB in LVHC work teams but the work itself must provide opportunities for those behaviors to be enacted. This research found that the design of a team's taskwork, in particular higher task interdependency, lower task routineness, higher team-level autonomy, and higher task feedback drives self-regulating teamwork behaviors.

Because the fundamental work cycle is long, designing the work such that it inherently provides task feedback should motivate LVHC work teams to adopt work assessment behaviors such as performance monitoring and systems monitoring. Because the scope of taskwork is large, creating a high degree of interdependency in the taskwork should motivate LVHC work teams to engage in task-related collaborative behaviors such as coordination, cooperation, and information exchange. Since the pace of taskwork is controlled by the members and not the technology, conferring a high degree of team-level autonomy but low individual autonomy should influence the team to use team-based work preparation behaviors such as goal setting and planning.

8.2 Limitations and Future Research

The limitations of this research also provide opportunities for future investigations. The research was conducted in the culture of one LVHC manufacturing organization. Future research should involve multiple LVHC organizations to assess the transferability of the propositions. The research used only qualitative methods to explore the influence of team composition and context on SRTB in the LVHC context. Future research would benefit from using a mixed-methods approach to gain some quantitative assessments from the relations as well. Although ranging from 9 to 15 working days, the length of the observation period for each case study was relatively short in comparison to the fundamental work cycles of the teams (ranging from 2 to 10 days). A long work cycle is a distinguishing feature of the LVHC production context and future research should investigate the influence of team composition and context on SRTB from a longitudinal perspective.

Future research should also be directed toward gaining additional understanding of the mechanisms for how the key factors identified from this research influence the different phases of SRTB. Specifically, team task design and team coaching appear from this research to be features of a team's context that can be used to deliberately manage distinct phases of SRTB in LVHC production work teams.

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APPENDICES

APPENDIX A: FACTOR DEFINITIONS

ORGANIZATIONAL CONTEXT

WORK SUPPORT SYSTEMS
The practices of an organization used to accomplish work and to provide employees with resources and support for taskwork. (Campion et al., 1993; Guzzo & Shea, 1992; Hackman, 1987; Rico et al., 2011; Wageman et al., 2005)

REWARD SYSTEMS
The practices of an organization used to provide employees with consequences for work performance. (Hackman, 1987; Morgeson et al, 2006)

EDUCATION SYSTEMS
The practices of an organization used to provide employees with training for the knowledge and skills required for taskwork and teamwork. (Hackman, 1987; Morgeson et al., 2006)

INFORMATION SYSTEMS
The practices of an organization used to provide employees with information to plan their work and manage their performance. (Hackman, 1987; Morgeson et al., 2006)

TEAM CONTEXT

STRUCTURAL EMPOWERMENT
The organizational policies, practices and structures intended to grant a work team with responsibility to make decisions and exert influence regarding work assignments, work methods, and scheduling of activities. (Cohen et al., 1996; Greasley, 2008; Mathieu et al., 2008)

EXTERNAL LEADERHSIP
The influence of an external leader who is responsible for, and has authority for, the team's performance. (Burke et al., 2006; Manz & Sims, 1987; Mathieu et al., 2008; Morgeson, 2005)

TEAM TASK DESIGN
How the team's work is accomplished, including the following components: (Cohen et al., 1996; Hackman, 1987; Hackman & Oldham, 1980; Harvey & Burns, 2005; Rousseau et al., 2006; Rousseau & Aube, 2010)
- *TASK INTERDEPENDENCE* is the extent to which members must interact by working collaboratively and sharing resources or information.
- *TASK ROUTINENESS* is the extent to which team members accomplish their work in a consistent or repetitive manner.
- *TASK VARIETY* is the extent to which the group members are allowed to learn and use different skills to accomplish their work.
- *TASK IDENTITY* is the extent to which the team's job provides a sense of collective responsibility for completing a whole piece of work.
- *TASK SIGNIFICANCE* is the extent to which the team views their work as being important to their organization, the customer, or to society.
- *TASK AUTONOMY* is the degree to which team members experience substantial freedom, independence, and discretion in their work.

- *TASK FEEDBACK* is the extent to which the team's job provides knowledge of the results of their work activities.

COACHING
Direct interaction with a team by an individual intended to help members make coordinated and task-appropriate use of their collective resources to accomplish work. (Hackman & Wageman, 2005; Rousseau et al., 2013)
- *MOTIVATIONAL COACHING* addresses effort to minimize social loafing and to build shared commitment to the group and its work.
- *CONSULTATIVE COACHING* addresses performance strategy to minimize mindless execution of task routines and to foster innovation.
- *EDUCATIONAL COACHING* addresses developing knowledge and skill to minimize suboptimal weighting of members' contributions.

TEAM COMPOSITION

TEAM SIZE
The number of individuals making up the team. (Campion et al., 1993; Frank & Anderson, 1971; Hackman & Vidmar, 1970)

MEMBER PERSONALITY
The enduring traits of individuals that determine their manner of behaving. Aspects of the five-factor model of personality traits were used for this research. (Digman, 1990; Fisher et al., 2012; King et al., 2005; McCrae & Costa, 2008; McCrae & John, 1992; Norman, 1963; Stevens & Campion, 1994)
- *OPENNESS TO EXPERIENCE* is a preference for novelty and a variety of activities over a strict routine.
- *CONSCIENTIOUSNESS* is a tendency to show self-discipline, act dutifully, and aim for achievement; described as organized and dependable.
- *EXTRAVERSION* is a tendency to be sociable and want to work with others.
- *AGREEABLENESS* is a tendency to be compassionate and cooperative rather than suspicious and antagonistic towards others, having a trusting and helpful nature.
- *NEUROTICISM* (or inversely emotional stability) is a tendency to display unpleasant emotions easily, such as anger, anxiety, depression, or vulnerability.

SKILLS-TASKWORK
The operations-related skills of team members used to accomplish tasks. (Morgan et al., 1993)

SKILLS-TEAMWORK
The interpersonal and work-management skills of team members used to accomplish a collective action, including the following components: (Morgan et al., 1993; Stevens & Campion, 1994)
- *SELF-MANAGING TEAMWORK SKILLS* are used to help establish team goals and plans, coordinate activities between members, and monitor performance with constructive feedback.
- *INTEGRATIVE CONFLICT MANAGEMENT SKILLS* are used to employ an integrative (win-win) negotiation strategy rather than distributive (win-lose).
- *COLLABORATIVE PROBLEM SOLVING SKILLS* are used to identify and participate in situations requiring participative group problem solving.
- *COMMUNICATION SKILLS* are used to understand communication networks, communicate openly and supportively, and recognize the importance of engaging in ritual greetings and small talk.

TEAM FLEXIBILITY
The ability of team members to perform tasks interchangeably, thus being able to back each other up through support or substitution. (Campion et al., 1993; Day et al., 2008; Dineen & Noe, 2003)

TEAM STABILITY
The change in team membership over time. (Dineen & Noe, 2003; van der Vegt et al., 2010)

TEAM EMERGENT STATES

TEAM INTEGRATION
The integration of members through psychological bonds of trust and respect to create an internalized "team", including the following components: (Cronin & Weingart, 2005; Mayer et al., 1995; Millward et al., 2010; Rico et al., 2011; Weingart et al., 2005)
- *INTERPERSONAL TRUST* is the extent members are willing to rely on one another in the absence of monitoring.
- *MUTUAL RESPECT* is the extent members value each other for their character, abilities, and contributions.
- *TEAM IDENTITY* is the degree members internalize the "team" as part of their self-definition, resulting in their thinking, feeling, and behaving representing and protecting the integrity of the team's interests.

TEAM CLIMATE
The norms, attitudes, and expectations members perceive in the context of working on their team, including the following components: (Anderson & West, 1998; Edmondson, 1999; Eisenbeiss et al., 2008; Loo & Loewen, 2002; Mathieu et al., 2008; Rico et al., 2011)
- *VISION* is the extent members share higher order goals they perceive as clear, attainable, and motivating.
- *PARTICIPATIVE SAFETY* is the extent members perceive the team is safe for interpersonal risk taking and involvement in decision-making.
- *CLIMATE OF EXCELLENCE* is the extent members perceive a shared concern for excellence of task performance in relation to outcomes.
- *SUPPORT FOR INNOVATION* is the extent members perceive an expectation, approval, and support for introducing improved ways for the team's work.

TEAM COHESION
The strength of the social and motivational forces that bond members together, including: (Aube & Rousseau, 2005; Beal et al., 2003; LePine et al., 2008; Millward et al., 2010; Weldon & Weingard, 1993)
- *INTERPERSONAL ATTRACTION* is the extent members share a liking for other members in the group.
- *TASK COMMITMENT* is the extent members share a commitment to the group's taskwork and goals.
- *GROUP PRIDE* is the extent members share an importance of the group.

TEAM MENTAL MODELS
A shared understanding of knowledge by team members involving: (Mathieu et al., 2000; Mathieu et al., 2008)
- *TECHNOLOGY* - The technology/equipment with which the team interacts.
- *TASKWORK* - How the job is accomplished in terms of procedures, task strategies, likely contingencies or problems, and environmental conditions.
- *TEAMWORK* - How members interact with one another including roles, responsibilities, interdependencies, and information flow.
- *MEMBER* - The knowledge, skills, attitudes, preferences, strengths, weaknesses, and tendencies of members.

TEAM EMPOWERMENT
Shared beliefs regarding the team's authority, responsibility, and capabilities: (Kirkman & Rosen, 1999; Kozlowski & Ilgen, 2006; Mathieu et al., 2006; Mathieu et al., 2008; Spreitzer, 1995; Spreitzer, 1996)

- *PSYCHOLOGICAL EMPOWERMENT* is the extent the team believes they have authority and responsibility to control their work environment and their team's functioning.
- *TEAM EFFICACY* is the extent members believe the team is capable of organizing and executing courses of action required to attain their goals.
- *TEAM POTENCY* is the extent members believe the team has the ability to be successful beyond the scope of attaining their immediate goals.

SELF-REGULATING TEAMWORK BEHAVIORS & TEAM EFFECTIVENESS

SRTB for WORK PREPARATION (Marks et al., 2001; Rousseau et al., 2006)
- *GOAL SETTING* is the identification by the team members of the level of performance that they individually or collectively have to achieve.
- *PLANNING* is activity carried out by the team members to create a plan to meet pre-established performance goals.

SRTB for TASK COLLABORATION (Marks et al., 2001; Rousseau et al., 2006)
- *COORDINATION* is the act of integrating team member's activities to ensure task accomplishment within established temporal constraints.
- *COOPERATION* is the act of two or more team members working together on the same task.
- *INFORMATION EXCHANGE* is the act of team members sharing task-related information among themselves.

SRTB for WORK ASSESSMENT (Marks et al., 2001; Marks & Panzer, 2004; Rasker et al., 2000; Rousseau et al., 2006)
- *PERFORMANCE MONITORING* is the act of members monitoring each other's task execution and exchanging constructive feedback regarding performance.
- *SYSTEMS MONITORING* is the act of members tracking resources for task accomplishment such as personnel, equipment, materials, and information.

SRTB for TEAM ADJUSTMENT (Cohen et al., 1996; Marks et al., 2001; Porter et al., 2003; Rousseau et al., 2006; Salas et al., 2005)
- *BACKUP BEHAVIOR* is the act of members providing tangible task-related help when a member is failing to reach their goals.
- *COLLABORATIVE PROBLEM SOLVING* is the act of members collectively engaging in finding and implementing solutions to problems that interfere with accomplishing their tasks and meeting their goals.
- *INNOVATION* is the act of members inventing and implementing new and improved ways of accomplishing their taskwork.

TEAM EFFECTIVENESS
The impact of a team on outcomes including the following criteria: (Bond, 1999; Campion et al., 1993; Cohen & Bailey, 1997; Jehn et al., 2008; Ross & Jones, 2008; Sundstrom et al., 1990)
- *PERFORMANCE* is the extent that a team's output meets customer expectations (within or outside the organization) regarding quantity, quality, timeliness, and cost reliability.
- *ATTITUDE* is the extent of affect members have toward involvement in the work team or the larger organization.
- OUTCOME BEHAVIOR is how team members act in response to each other, to job circumstances, and to perceived controls on behavior. Common measures include absenteeism, turnover, and safety.

APPENDIX B: CASE SELECTION CRITERIA MATRIX

	SELECTION CRITERIA	JUN	SEP	FEB
SRTB	Work Preparation	Med	High	Low
	Collaboration	High	Med	Low
	Work Assessment	High	High	Low
	Team Adjustment	High	High	Low
Effectiveness	Performance	High	High	Low
	Attitudes	High	High	Low
	Outcome Behaviors	High	High	Med
Comp	Team Size	9	3	9
	Team Stability [1]	Low	High	Med
Context	Fundamental work cycle [2]	3	10	2
	Spatial arrangement [3]	Low	High	Med
	Task interdependence [4]	High	High	Low
	Task routineness [5]	Low	High	High
	Structural empowerment [6]	High	Low	Low

1. JUN 3 of 9 members < 6 months; SEP all > 10 years; FEB majority > 2 years
2. Takt time in days
3. JUN separated; SEP collocated in small area; FEB collocated in large area
4. JUN sequential & reciprocal; SEP sequential but also pooled; FEB pooled but also sequential
5. JUN encounters frequent technical problems
6. JUN has salary members & 1 hourly Lead; SEP has 2 hourly Leads; FEB has 3 hourly Leads

APPENDIX C: EXCERPT FROM CASE STUDY DATABASE

|	A	B	C	D	E	F	G	H	I
1	IND CAT	IND CODE	STAGE	DEP CAT	DEP CODE	SOURCE	QUERY	DATA	SUBCODES
2	COMP	SKILLS-TASK	GEN	STATE	CLIMATE	ATech1	ADJUST	In my opinion, I think management should put the best on a new job so that they can set the standard for when other team members come on. Of course others might think they're the best which causes competition, so the team makeup has to be right to make it work. When other team members come on you've got to tell them "you'd better keep up", don't baby them.	EXCELLENCE
3	COMP	STABILITY	DEV	SRTB	COLLAB	LATech	COLLAB	*Referring to why current collaborative behaviors are effective...* We've been doing it now for a long time too, for years.	
4	STATE	INTEGRATION	GEN	STATE	COHESION	ATech2	PREP	It's not always been as good as it is now. When I started on this job there were more people on it than there is now. I think it started getting better when some people left the group, especially the one that was causing problems with our lead. When that person left, it was like our Lead was a different person. He seemed happier, talked with us all more, and we started working together better. You've got to like who you work with.	TEAM IDENTITY IP ATTRACTION
5	CTXT	TASK DSN	GEN	SRTB	COLLAB	OBS-SEP	COLLAB	Info exchange is accomplished informally and frequently (all 3 are within talking distance) by all team members. This was observed most often between LATech & ATech1. I heard ATech1 just say to ATech2 "I'm ready" and he knew what she was ready for without further explanation.	INTERDEPENDENCY INFO EXCHANGE
6	CTXT	STRUCT EMPWR	GEN	SRTB	PREP	SPV-SEP	PREP	During the lean implementation of 2009 we had takt schedules posted for the major assemblies that laid out all of the steps and time requirements.	
7	STATE	COHESION	DEV	SRTB	SRTBs	LATech	COLLAB	We sort of live off of taking 340 labor hours out of a shipset, that makes us feel good. It gives us more drive to do good on the next one. Every couple weeks the hours are checked. We've done it long enough now to know what it should take.	GROUP PRIDE
8	CTXT	STRUCT EMPWR	GEN	SRTB	PREP	ATech1	PREP	You've got to have a "Head Honcho" on the team to be able to start making your own work goals and plans and that person needs to be respected by all the other team members.	GOAL SETTING PLANNING
9	COMP	SKILLS-TASK	GEN	STATE	INTEGRATION	ATech2	PREP	*Referring to what influenced starting to use work prep behaviors...* I've worked for many years and I can honestly say that our lead is the smartest person I've worked with. He can figure it out, that's what makes him good at it.	RESPECT
10	STATE	CLIMATE	DEV	SRTB	ADJUST	OBS-SEP	ADJUST	Watching LATech & ATech1 perform a bond I noticed they were doing it differently from last one. I asked why and they said they never did any of the processes the same way between sets. They were always looking for a better way. Once found, they would run with that for a	SUPPT INNOVATION
11	CTXT	TASK DSN	GEN	STATE	TEAM EMPWR	LATech	PREP	I think we started making our work goals and plans when our supervisor just started leaving it up to us, when he wasn't taking as much effort to supervise us. When he got less involved we just worked out our own plans. When he saw that our plans worked out, he got even less involved and trusted us more.	AUTONOMY PSYCH EMPOWER
12	COMP	MBR-PERS	GEN	SRTB	SRTBs	SPV-SEP	COLLAB	One of the team members is a "doer", a follower, and it works out good.	AGREEABLENESS

APPENDIX D: TEAM JUN WORK FLOW DIAGRAM
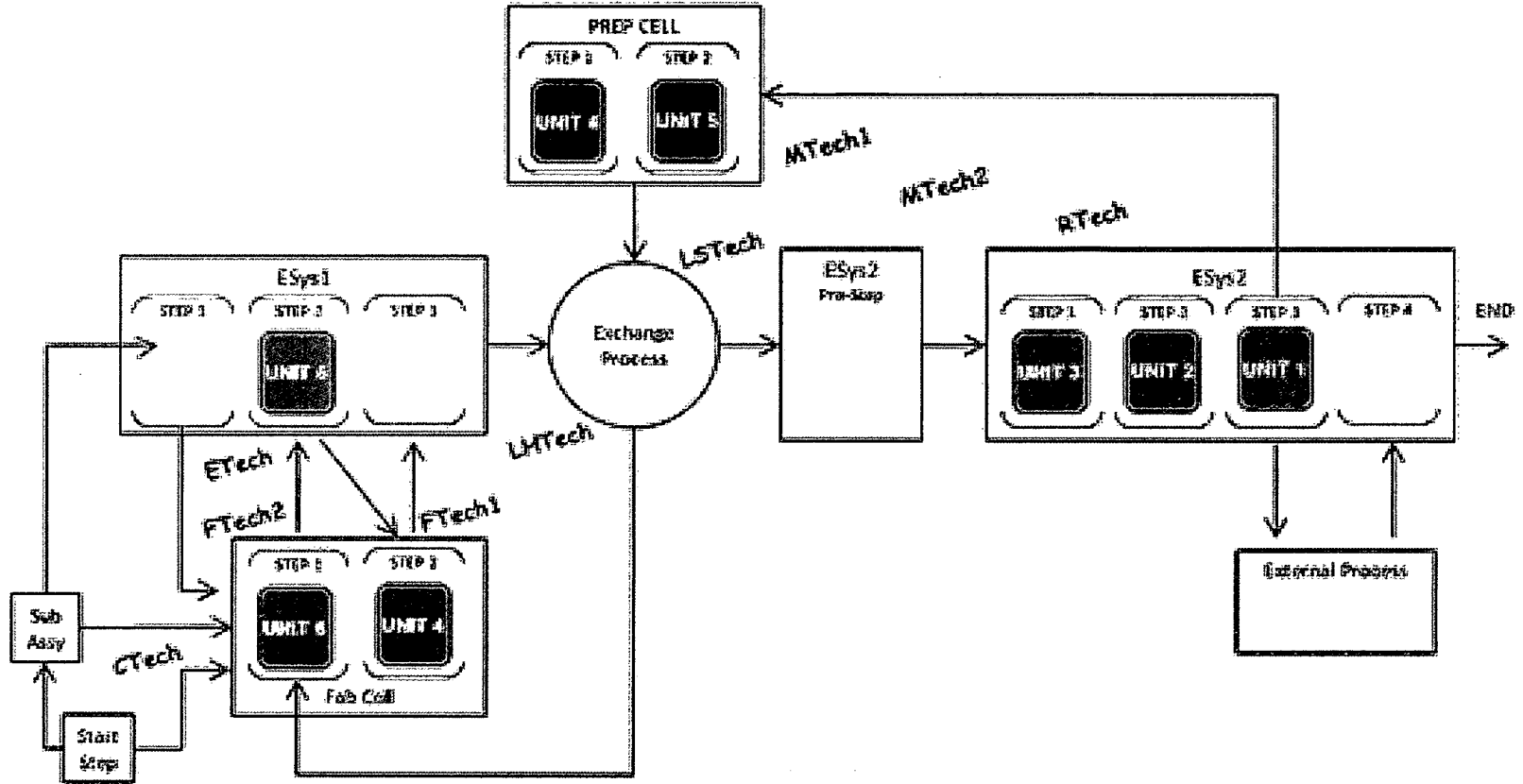
APPENDIX E: TEAM SEP WORK FLOW DIAGRAM
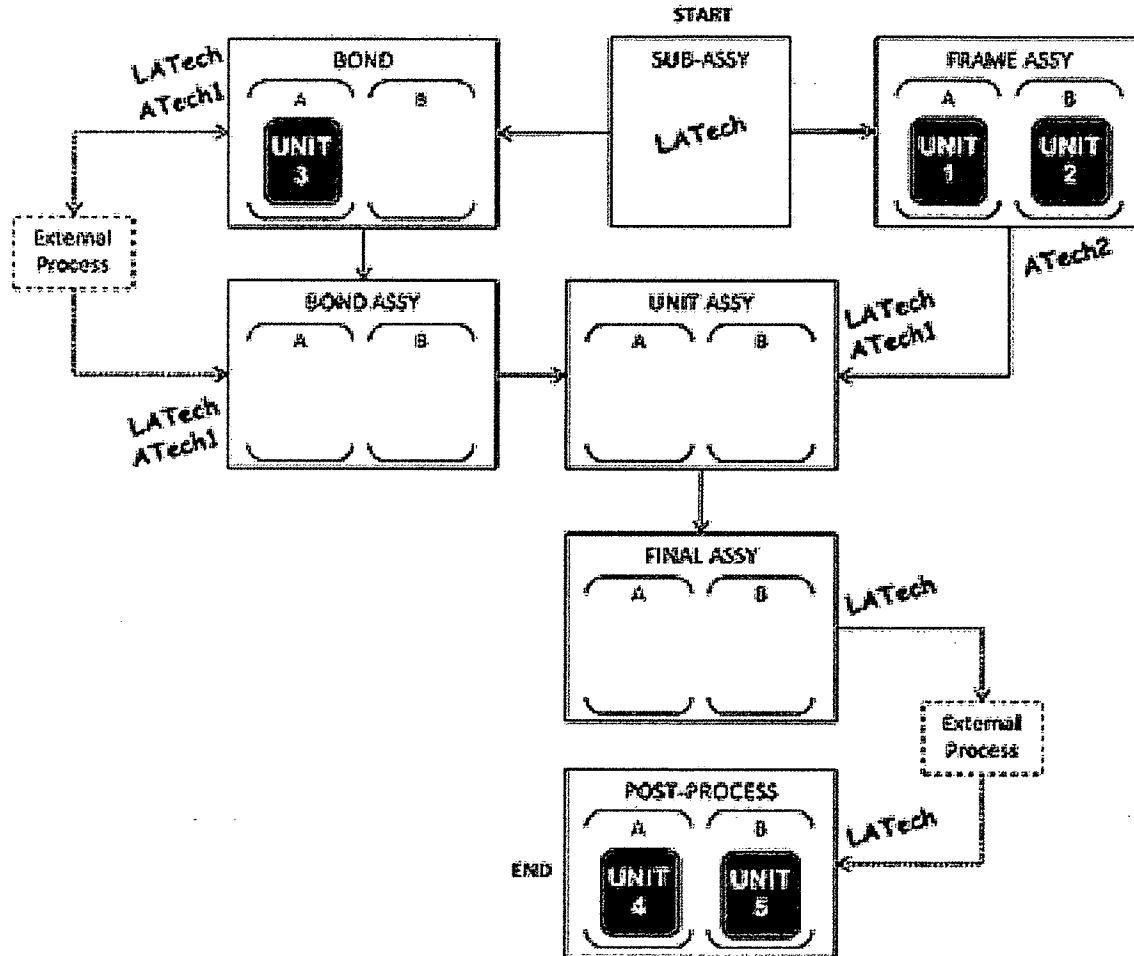
APPENDIX F: TEAM FEB WORK FLOW DIAGRAM
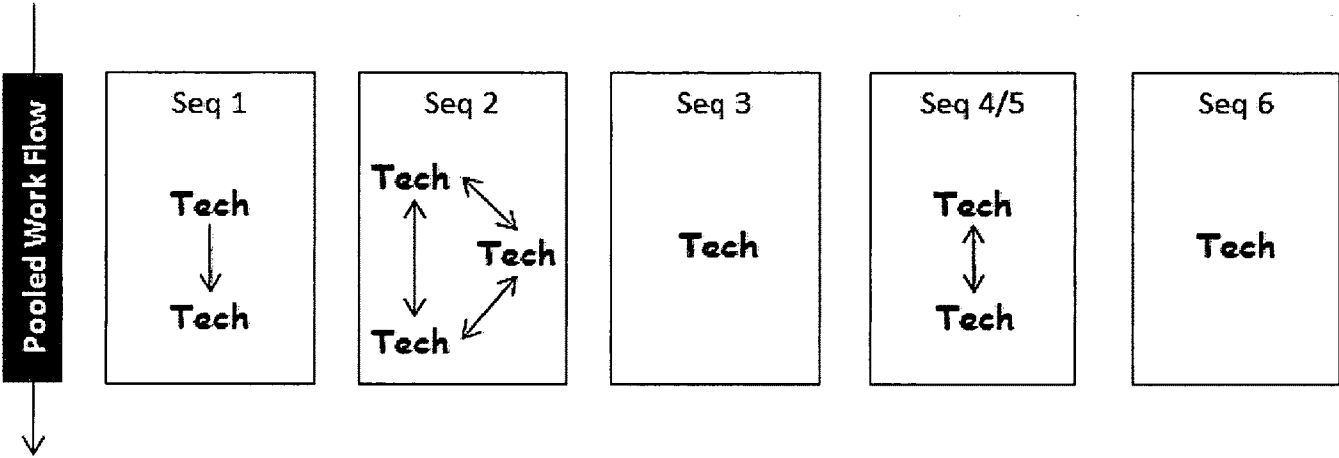
VITA

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