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# AN APPLICATION OF THE TEAM PROCESS CAPABILITY MODEL TO TEAM RESILIENCE FACTORS

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## Abstract

*Team resilience has gained in importance as organizations increasingly operate in diverse and challenging environments. This paper will apply core concepts of team resilience to the team process capability model (presented at the 2018 International Joint Conference on Industrial Engineering and Operations Management Conference in Lisbon, Portugal) to provide an understanding of the factors influencing team resiliency. An overview of the team process capability model will be provided followed by an application of team resiliency concepts applicable to the team process capability model. This paper is aimed mainly towards managers seeking to better understand team resiliency however academics may find the framework proposed in this model useful in similar pursuits.*

**Keywords**

Team Resilience, Team Performance, Team Process Capability, Team Management

## 1. Introduction

Team resilience has become an increasingly important factor in team performance as organizations become more global and subsequently more vulnerable to systemic global events. The recent events caused by the coronavirus (COVID-19) pandemic have shown that teams and organizations can be vulnerable to systemic events that directly expose existing team and organizational design weaknesses. Team performance can be affected by a myriad of sociotechnical factors such as a change in the team composition or intra-team conflict which can impact the ability of team members to leverage the strengths and capabilities of other team members (Alliger et al., 2015). Technical factors such as a change in team processes and procedures or worn equipment impact team ability to apply previously designed interactions with the technical system which directly impacts the quality and quantity of work. Environmental factors such as a change in the quantity or type of customer demand or the introduction of a new competitor affects both the level and variety of environmental demand and alignment of sociotechnical elements to environmental factors.

The team process capability model provides a means to understand the impact of these changes on team performance. The model provides a means for managers to understand both how his or her decisions influence team performance over time and how the team is performing before decisions are made which may require a change in how the team is aligned towards its required outputs. Team resilience can be understood within the context of this model depending on which region the team is operating within; a failure of a manager to understand the specific region a team may be operating within may result in the wrong types of corrective actions taken to address perceived issues due to such factors as delayed feedback response and errors in feedback relevancy (Sexe, 2018).

## 2. Team Resilience Definition

The concept of team resilience within the context of this paper refers to the ability of teams to react and adapt to complex and changing environmental factors. This definition focuses on both the ability of the team to overcome and withstand stressors in a sustainable way (Alliger, et al., 2015) and return operations to normal during turbulent times (Mandal, 2017). The concept within this paper also extends to team ability to analyze the environmental conditions responsible for the turbulence and stressors (both within the environment and the sociotechnical system which interacts with it) to develop long-term strategies for minimizing future impact on team performance. This focus on a long-term solution aims to move the team to a *new normal* in which the team develops a new homeostatic balance optimized towards the environment and sociotechnical system goals.

Turbulence within the sociotechnical context as defined by this paper refers to either complex or chaotic systemic interactions between the sociotechnical system and the environment. These interactions can introduce harmful effects which manifest themselves upon a team in a variety of ways between stress and complete team breakdown depending on the resilience of the team and the time that the team was expose to the stress (Alliger, et al., 2015). Teams operating under certain sociotechnical conditions can actually increase its ability to absorb variation and demand through an improved means of aligning internal and external resources flexibly in response to unexpected environmental demands. When teams operate in extreme conditions this turbulence can cause team breakdown in which internal relationships begin to dissolve, team members leave the team, and technical resources become unusable or unavailable (Driskall, et al., 2016). It is important to note that short-term turbulent events, when well-managed, can actually improve team resilience by improving efficiencies between sociotechnical elements (i.e. team members develop new ways to engage with other teammates, technical system processes are improved through lessons learned).

Team reaction to environmental demand stressors can be sorted into two categories based upon how a team adapts or adheres to team best practices. Team members should adhere to existing best practices when the antecedents of the disruption are similar to these processes (i.e. a sudden increase in demand for an existing team output) whereas teams must adapt existing work practices when the disruption is different than those the existing processes were designed to address (Mandal, 2017). It is important to note that both elements provide an essential capability of a team to both address the nature of the disruption while also evolving new processes that provide team outputs to address the disruption and provide long-term stability. These two strategies are complementary to each other yet provide a team with specific skills depending on either the complexity or variability in environmental demand.

*Process compliance* reflects the ability of a team to strictly adhere to organizational or team best practices and procedures (Mandal, 2017). The concept of process compliance within a sociotechnical context is identified as the ability of the team to perform within a set of previously-defined parameters represented by organizational best practices. These parameters relate mostly to the level of team process and procedure standardization within the context of previously-defined environmental variables the team is designed to exploit. Process compliance can actually hinder team performance when operating within complex (where best practices reduce team capability to realign sociotechnical system resources to address an increasing number of interactions present within the system) and chaotic (where best practices no longer are compatible with the required outputs to address increased demand) environments as the best practices may encourage actions which are counter to those required to address the environmental demand. However, process compliance is important within a disruptive environment as it provides a team with a baseline performance state in which future improvements can be based (Mandal, 2017).

*Process resilience* refers to the ability of a team to effectively adapt existing processes and procedures to evolving environmental demands. The concept of process resilience within the context of turbulent or disruptive operations focus mainly on restoring operations to either a normal (previous) or improved operating state (Mandal, 2017) which within a sociotechnical context involves the restoration of operations to a previously-maintained homeostatic state (or a long-term change to the system's homeostatic balance) during high variability or increased demand scenarios. Process resilience differs from process compliance in that the process is modified such that actions taken within the process may change in relation to the overall goal of the process. It is important to note that in some instances an organization's policies and procedures may actually discourage process resilience due to a focus on standardization which encourages compliance and discourages resilience.

The practice of process resilience has four main stages similar to a continuous improvement cycle. First, the team defines the needs of the environment through feedback with the environmental elements that the team interfaces with. The second step of the process resilience model involves comparing the defined needs of the environment with the best practices. This step is mainly concerned with identifying any shortcomings of the best practices on the team's ability to meet environmental demands. The third step involves modifying the best practices to meet the new demands. These modifications can be either short-term (in which addendum or exceptions are added to the best practice for those sociotechnical changes deemed to be temporary) or long-term (in which the best practice is rewritten as it applies to long-term homeostatic changes in the sociotechnical system). Fourth, the new process or procedure is monitored to determine the effects of the newly created process or procedure on the environmental demand. This step is also required to understand the short- or long-term nature of the changes such that any changes to environmental demand are identified and communicated to the team. The team either reverts to previous best practices (for short-term environmental requirements) or evolves the process or procedure further using a form of continual improvement loop depending on the nature of the environmental demand. This loop would ideally be conducted in a shorter time frame than the changes in environmental demand require from the team for the team to be able to adjust sociotechnical resources as required for long-term sustainability.

## 3. Process Capability Definition

The process capability model provides a framework for understanding environmental effects upon a team within a sociotechnical context. The model explains these effects by illustrating how team performance as it relates to process efficiency is capable of (and is affected by) demand placed upon it. This comparison allows the observer to better understand how decisions made in relation to the sociotechnical system impacts its ability to absorb demand. Further understanding can be gained by a manager through identifying performance measurements to determine the team performance state that the team is operating while subsequently applying remedies to either improve team resilience (through team learning and adaptation strategies) or reduce any harmful effects (through minimizing the strain upon the team as caused by the environment).

The team process capability model comprises two important interactions. The first interaction involves the relationship and key interactions between the social and technical systems. This relationship reflects the number and strength of interactions between the two systems which subsequently represent social system effectiveness in exploiting technical system elements towards team goals. The team's process capability within this context refers to the effectiveness of these exploitations as related to team goals as defined by the larger system (typically management decisions defining which segment of the environment to exploit. Technical system size is not only influenced by the number of technical system elements and its interactions with the social system but also how these interactions relate to overall size of the work domain (defined within this context as the segment of the environment the sociotechnical system is designed to exploit) such that a larger process capability relative to the work domain will allow the sociotechnical system to absorb demand imposed upon it by the work domain and vice versa (Pasmore, 1988).

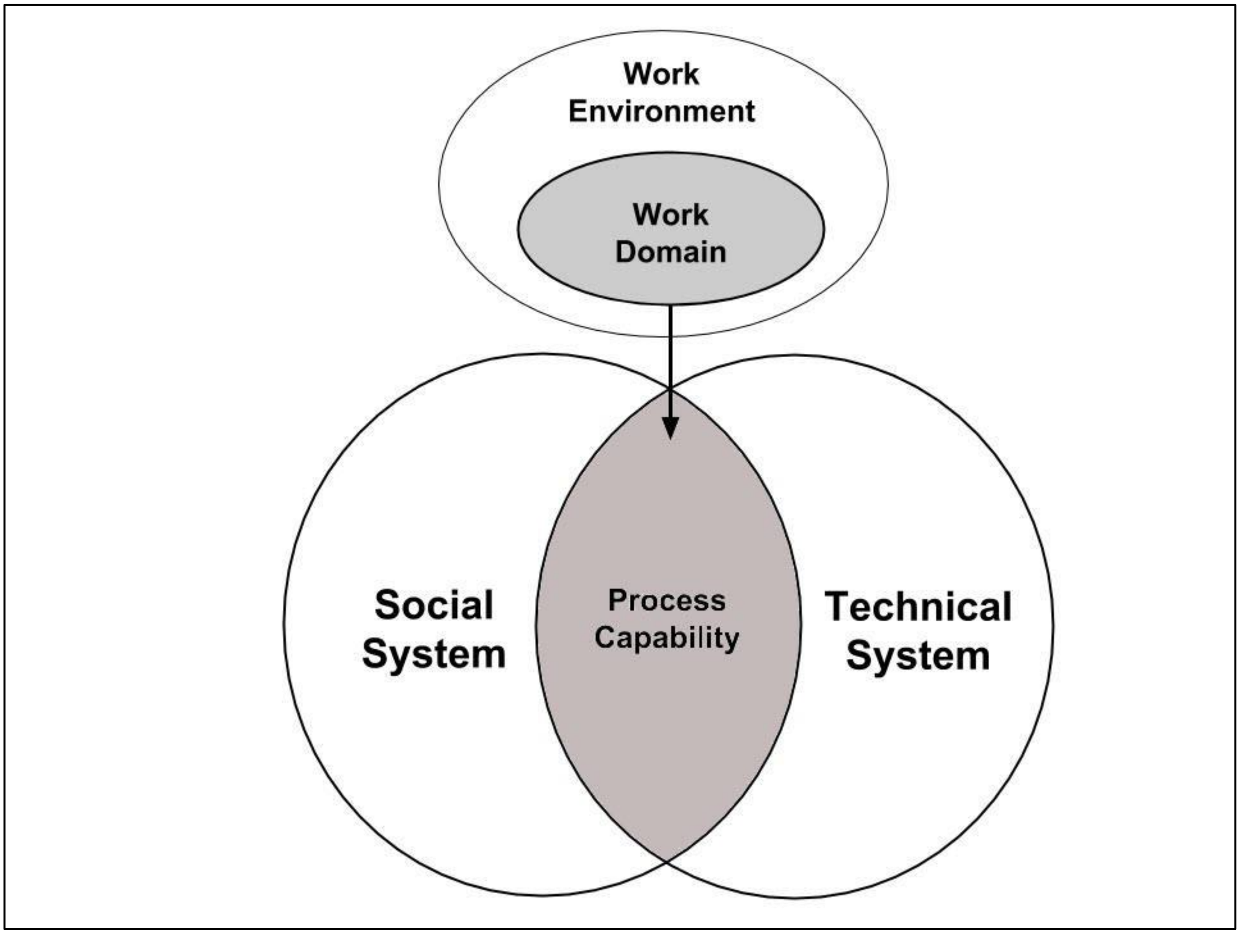


**Figure 1:** *Social and Technical System Interactions in Relationship with the Work Domain*

The second set of team process capability model interactions refers to the level of these interactions in relation to the demand imposed upon the sociotechnical system over time. Process demand (denoted as $P_d$ in the model) and process output (denoted as $P_o$ in the model) affect team performance such that team outputs and performance are stable while $P_d$ equals $P_o$ (which on the graph denote the area below the marginal process capability (denoted as $P_m$ in the model)). However, as team performance moves past its requisite process capability (defined as the ability of the team to perform at a homeostatic level) the team is forced to move beyond its *comfort zone* to maintain the required level of output. It is within this region (between $P_m$ and $P_r$ called the *adaptation region*) that process compliance and process resilience influences how the team recovers from and adapts to the turbulent environmental conditions (Sexe, 2019). Team resilience within this context relates to both the duration (i.e. how long the team can comfortably perform within this region) and time required to improve its long-term performance capability (which effectively moves requisite team capability rightward).

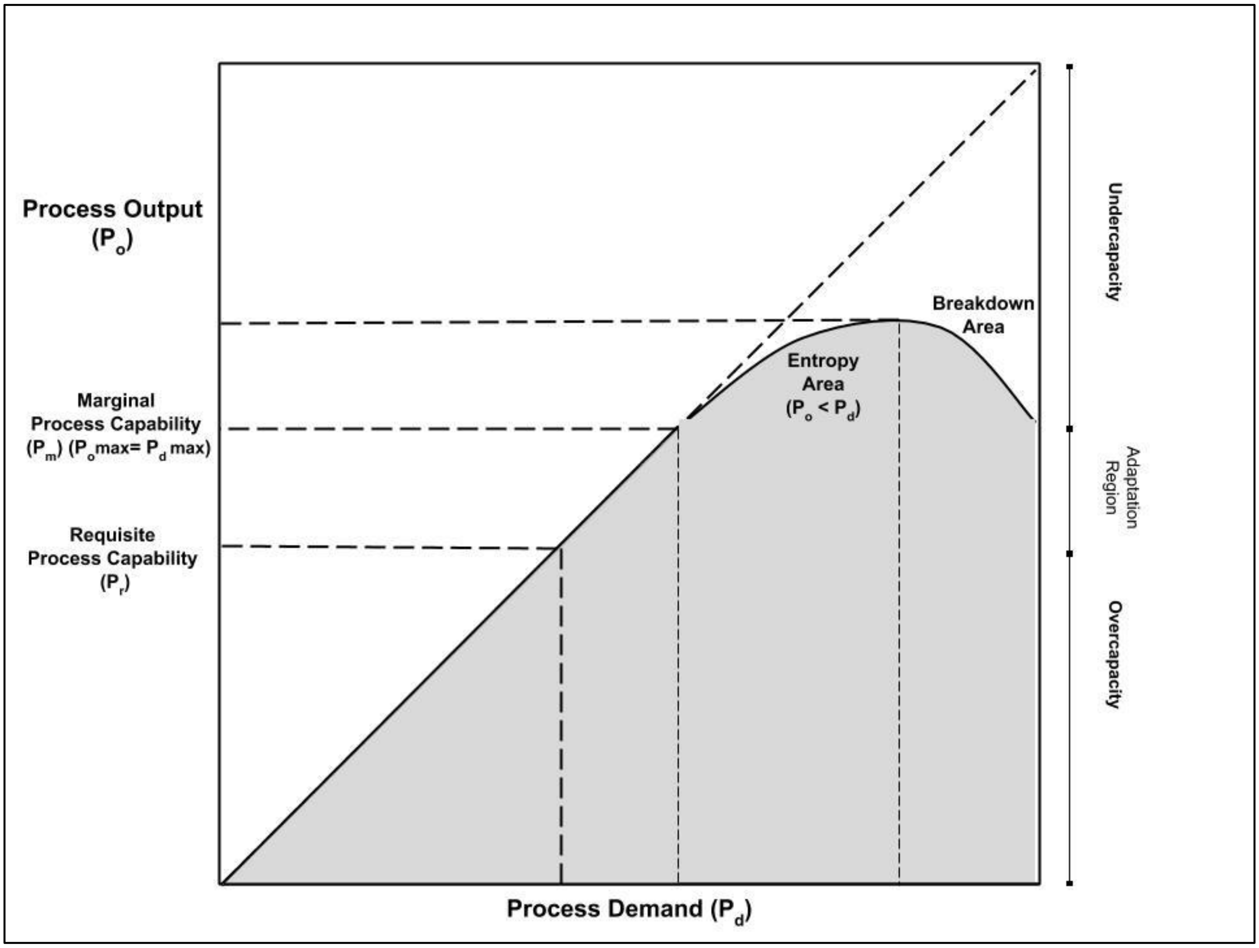


**Figure 2:** *Process Capability Model*

Process compliance works to help a team maintain a certain level of requisite process capability (defined as the level of output which a team can sustain over a long period of time) through a disciplined focus on the processes and procedures related to that particular demand output (Sexe, 2017). Process resilience, conversely, determines a team's marginal process capability (defined as the level of output beyond which can be sustained for a short period of time) as it defines the team's ability to exploit existing sociotechnical interactions to provide increased levels of output (examples of process resilience actions would be *coping mechanisms* such as employees "working harder", increased machinery and supplies usage, and adapting new processes to existing processes). However, these process resilience benefits are short-lived as the team works outside its *requisite process capability* over time. The coping mechanisms (defined as extreme and atypical actions taken by a social system to mitigate short-term disruptions) create additional stress on internal team relationships and reduce team member performance due to burnout and conflict. The technical system also suffers from disruptions due to factors such as wear and tear on physical technical system components as maintenance actions typically taken during operations at or below the requisite process capability level are delayed. Over time this scenario decreases requisite process capability (i.e. team members leave, machinery breaks down, supplies dwindle). Teams operating in this scenario during prolonged disruptions can have decreased long-term performance at the end of the disruption as the negative effects of the disruption compromise homeostatic sociotechnical system performance capability.

Severe disruptions (defined as disruptions in which sociotechnical system resources operate beyond the marginal process capability area) hasten the deterioration of a sociotechnical system requisite process capability. This deterioration occurs due to a *fight or flight* syndrome in which the system resorts to instinctive behaviors which reduces long-term viability of the social and technical systems (i.e. team members leave the team or become ineffective, machinery breaks down) and a corresponding reduction in social and technical system elements and interactions (Sexe, 2019). Team resilience within this region relates specifically to the ability of a team to *recover* from negative effects of the breakdown while also *learning* about breakdown causes and symptoms with the goal of improving the sociotechnical system and adapting the system to newly identified long-term requirements. Process resilience is useful within this context as it aids teams in identifying the nature of the disruption and developing effective mitigating coping strategies while also developing long-term strategies through a continual-improvement feedback loop in which the disruption is defined, long-term strategies are defined and tested, and feedback on the results of the new strategies is gathered (Mandal, et al., 2017).

## 4. Process Capability and Team Resilience

Team resilience influences a team's performance within the sociotechnical system at the team and individual level in several ways. First, individual team members to re-evaluate his or her role roles when physical changes to team composition (i.e. the social system) occur. This re-evaluation occurs based on socialization effects which aid team members in understanding both his or her standing within the team and what the team requires of them to perform the tasks required of them (Rousseau, 2006). Resilience at the team level requires team members to identify and learn new strategies aimed at exploiting interdependencies aimed at improving both his or her individual performance and overall team capability to perform towards team goals (Patterson & Stephens, 2012). Physical team compositions influence social system size within the team process capability model with team ability to exploit interdependencies within the new social system determining the leftward (less effective) or rightward (more effective) shift of the social system (Duff et al., 2014).

Technical system changes (i.e. processes, procedures, and equipment) require team members to learn how to both exploit these changes and apply them towards goal-oriented tasks (Patterson & Stephens, 2012). Each technical system change requires team members to understand how the change impacts his or her capabilities in the form of learning new capabilities (i.e. learning about how a new piece of equipment works) or in leveraging the change towards his or her role within the team (i.e. become a master at a new process in a bid to facilitate learning within the larger team). Social system interactions determine the leftward (more effective interactions) or rightward (fewer effective interactions) shift of the technical system in relation to the social system even when changes in specific technical system elements may increase or decrease its size. The overall relationship between the social and technical systems results in a change in team process capability even if technical system increases. Team resilience within this context is critical with both the timing (i.e. how quickly the team and its individual team members can learn how to exploit technical system changes) and duration (i.e. the ability of the team to achieve a homeostatic equilibrium with the changes in the technical system) of the shift and overall team process capability improvement.

## 5. Scope of Future Research

The process capability model provides an effective tool for illustrating how key sociotechnical interactions influence team resilience over time in relation to environmental complexity factors. Future iterations of this model can be developed with specific sociotechnical factors such as process and machine throughput to map a team’s reaction to environmental externalities over time. The use of throughput-measuring metrics can also be aligned with other time-based methods to measure how teams reacts and learns from these same externalities while also identifying team requisite and marginal process capability (Pasmore, 1988). Tools such as queuing methods and Kingman’s Equation can be used to provide a time-based means to measure the change in team performance, especially when combined with measures representing environmental shifts in the type and quantity of demand (Bicheno, 2012). This research should focus on diverse sociotechnical elements and how they can be measured through such a tool as a multivariate analysis of variation (MANOVA) to provide a diverse picture of complex environmental interactions and how they impact team performance.

Future research can also explore methods to map and quantitatively measure process capability and environmental and internal systemic effects on team resilience. These key interactions may provide useful clues to how human factors relate to an existing system design in relation to both the environment that it was designed to exploit and the actual context the sociotechnical system functions within. This information can be used to improve human and technical factors related to the desired environmental outcomes the team is designed to pursue (Naikar, et al., 2003).

## 6. Recommendations

Teams seeking to recover from a turbulent environmental condition could benefit from both process compliance and process resilience but in different ways. Process compliance aids teams in recovering from extreme environmental conditions in which the demands placed upon the team decrease. A focus on process compliance allows the team to focus on existing best practices as these would still be largely applicable to the environmental demand. However, when a team faces an extreme environmental condition in which the type of demand increases (which subsequently increases demand complexity) then process resilience is more important. This increased importance in process resilience is due to team requirement to adapt existing sociotechnical resources towards a new framework in which existing best practices are less applicable (Patterson & Stephens, 2012). Note that in many instances both process compliance and process resilience will be useful as they can be complementary in many scenarios (i.e. evolving environmental conditions which are similar to previous best practices but which low variation is present within the demand).

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