VALIDATION OF A SURVEY INSTRUMENT: TEAM CREATIVITY AND INNOVATION (C/I) PROCESSES AS COMPLEX ADAPTIVE SYSTEMS (CAS)

Jae Warren Schroeder

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APPROVED:

J. Michael Spector, Co-chair
John R. Turner, Co-chair
Rose Baker, Committee Member
Yunjo An, Chair of the Department of Learning Technologies
Kinshuk, Dean, College of Information
Victor Prybutok, Dean of the Toulouse Graduate School

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Companies are becoming increasingly dependent on teams to drive creativity and innovation, which usually involves multiple teams working together to solve complex problems However, the first problem is that work teams do not always manage creativity and innovation well, especially when partnering with other work teams on highly complex projects that demand greater interdependence and collaboration, which can constitute as much as 90% of today's organizational projects. The second problem is that researchers struggle to define and measure creativity and innovation for the past decade resulting in significant variation both within and between creativity and innovation scales that have restricted meaningful theoretical discoveries and advances. The current study is significant because it introduces a novel instrument derived by John Turner that measures team creativity and innovation processes as a single unit, thereby raising the level of theoretical sophistication and leading to better practical applications. After conducting factor analysis, the current study validates six factors, including 36 indicators, and measures team creativity and innovation processes as complex adaptive systems (CAS). The current study recommends deploying the new instrument in other sectors beyond the IT sector and using multilevel techniques that include the individual and executive/organization levels of analysis.

ACKNOWLEDGEMENTS

Even while writing this sentence, I marvel at having achieved what I thought was unachievable during difficult times throughout my dissertation journey, which began five years ago with naiveness and self-delusions. I was wholly unaware of the sacrifices and pitfalls that inevitably came about for myself and my family. When asked which single factor had the greatest impact on my doctoral completion, I answer quickly and without hesitation, “My better half and wife, Amy Schroeder!” You, above all else, inspired and motivated me to plow ahead, despite the numerous times I wanted to quit the formidable program. You have been my rock and anchor while making tremendous personal sacrifices on our family’s behalf (e.g., birthing and caring for our three children, all under the age of four, including identical twin boys, moving into a new home, and holding down the fort while I juggled a new job and doctoral studies concurrently). Your intelligence, tough-love, humor, and wit keep me on my toes and inspire me to be the best person I can be, hopefully, someone deserving of your love and respect. I look forward to continually making extraordinary memories with you and our beautiful children in the many years ahead.

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Lastly, I would like to express my graduation to my committee members – Dr. Rose Baker and Dr. Mike Spector – for their valuable feedback and insights that have further strengthened my scholarly work.

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CHAPTER 1

INTRODUCTION

Technological advancements accommodate consumers' demands and expectations, allowing them to rapidly form and change their tastes and preferences(Anning-Dorson, 2016). Organizations have to adapt and innovate quickly to meet the consumers' wants and stay relevant and viable (Poutanen et al., 2016; Somech & Drach-Zahavy, 2013; Turner & Baker, 2020; van de Wetering et al., 2017; Wipulanusat et al., 2017). Frequently, today's organizations operate in an ever-increasingly complex and ambiguous environment, requiring them to be more creative and innovative than their competitors (Anning-Dorson, 2016; Turner et al., 2019). However, innovation requires multiple individuals to create creative solutions for complex and ambiguous problems (Turner & Baker, 2019). As such, organizations increasingly turn to teams to drive the creativity and innovation needed to stay viable and competitive (Turner et al., 2019; Wipulanusat et al., 2017): Fortune 1000 firms increased their use of team-based structures from less than 20% in 1980 to roughly 50% in 1990, to over 80% in 2000 (Hollenbeck et al., 2012), to 91% in 2018 ("Teamwork in Business," 2018).

Most research efforts separated creativity and innovation as different constructs and linear processes: The first step, creativity, which is the idea generation, and the second step, innovation, which is the idea implementation (Anderson et al., 2014; Oman et al., 2013; Somech & Drach-Zahavy, 2013). However, team C/I is a nonlinear process that is dynamic and cyclical (Kumar et al., 2019; Poutanen et al., 2016; Turner & Baker, 2020) that requires non-sequential methodologies and complex perspectives (Anderson et al., 2014; Poutanen et al., 2016; Turner & Baker, 2020). For this reason, complexity theory (i.e., complexity sciences) offers a useful approach to conceptualize the complex nature of team C/I because it "provides an integrative and dynamic framework to understand the interaction patterns in networks of interdependent agents who interact and are bound by their common needs or objectives" (Borzillo & Kaminska-Labbé, 2011, p. 356).

However, Poutanen et al. (2016) observed that current complexity-based research was primarily explorative and metaphorical; hence, lacking conceptual and theoretical coherence. To make the complexity-based approach more useful, they recommended future research bridge complexity theory with innovation based on validated empirical evidence. As such, complex adaptive systems (CAS), a subset of complexity theory, serves as the bridge between innovation and complexity theory because CAS is a more coherent theory (Poutanen et al., 2016) that facilitates methodological approaches to explain the outcomes of complex, dynamic, and nonlinear interactions (van de Wetering et al., 2017). Previous research identified entities and functions as complex adaptive systems; for example, teams as CAS (G. Chen et al., 2013; Hoogeboom & Wilderom, 2020; Ramos-Villagrasa et al., 2018) and portfolios of agile projects as CAS (Sweetman & Conboy, 2018). Turner and Baker (2020) argued that the processes of team C/I have similar traits as CAS, such as "self-organization, emergence, adaptation, evolution, need for feedback and nondeterminism (p. 31); "thus, creativity and innovation are CAS" (p. 15). Accordingly, they created a new composite theory named Creativity and Innovation Processes as CAS that integrates eight creativity and innovation theories with the eight characteristics of a CAS: (a) path-dependent, (b) systems have a history, (c) nonlinearity, (d) emergence, (e) irreducible, (f) operates between order and chaos, (g) adaptive, and (h) self-organizing. (Turner, 2019). Subsequently, they created a survey instrument to test their composite theory to determine if a team's creativity and innovation processes are the same as complex adaptive systems. Indeed, if a team's creativity and innovation processes are CAS, then managers and leaders could use Turner and Baker‘s (2020) composite theory to “inform their creativity and innovation processes from a complexity theory perspective” (p. 34).

Problem Statement

Charles Darwin said, “it is not the strongest of the species that survive, nor the most intelligent, but the one that is most responsive to change” (Poutanen et al., 2016, p. 205). This is especially true for long-established companies being disrupted by younger, faster-moving, and more innovative challengers (Anning-Dorson, 2016; Turner et al., 2019). In fact, McKinsey & Company, a global consulting firm, reported the average tenure of Standard & Poor’s (S&P) 500 companies have gone from 35 years in the late 1970s to 20 years as of today and then projected to drop even further down to 12 years in 2027 (Hillenbrand et al., 2019). Consequently, companies are becoming increasingly dependent on teams–the “basic building blocks of modern organizations” (Wipulanusat et al., 2017, p. 59)–to drive creativity and innovation, which usually involves multiple teams working together to solve complex problems (Turner et al., 2019). Consequently, 91% of 1000 Fortune companies in 2018 used team-based structures to conduct business (“Teamwork in Business,” 2018). However, the first problem is that work teams do not always manage creativity and innovation well, especially when partnering with other work teams on highly complex projects that demand greater interdependence and collaboration (Edmondson, 2012; Khedhaouria & Ribiere, 2013), which can constitute as much as 90% of today’s organizational projects (Turner & Baker, 2019a). The second problem is that researchers struggled mightily with defining and measuring creativity and innovation for the past decade resulting in significant variation both within and between creativity and innovation scales that have restricted meaningful theoretical discoveries and advances (Hughes et al., 2018). To illustrate, Hughes et al. (2018) demonstrated in Table 1 the wide disparity of the two constructs’ conceptualization among the past decade's 164 current empirical literature, which has harmed the quality of the measurement tools available to researchers and practitioners.

Table 1

Conceptual Markers Used when Defining Workplace Creativity and Innovation

Conceptual properties of creativity definitions (N = 96)	%	Conceptual properties of innovation definitions (N = 68)	%
Generation of new/novel/ original ideas	95.83	Problem recognition	4.41
Generation of useful/ applicable ideas	95.83	Create new ideas/products/ processes	55.88
		Introduce or adopt new ideas etc.	26.47
		Modify or adapt creative ideas	8.82
		Promoting/championing Ideas	11.76
		Implementation or application	75.00
		Organizational benefit	22.05

Note: % = the percentage of articles within our cache that defined creativity or innovation with this property.

Source: Hughes et al., 2018, p. 551.

Despite the mix-up in current literature, Hughes et al. (2018) came to the same conclusion as the current study in that creativity and innovation should be combined because they saw "innovation as a broad construct that subsumes creativity" (p. 551), resulting in a more accurate construct delineation that could lead to a unifying framework and practical measurements. Instead, besides one empirical research study, Hughes et al. (2018) revealed that the creativity and innovation scales varied in their assessment of "persons/traits, processes/behaviors, and products/performance" (p. 562; see Table 2 herein), causing an entanglement of a complex set of relationships and non-unified frameworks. Moreover, 5 out of 6 creativity and innovation scales in Table 2 were poorly constructed and lacked structural analysis (i.e., factor analysis) for confirming construct validity (Hughes et al., 2018). For these reasons, Hughes et al. (2018) fervently called on researchers to develop new scales for assessing workplace creativity and innovation that “offer clear facet-level measurement and scales that distinguish between person, processes, and product” (p. 563).

Table 2

Summary Statistics from a Content Analysis of Items from Commonly Used Workplace Creativity and Innovation Scales

Scale name	Authors	Total	What is assessed No. of items (%)				Facet No. of items (%)			
			Creativity	Innovation	Both	Neither	Person	Process	Press	Product
Creativity	Zhou and George (2001)	13	5 (38%)	4 (31%)	1 (8%)	3 (23%)	3 (23%)	3 (23%)		7 (54%)
Employee creativity	Tierney et al. (1999)	9	6 (67%)		2 (22%)	1 (11%)	1 (11%)	3 (33%)		5 (56%)
Creative performance	Oldham and Cummings (1996)	3	1 (33%)	1 (33%)	1 (33%)					3 (100%)
Innovative work behavior	De Jong and Den Hartog (2010)[a]	10	1 (10%)	6 (60%)	2 (20%)	1 (10%)		7 (70%)		3 (30%)
Innovative work behavior	Janssen (2000)	9	2 (22%)	6 (67%)	1 (11%)			6 (67%)		3 (33%)
Innovative behavior	Scott and Bruce (1994)	6	1 (17%)	4 (67%)	1 (17%)		1 (17%)	4 (67%)		1 (17%)

Note: Total = total number of scale items.
[a] This scale was designed to assess four sub-factors but the authors suggest using a single scale-score, thus, this analysis of the scale as a whole is appropriate.

Source: Hughes et al., 2018, p. 562.

Meanwhile, if teams are the epicenter of complex work projects that propel organizational creativity and innovation, then more must be known about teams’ creativity and innovation processes. Copious research showed that teams of people are best suited to produce more innovative ideas of greater scope and complexity and better manage the size of the tasks needed for innovation over individuals (Edmondson, 2012; Sarooghi et al., 2015). With the vast majority of Fortune 1000 organizations leveraging team-based structures (“Teamwork in Business,” 2018) to produce innovative goods and services (Rosing et al., 2018) for capricious customers (Im et al., 2013), the study of teams’ creativity and innovation processes is essential for researchers and practitioners alike. However, as Hughes et al. (2018) pointed out earlier, researchers and practitioners alike will continue to struggle aimlessly without accurate and appropriate creativity and innovation measurements constructed from more reliable and useful theories.

Per Hughes et al.'s (2018) recommendation, this requires researchers to "think creatively to address the measurement, study design, and theoretical concerns above, so that the field can build and examine theoretical propositions in a manner that produces accurate and reliable policy recommendations" (p. 565). Hence, the next several sections describe how the current study answers Hughes et al.'s (2018) call to develop and validate a more meaningful and accurate tool to measure workplace creativity and innovation based on structurally sound and useful theories.

Significance of the Study

The current study was significant for the following key reasons:

1. Thinking creatively to address the measurement, study design, and theoretical concerns of creativity and innovation, I identified and measured creativity and innovation based on CAS characteristics that come from complexity and CAS theories, which is radically different from the current literature that focused on creativity being an idea generator and innovation being an idea implementor.

2. I solely identified and measured creativity and innovation *processes* rather than what others have done to measure people, processes, and products.

3. I conducted a quantitative study design to validate an instrument that measures team C/I based on complexity and complex adaptive systems theories. Unlike the plethora of other current empirical literature, the current study attempted to determine construct validity using factor analysis to ensure proper scale construction (Hughes et al., 2018). As a result, recognizing team C/I processes as CAS can facilitate change in the epistemology of team C/I processes, allowing researchers to "(a) adopt a different logic of inquiry, (b) to deal with temporal issues,

(c) to raise the level of theoretical sophistication, and (d) thus to lead to better practical applications" (Ramos-Villagrasa et al., 2018, p. 136).

Purpose of the Study

The current study aimed to test an instrument that measures team C/I processes as CAS—utilizing AMOS 26.0. The first part of the study employed exploratory factor analytic strategies to examine the eight measurement models' hypothesized factor structure by estimating model fit and reliability across multiple organizational teams, including industries, employee levels, and functional roles. Subsequently, the endogenous variable (i.e., dependent variable) identified was the creativity and innovation process, whereas the eight exogenous variables (i.e., independent variables) identified were (a) path-dependent, (b) systems have a history, (c) nonlinearity, (d) emergence, (e) irreducible, (f) adaptive, (g) operates between order and chaos, and (h) self-organizing (Turner, 2019). The second part of this investigation applied confirmatory factor analytic strategies to check on the constructs and identify the model fitness. This was conducted by following a three-step data pruning process, second-order confirmatory factor analysis, and nested models.

Theoretical Foundation

The current study's theoretical foundation was based on Turner and Baker's (2020) theory of team C/I processes as complex adaptive systems (CAS). In that theory, complexity theory and complex adaptive systems theory provide the theoretical framework to explain how a work team's creativity and innovation processes are the same as the eight CAS's characteristics.

First, complex adaptive systems are path-dependent in which future outcomes are sensitive to their initial conditions. For example, a work team's ability to launch a successful product is contingent on having available resources (Amabile, 1988).

Second, complex adaptive systems have a history, meaning that past successes, failures, and experiences can impact their future histories. Many innovative products have resulted from participants relying on their past experiences and knowledge to generate creative ideas and solutions (Hargadon & Bechky, 2006).

Third, as a CAS characteristic, nonlinearity is when a small change in a complex system's component can lead to a more considerable change resulting in different and unpredictable consequences (Turner & Baker, 2019b). Past research has identified creativity and innovation as separate processes using a linear approach. However, current research argues that creativity and innovation is very much a nonlinear process where innovation can occur in creativity and creativity can occur during innovation (Amabile & Pratt, 2016; Kumar et al., 2019; Paulus, 2002; Poutanen et al., 2016; Somech & Drach-Zahavy, 2013; Turner & Baker, 2019b). The current study continues to advance the theory that creativity and innovation processes are iterative and achieved nonlinearly.

Fourth, CAS's emergence characteristic occurs when the restructuring of two or more independent systems generates profoundly different outcomes that never existed before, nor anticipated or predicted (Poutanen et al., 2016; Srinivasan & Mukherjee, 2018; Turner & Baker, 2017). For instance, the current study advances the theory that creativity and innovation are a multilevel process where creativity and innovation can start at an individual level and then moves up to a team level and eventually up to the organizational level. Past research has failed to capture the real complexity of the creativity and innovation process that is limited solely to either the individual, team, or organization (Anderson et al., 2014, 2014; Poutanen et al., 2016). In contrast, even if the creative idea or innovative solution comes from an individual, that person's ideas and thoughts have been subjected to a myriad of feedback and support from their family, friends, work colleagues, stakeholders, and supervisors (Larrasquet et al., 2016). Because creativity and innovation occur at several different levels, a multilevel perspective is needed to truly uncover, at which point the creativity and innovation attempts occur to generate novel and unpredictable outcomes (Anderson et al., 2014).

Fifth, irreducible as a CAS characteristic is the non-decomposable or irreversible process in which higher-level states cannot be reduced to their previous lower-level states because the whole is different from the sum of its parts (Turner & Baker, 2019b). Today's organizations recognize the complexity of the creativity and innovation processes, so much so that they prefer to insulate their new creativity and innovation processes from their old ones (Hillenbrand et al., 2019). For instance, parent companies are buying or creating new core businesses outside of their legacy organization to scale up their new creativity and innovation processes because the new processes are irreducible to legacy processes (Hillenbrand et al., 2019).

Sixth, the CAS characteristic, operating between order and chaos, is where optimum CAS behavior occurs, between the edges of chaos and order due to the adaptive friction among the system and its environment. Likewise, team C/I process is an iterative process full of paradoxical interactions: Creativity requires experimenting with random ideas, challenging the status quo, disrupting routines, minimal resources, and little to no consequences of failure; whereas, innovation – idea implementation – requires a disciplined process, routine execution, goal orientation, capping resources, and potentially devastating consequences (Sarooghi et al., 2015). Therefore, optimum performance and results occur when organizations empower their creative teams to operate between these two paradoxical forces of creativity and innovation and why so many organizations' innovation efforts fail (Foster et al., 2015).

Seventh, complex adaptive systems are adaptive systems because they have both order and disorder co-occurring simultaneously, which allows them to be even more malleable and resilient (Turner & Baker, 2019b). As stated previously, team C/I operates between order and chaos, with creativity being disorderly and chaotic and innovative processes demanding order and coordination. However, teams operating well between these two states improve their ability to produce more creative ideas of greater scope and complexity and better manage the size of the tasks needed for innovation (Sarooghi et al., 2015).

Lastly, complex adaptive systems provide interdependency and interaction between their parts while maintaining diversity throughout the entire system (Turner & Baker, 2019b). Regarding team C/I, Turner and Baker (2019b) suggested that self-organizing creativity and innovation processes become automatic only after the team members work on their desired projects. In other words, internal motivation plays a critical factor in influencing the self-organizing behaviors that drive creativity and innovation processes (Amabile, 1997; Chamakiotis & Panteli, 2017).

Arguably, one of the biggest challenges of complexity theory is turning the metaphorical and anecdotal evidence into more concrete applications or practical uses. That is because complexity theory provides a macro perspective that includes the basic set of principles, theories, ideas and approaches of team C/I processes, which explains why many of the reviewed studies on complexity theory were of an exploratory nature that used metaphorical explanations and anecdotal evidence to describe such phenomena (Fenwick, 2012; Poutanen et al., 2016; Speakman, 2017). For this reason, this study employed the CAS theory as it expands and strengthens complexity theory by offering a micro perspective and framework to explain how team C/I processes occur as a phenomenon. Furthermore, Poutanen et al. (2016) recommended bridging innovation and complexity theory with empirical evidence, which would validate the complexity-based approach. Therefore, the current study collected empirical evidence using a quantitative study design to verify whether team C/I processes are CAS. Figure 1 is a concept map of Chapter 2: the literature review that shows up to the third level heading. The concept map's purpose is to reveal the macrostructure of my dissertation proposal to help the readers "see the forest from the trees."

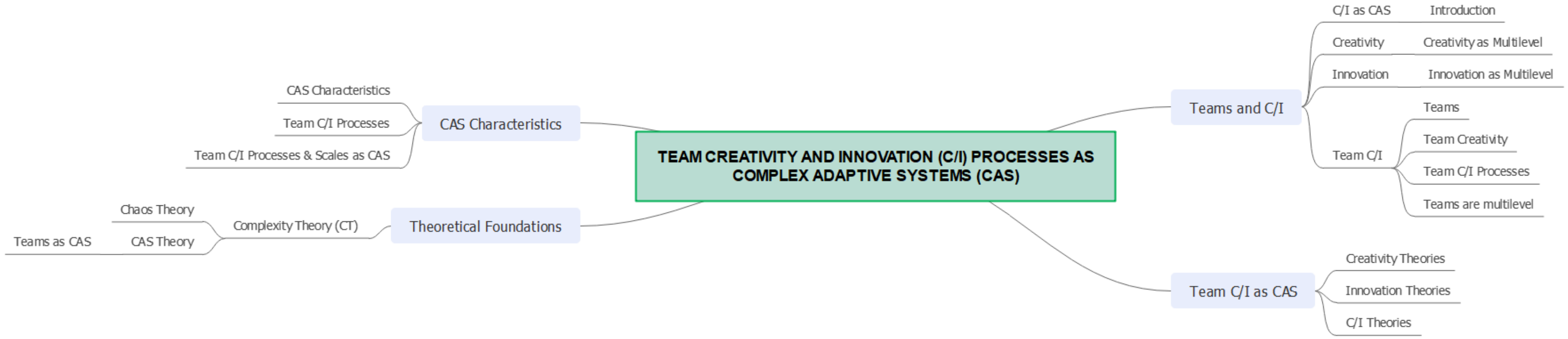
Nature of the Study

The current study used a quantitative survey design that offers validity tests for association among a population's variables by studying a population sample (Creswell & Creswell, 2018). The current study utilized a survey design that provides quantitative tests for associations among a population's variables by studying a population sample (Bernard, 2013). As such, survey designs help the researcher answer descriptive questions, discover relationships between variables, and make predictions about the variables' relationships and interactions (Creswell & Creswell, 2018).

Therefore, this research sought to validate a survey method that identifies the observable variables that make up the eight latent factors of CAS characteristics and test the relationships between the observable and latent variables of TCI-scales as CAS. Another advantage of using the survey design approach is the economy of scale and quick data collection turnaround (Creswell & Creswell, 2018). Conversely, an experimental design was not considered because of the risk of causing demand characteristics where "research project cues may influence or bias participants' behaviors such as suggesting the outcome or response that the experimenter expects or desires" (American Psychological Association, n.d.). Also, conducting experiments during the ongoing Coronavirus 2019 (COVID-19) pandemic where people practice social distancing was deemed infeasible.

Figure 1

Conceptual Map of the Literature Review



The current study utilized Hinkin et al.'s (1997) seven-phase approach for developing reliable and valid measurement instruments within the survey design framework since Turner's (2021) TCI-Scale instrument has never been deployed in the field. Therefore, Hinkin et al.'s (1997) approach included the following seven phases:

1. The first phase is where scale development started with producing the survey items.
2. In the second phase, content adequacy was evaluated to verify the survey items' conceptual consistency.
3. The third phase was administering the questionnaire, which included determining the item's appropriate sample size and defining scales.
4. Phase 4 included the use of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to minimize items and test the significance of the hypothesized scales.
5. The fifth phase included checking the instrument's reliability via Cronbach's alpha test of internal consistency.
6. The sixth phase validated the construct validity by assessing the convergent and divergent validity.
7. The seventh and final phase may involve replicating the study with the new scales, repeating the scale-testing process. However, the current study skipped this phase because it fell beyond its reach and scope.

In the first phase (i.e., item generation), the TCI-scales were generated using both inductive and deductive methods for evaluating their constructs (Hinkin et al., 1997). For the inductive method, Turner and Baker (2019b) created the 63 TCI-scale items after collecting and analyzing the qualitative data from professional artists (i.e., creativity and innovation experts) regarding their creativity and innovation processes. The current study utilizes the deductive method, a strategy that starts with a theoretical explanation from which the items are generated to assure the final scale's adequacy (Creswell & Creswell, 2018) by focus-coding Turner and Baker's (2020) theoretical descriptions of TCI-scale as CAS items and other related literature.

In the second phase (i.e., content adequacy), Turner and Baker (2019b) consulted with team C/I experts to solidify the 63 TCI-scale items' content validity (Thorn & Deitz, 1989).

Third, in the survey administration phase, the current study employed third-party online survey panels to gather convenience samples in which respondents are chosen based on their availability (Creswell & Creswell, 2018). Convenience sampling was used because the current study's primary purpose was to test a theoretical model that has never been empirically tested before (Bernard, 2013). Further, convenience sampling is useful for collecting large sample sizes (Creswell & Creswell, 2018) since scale creation usually involves broad sample sizes due to factor analysis using several correlation coefficients (Costello & Osborne, 2005). Hence, the current study collected 343 sample sizes each for its exploratory and confirmatory factor analyses for a total of 600 survey respondents based on a statistical power calculation, which many experts consider to be the best method for determining the minimum sample size requirement (Costello & Osborne, 2005; Creswell & Creswell, 2018; Henson & Roberts, 2006; Huck, 2012; Tabachnick et al., 2019).

For determining the accuracy and reliability of the TCI-scale measuring team creativity and innovative processes, the fourth phase used exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). As an exploratory strategy, EFA's primary objectives are to determine the factors that influence variables and examine which variables belong together (Henson, 2010; Hinkin et al., 1997). Subsequently, as a confirmation strategy that is first derived from theories and hypotheses (Hancock et al., 2018), CFA reinforces EFA results by verifying the measurement scale's validity (Wipulanusat et al., 2017). Confirmatory factor analysis uses path analysis models to represent variables and factors to test hypotheses. Chapter 3 delves deeper into the composition and analysis of the current study's path analysis mode (see Figure 4); in the meantime, the oval shapes on the left-hand side are the hypothesized eight latent factors of CAS characteristics, and the squared shapes on the right-hand side are the 63 TCI-scaled items or observable variables. The underlying complexity and CAS theories determined the non-directional relationships between the eight latent factors of CAS characteristics and the 63 observable items: Team C/I processes work in tandem and have a nonlinear relationship because creativity can occur during innovation and innovation can occur during creativity, at various points and time throughout the process. In summary, an EFA was conducted to determine the CAS characteristics' factors and examine which of the 63 observable variables or items belong together; subsequently, a CFA was performed to confirm the EFA's measurement scale's validity.

The fifth phase consisted of testing the TCI-scales' internal consistency and reliability using Cronbach's alpha, representing the mean association between each pair of survey items and the number of items comprising a total factor (Bandalos & Finney, 2018b). Based on George and Mallery's (2016) recommendation, the current study sought alphas larger than .70, which indicates that a sampling domain has been adequately captured.

The sixth and seventh phases included determining construct validity and replicating the scales construction study, respectively. Construct validity was ascertained in the fourth phase because the convergent and divergent validities were calculated during CFA to confirm construct validity (Danks, 2016; Hinkin et al., 1997; Huck, 2012; Wipulanusat et al., 2017). As for replicating the scales study, this was outside the current study's scope and was not replicated.

Scope and Delimitations

The current study focused primarily on the eight latent variables (path-dependent, systems have a history, nonlinearity, emergence, irreducible, adaptive, operates between order and chaos, and self-organizing) and 63 observable variables or survey items—the current study concentrated mainly on the non-directional relationships identified by the path-analysis model in Figure 2. Any findings outside of these relationships will be recommended for future research but were not analyzed thoroughly during the current study.

The current study attempted to capture participants' perceptions to better understand how team C/I processes take place as CAS among team members in the workplace. The participants in the study were limited to information technology or IT workers in the United States. The current study was delimited to the participants' survey results, assuming that their responses were based on their most recent workplace team experience.

The current set of measures have not been compiled together in any previous study. A comprehensive confirmatory factor analysis (CFA) was conducted on the current study's measures. The CFA results may alter the original non-directional relationships in the path-analysis model. As a consequence of the CFA outcome, any adjustments required are identified at the time, and per Bandalos and Finney's (2018) recommendation: report the poor model fit rather than trimming the variables. The current study based its findings on the results from the CFA.

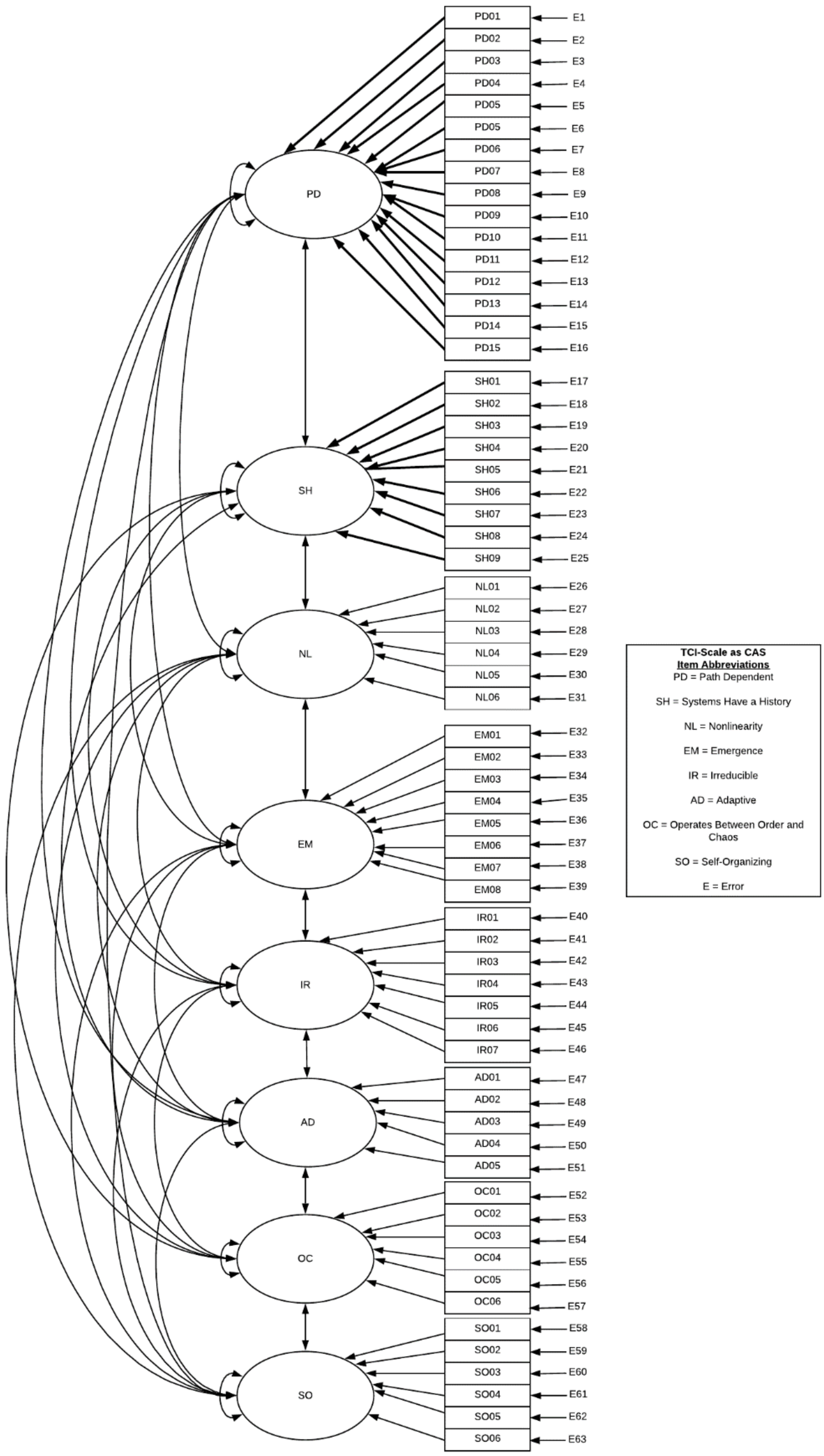
Limitations

The current study's design captured how team C/I processes occur as CAS among workplace teams. Every effort was made to construct a high-quality study that would yield rigorous data analysis. Each study, however, has its own constraints, and the current study is no exception. The following were limitations for the current study:

Qualtrics' survey-panels provided the pool of participants for the current study. Qualtrics is a private research software company that partners with over 20 web-based platform providers to supply diverse participants.

Figure 2

Path Analysis Model: TCI-Scales as CAS



The current study participants agreed to complete surveys via the Internet in exchange for a form of compensation (small amounts of money or reward points). The current research did not attempt to infer results to the general population, recognizing that the participants sampled were from a particular pool given by Qualtrics.

The current study used a convenience sample in which respondents were chosen based on their convenience and availability (Creswell & Creswell, 2018). The primary advantage of using a convenience sample is that the sample is made available to the researcher; however, the disadvantage is that no definitive generalization can be made to any specific population (Creswell & Creswell, 2018). The convenience sample was appropriate for the current study because its primary purpose was to test a theoretical model that has not been empirically tested before.

The current study was limited in its conclusions since it only looked at the relationships between the eight CAS latent variables and 64 observable items. Due to the current study being a correlational research study, no causality claims could be made. A better understanding of the team C/I process's causal nature would contribute to the literature. However, given that the current study confirmed particular relationships, future studies can assess if causality is involved.

The current study asked professionals in the workplace to reflect on their experiences from working on a recent team or small group in which they participated in discussions and decision-making functions. The participants' answers were their perceptions of team C/I, based on their most recent work experiences. The current study was limited based on participants' responses based on their own perceptions of team C/I.

Definitions of Terms

- *Adaptive*: One of Turner and Baker‘s (2019b) eight CAS characteristics where both order and disorder co-occur, allowing complex adaptive systems to be more malleable and resilient.

- *Complex adaptive systems (CAS)*: "A network of many agents acting in parallel, where control is highly dispersed, where coherent behavior in the system arises from competition and co-operation among the agents themselves, where there are many levels of organization, with agents at one level serving as the building blocks for agents at a higher level, where there is constant revising and rearranging of their building blocks as they gain experience, where the agents constantly test the implicit or explicit assumptions about the environment" (Waldrop, 1995, pp. 145-146).

- *Complex system*: "A complex system is comprised of a large number of nonlinearly interacting non-decomposable elements. The interactivity must be such that the system cannot be reducible to two or more distinct systems, and must contain a sufficiently complex interactive mixture of causal loops to allow the system to display the behaviors characteristic of such systems" (Richardson, 2010, p. 14).

- *Complexity theory (CT)*: Complexity theory is a dynamic framework that explains the nonlinear, random, unpredictable, and chaotic interplay between creativity and innovation (Poutanen et al., 2016; van de Wetering et al., 2017), which allows researchers to better explain today's complex problems (Turner & Baker, 2019a).

- *Creativity*: Creativity is commonly characterized as original, useful ideas beyond routines and traditional assumptions and experimentations (Rosing et al., 2011); creativity is also considered by many as the first step in innovation (Anderson et al., 2014).

- *Emergence*: One of Turner and Baker's (2019b) eight CAS characteristics in which restructuring two or more interdependent systems generate profoundly different outcomes that never existed before nor anticipated or predicted.

- *Innovation*: Defined as "[t]he intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit role performance, the group, the organization or the wider society" (West & Farr, 1989, p. 16). If creativity is the generation of novel ideas, then innovation could be identified as the successful implementation of those novel ideas (Amabile & Pratt, 2016).

- *Irreducible*: One of Turner and Baker‘s (2019b) eight CAS characteristics is that non-decomposable or irreversible process in which higher-level states cannot be reduced to their previous lower-level states because the whole is greater but *different* from the sum of its parts.

- *Nonlinearity*: The relationship between the CAS and the entire CAS components from which a small change can disproportionately change its entirety.

- *Operates between order and chaos*: One of Turner and Baker‘s (2019b) eight CAS characteristics where optimum CAS behavior occurs between the edges of chaos and order due to the adaptive friction among the system and its environment.

- *Path-dependent:* One of Turner and Baker‘s (2019b) eight CAS characteristics in which sensitive dependence on initial conditions causes the same force to impact CAS differently (Speakman, 2017).

- *Process*: "A natural phenomenon marked by gradual changes that lead toward a particular result; a series of actions or operations conducing to an end" (Merriam-Webster, n.d.–b).

- *Self-organizing*: One of Turner and Baker‘s (2019b) eight CAS characteristics in which CAS provides interdependency and interaction between its parts while maintaining diversity throughout the system.

- *Systems have a history*: One of Turner and Baker's (2019b) eight CAS characteristics in which the CAS's future behavior depends on its initial beginning and later histories.

- *TCI-scales*: This being a new construct, the current study defines it as the observable items or variables that show how the processes of team C/I have similar characteristics as CAS: path-dependent, systems have a history, nonlinearity, emergence, irreducible, operates between order and chaos, adaptive, and self-organizing (Turner & Baker, 2019b, 2020). The underlying theoretical foundation for TCI-scales is driven by complexity and CAS theories in which nonlinear creativity and innovation processes work in tandem resulting in unpredictable requirements that ensue over time.

- *Team*: Defined as multiple agents working independently and interdependently toward a common goal (Salas et al., 2017; Turner, 2014).

- *Team creativity and innovation (C/I):* Team creativity and innovation (C/I) combined incorporates both the generation of novel ideas (creativity) and the implementation of those ideas (innovation) as a single unit (Amabile & Pratt, 2016; Anderson et al., 2014; Somech & Drach-Zahavy, 2013; Turner & Baker, 2020; Wipulanusat et al., 2017).

CHAPTER 2

LITERATURE REVIEW

This study aimed to test an instrument that can measure the combined processes of team C/I as a CAS. Longitudinal studies of Fortune 1000 firms have shown a steady increase in the use of team-based structures, from less than 20% in 1980 to roughly 50% in 1990 to over 80% in 2000 (Hollenbeck et al., 2012) to 91% in 2018 ("Teamwork in Business," 2018). The current study was necessary for several reasons. First, understanding the components that influence team C/I is advantageous for organizations that rely on their teams to drive innovation. Second, team C/I are complex and challenging phenomena to measure, requiring theoretical perspectives that entail complexity and unpredictability (Larrasquet et al., 2016; Torugsa & Arundel, 2016). Finally, this study filled a gap in the current literature that lacks empirical measures for team C/I processes (Anderson et al., 2014; Poutanen et al., 2016), especially when viewed together and as a CAS.

Chapter 2 includes a discussion and review of research on creativity, innovation, the combination of creativity and innovation, and how creativity and innovation are demonstrated among teams within organizations. Following is a discussion of the study's theoretical foundation, based on Turner and Baker's (2020) theory of team C/I as a CAS. A review of the research on the team C/I processes and the eight CAS characteristics follow.

Literature Search Strategy

A systematic, comprehensive search was conducted using the University of North Texas' online library portal to locate research for the literature review. The search included the following search tools and databases: Academic Search Complete EBSCOhost, Academic Search Premier, Google Scholar, JSTOR, SAGE, and Web of Science (using Business and

Economics). The terms *team creativity* OR *team innovation* and *complex adaptive systems* AND *team* were used to search full-text articles with publication dates between January 1, 2010, to December 31, 2020. Additional qualifiers included articles being peer-reviewed and published in English. Abstracts of articles were screened to determine if they were relevant to the study. The first screening process also involved removing duplicate articles. The second screening process involved scanning the articles and removing any that failed to mention team creativity or team innovation. Also, articles with abstracts solely mentioning creativity as an attribute versus a process were removed from the selection, resulting in a count of 143 references. I also added three highly-cited articles, all considered seminal literature on creativity and innovation published before 2010. Finally, I included five books and five articles referenced in Turner and Baker's (2020) manuscript regarding creativity and innovation processes for a total count of 153 resources. Subsequently, I followed a strict protocol of merely citing from the 153 references to avoid confirmation bias and publication bias-like behaviors.

Teams and Creativity/Innovation (C/I)

This study tested the reliability and validity of a survey instrument that measures team C/I as a CAS. Despite innovation and creativity being increasingly important in the modern workplace for organizational survival (Anderson et al., 2014), "measuring creativity in teams is a can of worms" (Jiang & Zhang, 2014, p. 265) because team creativity is more complicated than simply adding the creativity of individuals together (Amabile & Pratt, 2016; Gong et al., 2013; Jiang & Zhang, 2014). Team creativity is not an aggregate of individual efforts. Much of the measurement difficulty and confusion stems from identifying whether creativity and innovation are linear or nonlinear processes (Anderson et al., 2014). Researchers traditionally identified creativity and innovation as linear processes that follow a sequential pattern in which the response or output is directly proportional to the input; creativity is the first stage where ideas are generated, and innovation is the second stage where ideas are implemented (Rosing et al., 2018; Wipulanusat et al., 2017).

On the other hand, researchers argued that creativity and innovation are nonlinear processes in which the processes overlap and intersect with one another (e.g., creativity can occur in innovation and vice versa) (Kumar et al., 2019; Oman et al., 2013; Paulus, 2002; Somech & Drach-Zahavy, 2013; Turner & Baker, 2020). Nonlinear processes often have disproportionate results where a small change can lead to a more substantial overall change (Jiang & Zhang, 2014; Werder & Maedche, 2018).

Accordingly, this study's instrument reflects the view that creativity and innovation are nonlinear processes that encompass both creativity and innovation (Kumar et al., 2019; Paulus, 2002; Somech & Drach-Zahavy, 2013; Turner & Baker, 2020; Wipulanusat et al., 2017). To validate the complexity-based approach, Poutanen et al. (2016) challenged researchers to conduct team C/I studies that use quantitative empirical evidence to bridge innovation and complexity theory (CT). This study is designed to meet that challenge by validating a survey instrument that empirically measures team C/I.

Overview of Creativity/Innovation (C/I) as Complex Adaptive Systems (CAS)

The underlying theoretical framework of Turner's (2021) Team C/I Processes as CAS instrument is based on Turner and Baker's (2020) theory of creativity and innovation (C/I) processes as complex adaptive systems (CAS), in which the researchers used eight characteristics of complex adaptive systems and the elements of multiple creativity and innovation theories to synthesize a composite theory of the innovation process from the perspective of complexity theory. Table 3 summarizes the definitions of each of the eight CAS characteristics.

Table 3

Summary of the CAS Characteristics

CAS Characteristic	Description
Path Dependent	Sensitive dependence on initial conditions in which the same force could impact CAS differently (Turner & Baker, 2020), aka the "Butterfly Effect" (Speakman, 2017).
Systems have a history	CAS's future behavior depends on their initial beginning and later histories (Turner & Baker, 2019a).
Nonlinearity	Relationship between the components in the CAS and the entire CAS from which a small change in a component can disproportionately change its entirety (Turner & Baker, 2020; Werder & Maedche, 2018)
Emergence	Process in which the restructuring of two or more interdependent systems generates profoundly different outcomes that never existed before nor anticipated or predicted (Poutanen et al., 2016; Turner & Baker, 2017). Put simply, the whole is greater but *different* than the sum of its parts (Turner & Baker, 2019a).
Irreducible	Non-decomposable or irreversible process in which higher-level states cannot be reduced to their previous lower-level states because the whole is *different* from the sum of its parts (Turner & Baker, 2019a, p. 10).
Adaptive	CAS are adaptive systems because they have both order and disorder occurring at the same time, which allows them to be even more malleable and resilient (Turner & Baker, 2019a)
Operates between order and chaos	Optimum CAS behavior occurs between the edges of chaos and order due to the adaptive friction among the system and its environment (Speakman, 2017; Turner & Baker, 2020).
Self-organizing	CAS provides interdependency and interaction between its parts while maintaining diversity throughout the entire system (Turner & Baker, 2020)

Source: Turner & Baker, 2020. CAS = Complex Adaptive Systems; 1 = Theory of Creative & Innovative Processes as CAS

Put simply, this new composite theory integrates various team C/I theories with the eight characteristics of a CAS. Results provided support for identifying team creativity and innovative processes as a CAS. Each of the eight characteristics of a CAS was supported in their qualitative research study (Turner & Baker, 2020). To expand upon these results, a survey instrument was developed with items for each of the eight characteristics of CAS relating to team C/I processes as a CAS.

The following sections cover how current literature discusses creativity, innovation, and creativity and innovation combined. Special attention is given to team C/I processes. Following is an introduction to complexity theory, which serves as the theoretical perspective that focuses on team C/I processes' macrostructures. To better reflect real-life complexity, CAS theory is subsequently introduced as the framework that provides a micro-view of the team C/I processes (Turner & Baker, 2019a). From that micro perspective, this study confirmed how Turner and Baker's (2020) research provided support for each of the eight CAS characteristics previously identified from the literature. Equally important, a synthesis of ten different creativity and innovation theories was conducted to reveal any relationships between the team C/I processes with the eight CAS characteristics. Further, the researcher adopted a descriptive or literal coding method to match the survey items with their team C/I components and then categorizes them under one of the eight CAS characteristics. As a result, this study utilized both a macro-view or top-down approach (such as CT) and a micro-view or bottom-up approach (such as the CAS framework) to ascertain that team C/I processes are indeed CAS.

Creativity

Creativity and innovation are similar but distinctively different constructs (Anderson et al., 2014), even though they are often confused with being the same (Turner & Baker, 2020). Put simply, creativity is often seen as the first step of innovation where ideas are first generated, whereas innovation is implementing those ideas (Anderson et al., 2014; Wipulanusat et al., 2017, p. 58). Creativity is commonly referred to as an individual activity, especially in the workplace, where a single person generates an idea that could provide a tangible and useful outcome for an organization (Wipulanusat et al., 2017).

The creativity process is often thought of as "thinking outside the box" with something new, novel, or original (Oman et al., 2013; Turner & Baker, 2020). Moreover, this novelty or originality must be pragmatic and domain-specific and relate to the norms, rules, and culture of the environment (Csikszentmihalyi, 2013; Turner & Baker, 2020), or what Ford (1996) referred to as "accepted wisdom" (1996, p. 1132). Turner and Baker (2020) gave an example of networked computers' impracticality if they were invented before the advent of personal computers. Thus, the novel ideas must be deemed as being practical and relative to the environmental culture, norms, and rules.

Creativity is also a cumulative social process built on previous experiences (Giberson & Miklos, 2013; Sousa et al., 2012) and shared understanding (Harvey, 2014). Consequently, creativity is a contextual process affected by other people's actions and past situations.

Amabile (1997) showed intrinsic motivation greatly influences creative outcomes, especially when they find personal meaning or uplifting challenges when pursuing creative work. Hence, intrinsic motivation is beneficial to developing creativity (Jiang & Zhang, 2014).

Creativity is Multilevel

Although prior research identified creativity at an individual or single level construct, creativity occurs at multiple levels, such as the team or organizational levels (Gong et al., 2013). In today's complex environment of globalization and technological advancements, researchers and practitioners identify team creativity as a more influential antecedent for organizational innovativeness than individual creativity (Anderson et al., 2014; Poutanen et al., 2016; Turner et al., 2019). Team creativity is a composite of all team members' ideas, providing a better resource for resolving organizational issues as the ideas and solutions are distributed among agents (Turner & Baker, 2020). Team creativity is defined as "processes by which employees generate novel and useful ideas to solve problems related to team productivity and effectiveness" (To et al., 2017, p. 441). In this context, creativity occurs within a team setting to meet team goals. The creative process does not come to the individual or team instantaneously because it requires team members to have goal-driven tasks and purposeful interactions with each other (To et al., 2017; Turner & Baker, 2020) across time (Cirella et al., 2014). Equally important, creativity is *not* a simple aggregate of all team members' creativity (Gong et al., 2013; Somech & Drach-Zahavy, 2013). Instead, team creativity is "represented by expertise, creativity skills, and task motivation" (Turner & Baker, 2020, p. 22).

Organizational creativity refers to generating ideas to develop useful and novel products and services involving teams of people (Rosing et al., 2018). These small teams or groups work in a social network that cooperates to achieve a common goal (Cirella, 2016). To summarize, creativity is a multilevel construct because the literature identified creativity at multiple levels of analysis (individual, team, organizational).

Innovation

Innovation is defined as "the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit role performance, the group, the organization or the wider society" (West & Farr, 1989, p. 16). Alternatively, Somech and Drach-Zahavy (2013) defined it as the "successful implementation of creative ideas" (p. 685). More importantly, the resulting output must demonstrate a paradigm shift resulting from breaking away from existing principles upon which previous products were based (Larrasquet et al., 2016). Experts still debate whether or not innovation must be beneficial to be deemed as "innovative" (Hughes et al., 2018; Rosing et al., 2018). Some researchers suggested that one or more entity must value the final output or outcome for it to be called innovative (Amabile & Pratt, 2016; Anderson et al., 2014; West & Farr, 1989), while others argue that judging innovation by its usefulness or being successful is severely limiting (Drazin et al., 1999; Hughes et al., 2018). Rosing et al. (2018) sought to settle the debate by pointing out that research often confounds innovation as a process (i.e., creativity and implementation) with innovation as an outcome (i.e., innovative products). In fact, most empirical studies are heavily skewed towards identifying innovation as an outcome versus a process (Rosing et al., 2018). As a result, existing literature has minimal evidence of how innovation occurs as a useful outcome or benefit (Hughes et al., 2018; Rosing et al., 2018).

Despite the limited evidence, it is widely acknowledged that innovation is a complex process in that creativity and implementation do not proceed linearly and cannot be separated into phases or stages easily (Anderson et al., 2014, p. 1299; Larrasquet et al., 2016, p. 138; Poutanen et al., 2016, p. 190; Rosing et al., 2011). The complexity perspective stems from the paradoxical interactions between creativity and innovation where creativity (i.e., generation of novel ideas) thrives in a dynamic, unpredictable, and iterative environment, whereas innovation (i.e., successful execution of novel ideas) demands a disciplined approach full of routine procedures, fixed sequential events, and predictable results. Researchers who aligned themselves with the complex or nonlinear perspective argued that innovators could not succeed by adhering to the linear approach; yet, those same researchers ignored the linear fact that idea creation precedes idea implementation (Rosing et al., 2018). The nonlinear theorists' dilemma was that the majority of evidence lies squarely in the linear-perspective camp. As stated earlier, most empirical studies viewed innovation as a useful outcome versus a process, signifying that the linear approach was observed and measured rather than the nonlinear approach (Rosing et al., 2018).

Innovation is Multilevel

Whereas creativity can be an individual, team, or organizational construct, “innovation is a collective construct (team, organizational, community)” (Turner & Baker, 2020, p. 7). . innovation is not considered a one-dimensional construct like creativity can be; it is a multilevel construct involving groups of people or teams (Turner & Baker, 2020). Innovation is a multilevel construct where innovation starts from the team or group level to the organization’s level and even society (Turner & Baker, 2020). For innovation to progress from the team to the organizational level, Rosing et al. (2011) noted that executing creative ideas requires selling to other persons and/or groups, making it a social process. Furthermore, it requires groups of people and organizational resources to (a) implement the creative ideas and (b) drive usage or adoption of the new products or procedures by promoting its benefits (Anderson et al., 2014; Rosing et al., 2011; Sousa et al., 2012).

The multilevel and social constructs of innovation and creativity is discussed more thoroughly in the next section covering teams, team creativity, team innovation, and team creativity, all of which are multilevel and social constructs.

Team Creativity and Innovation Combined (C/I)

Current literature often described team C/I in linear terms and only focuses on either the first step (idea generation) or the second step (idea implementation) (Anderson et al., 2014; Wipulanusat et al., 2017). The innovative process is more accurately represented as a nonlinear process in which “creativity and innovation work in tandem and do not follow a straight line…creativity can occur during innovation and innovation can occur during creativity” (Paulus, 2002, p. 395). The boundaries between creativity and innovation are blurry and muddled (Anderson et al., 2014). Team C/I are also nonlinear processes that do not follow any prescriptive or sequential order in real-life (Kumar et al., 2019; Somech & Drach-Zahavy, 2013). Turner and Baker's (2020) theory of team C/I processes as CAS also holds that creativity and innovation ought to be viewed as a single process or entity.

Teams

The current study defined teams as multiple agents working both independently and interdependently toward a common goal. Teams' importance cannot be overstated since most Fortune 1000 companies rely on them to drive their creativity and innovation initiatives. Teams can generate more creative ideas and innovative solutions than individuals because they offer a range of experiences, a more in-depth collection of skills and expertise, and a greater capacity to perform challenging tasks (Sarooghi et al., 2015). Sousa et al. (2012) even went as far as to claim that "real innovation in companies is always a team effort" (p. 31).

Rosing et al. (2018) observed that the need to innovate extends beyond the typical R&D teams to other workplace teams that execute non-routine tasks and activities such as project, sales, and service teams. To narrow down the workplace team types, I cross-referenced Devine's (2002) typology of workplace teams with Hollenbeck et al.'s (2012), resulting in the following five categories: working teams, special-purpose teams, multifunctional teams, self-directed teams, and management teams. Hollenbeck et al. (2012) described these five team categories:

1. Working teams are the conventional workgroups usually found in production and service environments and are responsible for producing goods or providing services, led by managers who do most of the decision-making.

2. Special-purpose teams are formed to fulfill a particular objective or a one-time-off project (e.g., project teams and new product development teams).

3. Multifunctional, or parallel, teams are groups of people drawn from various work units or roles to perform tasks that are not well-equipped for the average organization. These teams exist parallel with the formal organizational structure to solve problems

and improve the organization, but with limited authority, they typically make suggestions to people higher up in the corporate hierarchy.

4. Self-directing or self-managing teams workgroups do not have a designated leader; participants hold a set of skills unique to a group task; group members exercise discretion over choices such as working procedures, work schedules, and labor division.
5. Management teams oversee and guide the sub-units under their command; their authority stems from its members' hierarchical rank, consisting of managers accountable for each sub-unit.

Later in Chapter 3, I expand on these five types of workplace teams because they were included in the survey instrument for participants to identify their team type when filling out their responses. Workplace teams are increasingly dynamic, cross-level, and multilevel (Turner et al., 2019), where the hierarchical boundaries between the individual, teams, and organization are blurred and impinged to bring about innovative solutions and complex problem-solving (Anderson et al., 2014).

Turner et al. (2019) reported that organizations rely more on multiteam structures to implement more extensive and complex innovative projects. Multiteams are composed of two or more teams that interact directly and interdependently towards achieving at least one shared goal. For example, I worked at an NYSE financial services firm where I was asked to lead the Change Management (CM) team, a multifunctional and special-purpose team. Our team was made up of multiple members from various backgrounds with different skill sets (e.g., sales, service, and training), including a few instructional designers. Our team, along with several other teams that included traditional working teams (e.g., software development team, service team, learning and development teams, and compliance teams), special-purpose teams (e.g., new product development team and customer-relationship teams), parallel teams (e.g., third-party consultant teams composed of external product experts and agile experts), and a management team. All these teams shared the same goal of creating a new digital financial services product estimated to increase revenue by several billion dollars in the next three years. The CM team's goal was to motivate and train the current workforce to ethically and effectively market the new product to its existing and prospective clients. The CM team interacted directly and interdependently with all the teams, especially with the management team, new product development team, and sales and service pilot teams. Sizeable organizational resources were allocated for creating the new digital product that included a multi-million budget, multiple teams, several external consultants, software engineers, and over a hundred employees dedicated to the project. The organization adopted the agile methodology to deploy the new digital product described in further detail below.

To grow and maintain innovative products, Sweetman and Conboy (2018) found that organizations rely on project portfolio management (PPM) for the multi-project management of mutual resources to optimize business advantages and achieve strategic alignment. In particular, over 95% of information systems (IS) software teams in diverse environments are employing multiple *agile* software project management approaches for pushing enterprise-wide software solutions.

Srinivasan and Mukherjee (2018) explained how agile approaches are considered an alternative process for traditional software engineering methods for designing software products and systems: agile software development differs by concentrating on software product development and customer delivery where "people focus on value, eliminate waste, work faster and produce a better quality product, manage change appropriately and focus on novel techniques of undertaking work" (Srinivasan & Mukherjee, 2018, p. 369). These achievements are spurred by agile's core focus of prioritizing and incorporating customer needs, people, and team factors (e.g., psychological safety, self-direction, team goals, conflict management) into the software development process. As a result, agile software project management approaches are often credited with dramatic improvements such as enabling teams to better manage changing priorities, improve project visibility, and increase overall productivity, as much as 85% improvement in one study.

Based on the positive results such as those listed previously, Ciric et al. (2018) found that numerous companies have extended the agile processes beyond their IS teams to executive teams (e.g., Mission Bell Winery), marketing teams (e.g., C.H. Robinson, a global third-party logistics provider), product teams for creating new farm equipment (e.g., John Deere) and fighter jets (e.g., Saab), and content teams for producing original programming (e.g., National Public Radio). Furthermore, agile's adoption trajectory is not at all slowing down but speeding up as more and more non-software companies and industries are adopting its approaches outside of software development (Ciric et al., 2018).

Meanwhile, at the portfolio level, Sweetman and Conboy (2018) pointed out (see Figure 3) that agile adopters quickly realize that agile projects command a higher degree of chaos and complexity than traditional projects for two primary reasons:

1. Agile's increased focus on coordinating customers' needs, organizational goals, and multiple teams' interactions causes "constant improvisations and interactions, potentially across hundreds of projects that cannot be managed by a traditional top-down portfolio approach" (p. 19).

2. Enterprise-wide agile projects often entail *multiple teams* of people collaborating and working simultaneously towards a common goal across different business units and departments. Traditional plan-driven projects typically follow a consecutive linear approach with delineated processes and phases where the work is handed off from one workgroup to the next. For

example, in a traditional plan-driven software project, the training-delivery workgroup is looped in at the end of the software development process when the software product is fully developed and ready for deployment. On the other hand, in an agile project, the training-delivery workgroup is brought in at the *beginning* of the software development process, even before the IS team begins developing the software product. By bringing the training team early on, the upside is that the product will be built with the end-users experience from start to finish. The downside is that agile's commitment to "'people over processes' increases the interactions both within and between projects and poses challenges for management at the portfolio level" (p. 19).

Figure 3

Differences between Portfolios of Plan-Driven Projects and Agile Projects

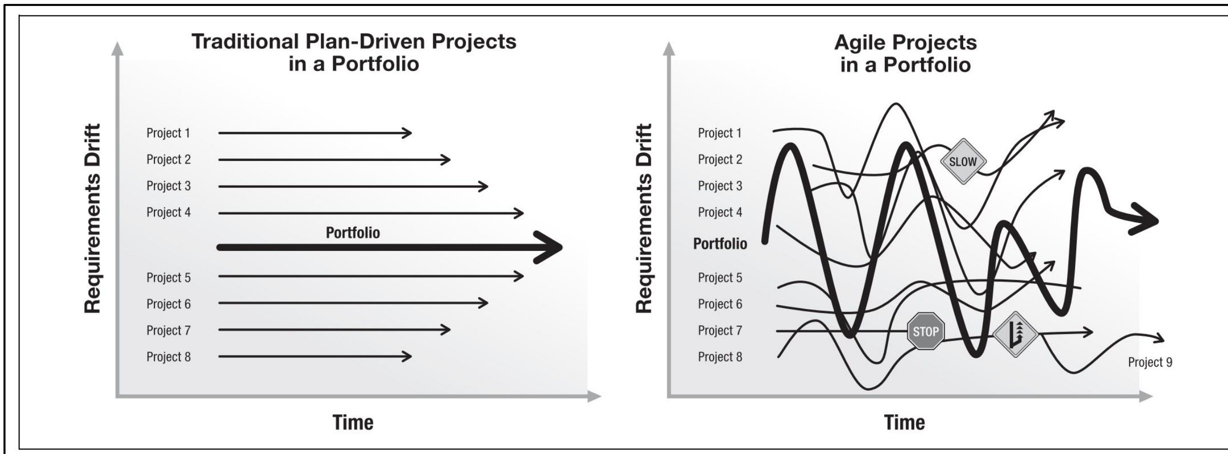


Figure 1. Differences between portfolios of plan-driven projects and agile projects.

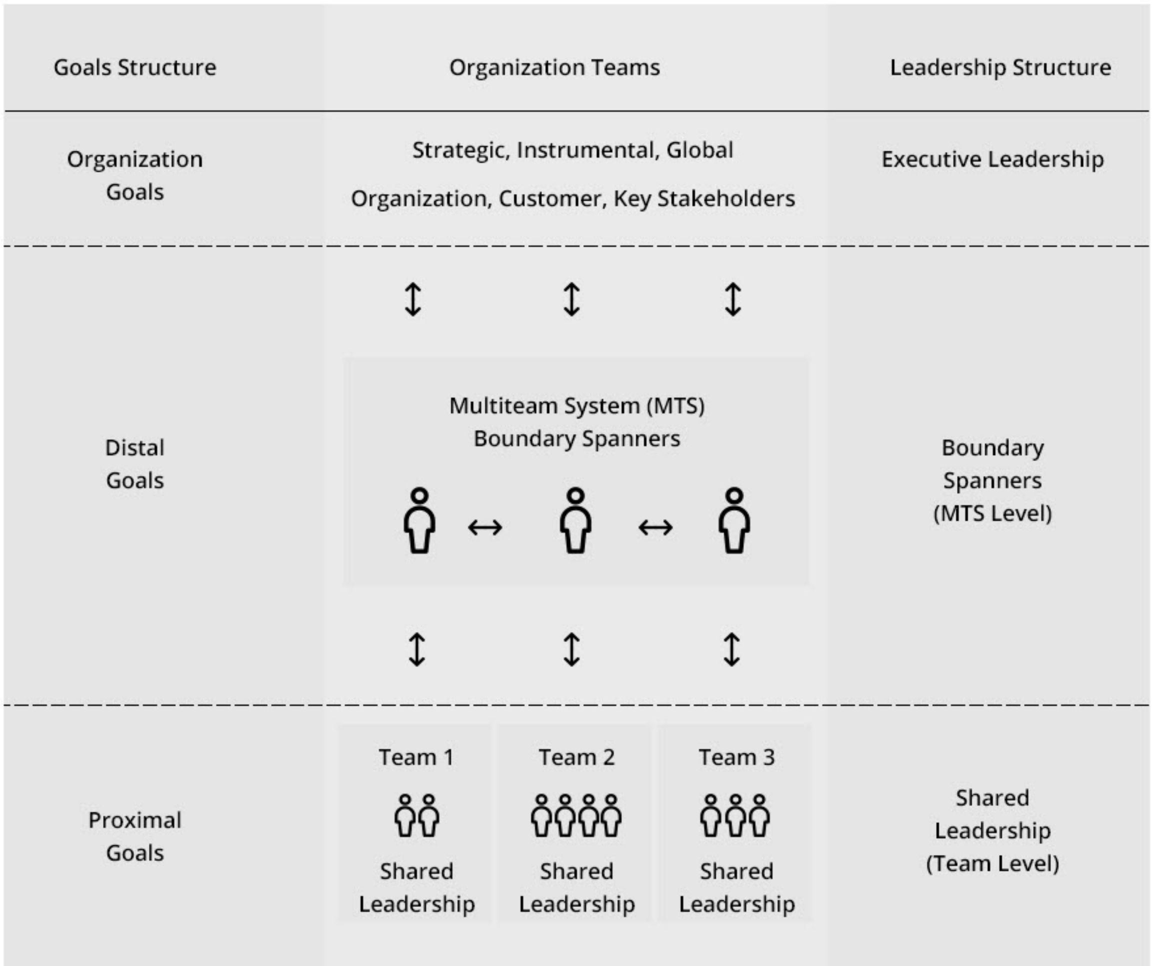
Source: Sweetman & Conboy, 2018, p. 19).

Turner et al. (2019) addressed these management "portfolio" challenges by first recognizing that teams are complex, "embedded in a hierarchy of levels and characterized by multiple, bidirectional, and nonlinear causal relations" (Turner et al., 2019, p. 7). Turner et al. (2019) further defined teams as multilevel structures because they function on two levels (individual, team) while integrated into a larger organizational structure. Understanding the multilevel perspective for teams is essential for addressing Sweetman and Conboy‘s (2018) management challenges of agile multiteams, especially since these systems already exist in today’s workplaces and are expanding throughout multiple organizations in diverse industries—already over 95% for IS teams (Sweetman & Conboy, 2018). Current organizational operations are proliferated with self-directed teams (SMT) that have multilevel performance factors comprised of “individual-level variables (e.g., autonomy, leadership, self-management skills), team-level variables (e.g., external leadership, peer control, diversity), and organization-level variables (e.g., corporate culture, organizational structure, resources)” (Turner et al., 2019, p. 6).

Turner et al. (2019) illustrated these multilevel team-performance variables in Figure 4, a multiteam systems (MTS) model where two or more teams work concurrently and interdependently towards achieving a common goal. Although the MTS model deserves more in-depth study and review, my brief synopsis remains within multilevel teams' narrow scope. The boundary spanners, composed of organizational members, play a pivotal functional leadership role by doing the following: (a) communicate extensively with the key organizational stakeholders (i.e., executive leadership, middle management, and individual component teams), (b) guaranteeing that people matter more than processes by”building a vision, empowering agile execution, cultivating psychological safety, and developing shared mental models” (Turner et al., 2019, pp. 10–11), and finally, (c) ensuring and then facilitating the alignment between the executive leadership teams’ organizational goals, middle managements’ distal goals, and the component teams’ proximal goals. Team efficiency depends on the interactions between the component teams and the boundary spanner at the higher level of the multiteam structure, “each informed by the transfer, intervention, and interpersonal process” (Turner & Baker, 2019a, p. 15).

Figure 4

MTS model.jpg



Source: Turner et al., 2019, p. 11.

Until now, there was "no multilevel team effectiveness framework that accounts for the MTS level of analysis" (Turner et al., 2019, p. 2), which makes the MTS model timely for team C/I because innovation requires multiple teams in today's organizations (Ciric et al., 2018; Rosing et al., 2018; Sousa et al., 2012). Turner et al.'s (2019) MTS model offered a way for organizations to achieve their innovation goals more effectively by providing a multilevel framework where teams of teams can work, interact, and adapt in complex and highly competitive environments.

Team Creativity

Current literature acknowledged that the concept of creativity and innovation represents the development and achievement of ideas: Creativity is the generation of novel ideas, and innovation is the implementation of those novel ideas (Rosing et al., 2018). Equally important is that team creativity is not merely the average creativity of individuals; it is the product of social forces resulting from creative actions (Gong et al., 2013). In confluence with the current study's focus on creativity and innovation processes, team processes are how team inputs are converted into outputs, and team members are engaged in activities and actions that coordinate and instigate work towards a common goal (Curşeu, 2010, p. 101). Accordingly, team creativity concerns teams' processes of generating novel ideas (Cirella et al., 2014; Hughes et al., 2018).

Team creativity begins with Curşeu's (2010) input-process-output (I-P-O) framework. Inputs are antecedent factors using a system theory framework that contributes to the development of the process and ultimately produce a result. About I-P-O team creativity, antecedents relate to conditions that permit or prohibit creativity in a team. Team creativity processes are the vehicles that transform teams' novel ideas inputs into outputs and refer to team members' acts and efforts to coordinate and orchestrate work towards a common objective. Team creativity output is the aggregate process of integrating and converting antecedents into outcomes.

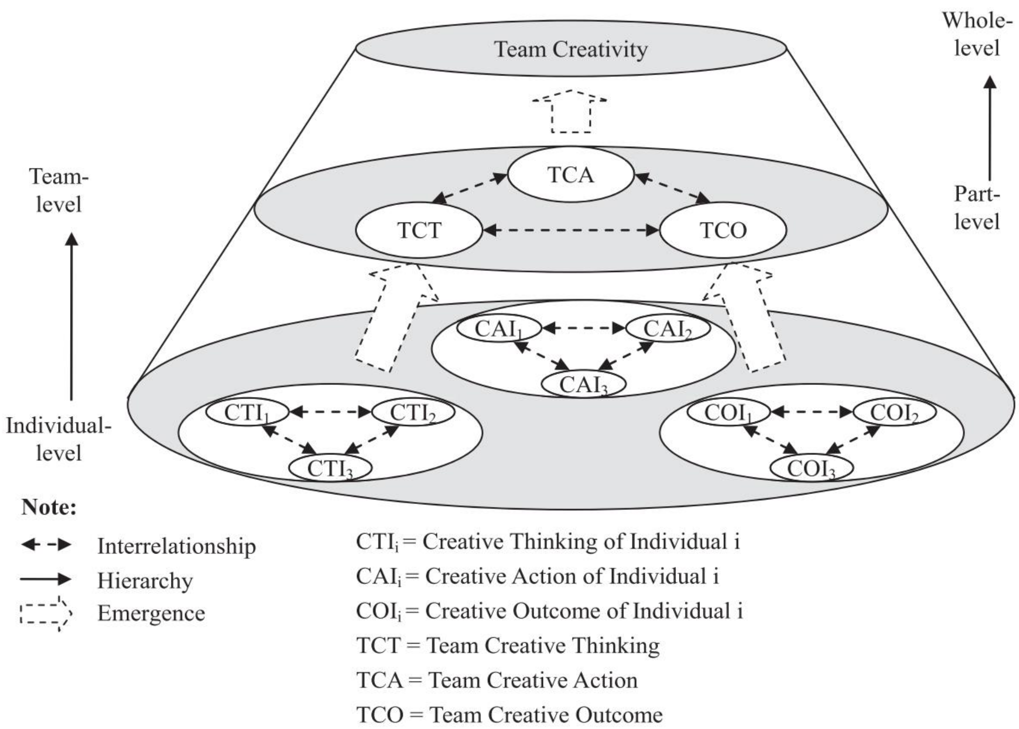
Team creativity inputs are made up of four main antecedents, of which the first three antecedents are the following: (1) expertise, (2) creative-thinking skills, (3) intrinsic task motivation (Amabile, 1997). The more the individuals' skills are aligned with their intrinsic interests, the greater probability that team creativity will happen. Team creativity literature also overwhelming found that if leadership offers team members more self-autonomy and discretion over their work, team creativity often occurs (Amabile, 1988; Sweetman & Conboy, 2018; K. Wang, 2016; West & Farr, 1989). The fourth and final antecedent for team creativity input is contextual influences: West and Farr (1989) asserted that team creativity flourishes when the team operates in an innovation-friendly environment that gives them organizational resources, clear feedback from management, and leadership support. Zhou (2006) argued that while those factors might be appropriate for Western cultures, Eastern cultures, on the other hand, prefer greater paternalistic organizational control—top management control over the team's work and personnel. Paternalistic organizational control had opposite effects on intrinsic motivation and team creativity for different national cultures: increasing them for teams in the East but decreasing them for teams in the West. However, empirical evidence of such a phenomenon is scarce, if it even exists at all, because multilevel theorizing requires researchers to mine data from a large number of teams in both Eastern and Western countries (Anderson et al., 2014).

Continuing with Curşeu's (2010) I-P-O model, team creativity processes refer to the team members' actions and activities that result in team creativity outcomes. Those processes are often differentiated in the current team creativity literature as linear or nonlinear processes. During a project lifecycle, team creativity as a linear process occurs when idea generation precedes idea implementation (Somech & Drach-Zahavy, 2013). Furthermore, the team creativity process is most often depicted in stages or phases in which the new and novel ideas stem from single individuals to the entire team in a linear fashion (Rosing et al., 2018).

Following the I-P-O linear framework, Jiang and Zhang (2014) developed a team creativity model (see Figure 5) in which they illustrated how team creativity emerges from the individual level to the team level in workplace teams. The team creativity model's linear process includes creative thinking, creative action, and creative outcome. Individual creative thinking is the starting point of team creativity, which then proceeds to team creative actions where "thinking interactions occur, overcoming obstacles through thinking complementation, and maintaining the integrity of team thinking by thinking integration" (p. 268). As a result, these team creative actions often come with breakthrough creative outcomes unreachable by individual creativity alone.

Figure 5

Illustration of Team Creativity as a Linear Process



Source: Jiang & Zhang, 2014.

On the other hand, the nonlinear approach or complexity perspective suggests that team creativity occurs throughout the process and not in any particular order or sequence of events (Rosing et al., 2018). Thus the temporal order of team creativity is unpredictable from the viewpoint of complexity. Hargadon and Bechky's (2006) study framed team creativity as collective creativity to capture when unpredictable creative insights occur in small groups or teams. The results were that four interrelating activities triggered moments of team creativity: (a) help-seeking, (b) help-giving, (c) reflective reframing, and (d) reinforcing. Help-seeking occurs when team members actively seek help or assistance from teammates giving rise to creative solutions. Help-giving represents the time and effort that team members are willing to give to each other to bring about creative ideas that benefit the entire team. Reflective reframing occurs when team members restate and build upon each other's comments and actions to generate creative team mental models. Reinforcing behaviors are those activities that "reinforce the organizational values that support individuals as they engage in help seeking, help giving, and reflective reframing" (Hargadon & Bechky, 2006, p. 490). These four interrelating, unpredictable, and recurring activities lead to team learning, an aggregated construct greater than its individual components (Turner & Baker, 2017).

Team creativity output results from team creativity's aggregate processes that enable teams to handle problems and enhance opportunities for the team and organization (Jiang & Zhang, 2014; Luu et al., 2019). Hence, the previously mentioned "team learning" would also be considered a team creativity output because creative insights come from collaborative rather than individual actions, and where no individual idea is responsible for solving the problem (Hargadon & Bechky, 2006; Turner & Baker, 2017).

Team Innovation

Hargadon and Bechky (2006) requoted Francis Jehl, one of Thomas Edison's longtime assistants, who explained that "'Edison is in reality a collective noun and means the work of many men'" (p. 484). Despite the specious folklore that Edison was the sole innovator, he could not have created the light bulb without his team of engineers who worked together in the oneroom laboratory in Menlo Park. Whereby creativity can be identified as an individual, team, or organizational construct, innovation is inherently a collective construct that includes team, organization, community, and society (Turner & Baker, 2020). In staying aligned with the process perspective, team innovation concerns the processes that teams apply when implementing new ideas (Cirella et al., 2014; Hughes et al., 2018).

The current study referred to Curşeu's (2010) input-process-output (I-P-O) framework to identify team innovation's constructs. About I-P-O team innovation, antecedents relate to conditions that permit or prohibit innovation in a team. Team innovation processes are how teams manage the implementation of novel ideas. Team innovation output is the innovative outcomes that teams produce, such as original and useful new products and services.

Team innovation inputs or antecedents, as a collective construct, are composed of the following four factors: (1) shared mental models that help team members have a mutual understanding about their team's work and purpose (e.g., team vision, team goals, task objectives), (2) the interactions of the team members (e.g., team composition, participative safety), (3) team characteristics (e.g., norms, size, and cohesiveness), and (4) contextual influences (e.g., the larger organization, culture, management, task characteristics) (Somech & Drach-Zahavy, 2013; Sousa et al., 2012). Participative safety has two elements: First is intra-team safety, which implies a non-threatening psychological team environment full of mutual trust and support (i.e., psychological safety), and the other is participation in decision making (Somech & Drach-Zahavy, 2013). Regarding contextual influences, management support backed by available organizational resources and strong leadership substantially impacted team innovation (Anderson et al., 2014; Sousa et al., 2012).

I could not find supportive literature from my search strategy that explained why shared mental models were not a critical antecedent for team innovation. However, I surmised that an individual could initiate team creativity, a multilevel construct, by coming up with the novel idea and then sharing it later with the team, thus bypassing the outset need for shared mental models. Although it too is a multilevel construct, team innovation begins with the team at the entry-level, causing shared mental models to be a critical antecedent for teams to implement creative ideas. As for which components had the most significant effect on team innovation, Anderson et al. (2014) concluded that team climate, composed of shared mental models, participative safety, task orientation, and support for innovation, had the most influence on team creativity. Conversely, team composition or the team's makeup as inputs or antecedents had the least effect on team creativity.

The current study continued to build upon the I-P-O framework by focusing on team innovation as a process. Still, current literature often confounded team innovation as an outcome (e.g., innovative products) rather than a process; consequently, there is scant evidence of how teams manage innovation to produce results (Rosing et al., 2018). Understanding how teams manage innovation to produce results is critical in today's competitive environments where less than 0.1% of organizations pass their 40^{th} anniversary (Poutanen et al., 2016), and the average tenure of S&P 500 companies are predicted to drop from approximately 35 years in the late 1970s to 12 years by 2027 (Hillenbrand et al., 2019).

Team innovation processes convert the inputs or antecedents into outputs. Experts disagree on whether team innovation processes are linear or nonlinear. Earlier seminal literature held more linear perspectives in which team innovation occurred in sequential and logical phases: First, teams identified and defined the problem (i.e., idea identification); second, they came up with ideas to solve the problems (i.e., idea generation); third, they discussed and evaluated the ideas that best solved the problems (i.e., idea evaluation); and finally, they executed the ideas (idea implementation) (Amabile, 1988; Farr et al., 2003; Lubart, 2001). Despite the various sequences and phase numbers, all linear approaches assume that closely following the sequential phases will result in superior outcomes (Rosing et al., 2018). That said, most authors of linear approaches later acknowledged that recursive overlaps occur during different phases (Amabile & Pratt, 2016; Rosing et al., 2018).

Table 4

Conceptual Markers Used when Defining Workplace Creativity and Innovation

Conceptual properties of creativity definitions (N = 96)	%	Conceptual properties of innovation definitions (N = 68)	%
Generation of new/novel/ original ideas	95.83	Problem recognition	4.41
Generation of useful/ applicable ideas	95.83	Create new ideas/products/ processes	55.88
		Introduce or adopt new ideas etc.	26.47
		Modify or adapt creative ideas	8.82
		Promoting/championing Ideas	11.76
		Implementation or application	75.00
		Organizational benefit	22.05

Note: % = the percentage of articles within our cache that defined creativity or innovation with this property.

Source: Hughes et al., 2018, p. 551.

It must be noted that the first two elements of team innovation's linear process include idea identification and generation, which are also the same as team creativity. Table 1 has been reproduced above again as Table 4; as shown in the table, Hughes et al. (2018) revealed that researchers still disagree on what constitutes creativity and innovation among 164 publications in the past decade. As Table 4 shows, researchers often confuse the constructs between creativity and innovation; for instance, they classify creativity under "idea generation" and innovation under "creation of ideas" and/or "introduction of new ideas," not realizing or ignoring the fact that those classifications are synonymous. Meaningful research and literature about creativity and innovation cannot advance if these constructs are being conflated and confused by scholars and practitioners alike (Anderson et al., 2014; Hughes et al., 2018; Poutanen et al., 2016; Turner & Baker, 2020). Later on in this section, the current study addresses the construct issue and then provide an alternative solution for overcoming the conflation and confusion.

Whereas the linear process of team innovation emphasizes distinct phases, the nonlinear process of team innovation is "characterized by chaos and complexity rather than by a predictable sequence of events" (Rosing et al., 2018, p. 801). Scholars have recently begun to take a more complex innovation perspective (Poutanen et al., 2016) in which team innovation does not follow a linear sequence of activities but rather an iterative process (Kumar et al., 2019). Within the workplace, Kumar et al. (2019) described this iterative process as having four nonlinear, multilevel components: a problematic situation that disrupts the status quo, a search for inspiration from others, followed by the invention phase, which is then proceeded by a validation of the problem and the solution. For example, the new product development team is in the middle of developing a novel enterprise-wide product (i.e., invention phase) when the MTS boundary-spanners team suddenly orders them to halt production due to a critical missing feature (i.e., problematic situation). A group of external product experts (i.e., parallel team) discovered the missing feature and requested to halt production to the MTS boundary-spanners team (i.e., management team)—influential leaders responsible for coordinating the multiple workstreams between the different agile teams and communicating with the executive leadership team. The MTS boundary-spanners team persuaded executive leadership that the product's value would be significantly less without it (i.e., validation of the problem and solution). The boundary-spanners team then creates a new workstream and tasks the parallel team of product experts and a smaller subgroup of the new product development team with adding the missing feature (i.e., invention phase). Meanwhile, the new product development team's remaining members continue working on a different aspect of the product unrelated and separate from the missing feature (i.e., invention phase).

Although overly simplified, my MTS agile real-life experience is an accurate snapshot of what real organizations face in today's complex and competitive environment. Team innovation output is the functioning result of the team's innovative processes, whether that be new products, services, methods, processes, or procedures. Much like creativity output, experts are continually debating whether the functioning result must be useful or beneficial. Cirella et al. (2014) clarified the meaning of "useful" to be something new that organizations can use to increase their competitive advantage, manage their resources more efficiently, and/or develop their employees' well-being. This meaning would imply that the functioning result would not be deemed innovative until its effects are revealed. Based on that notion, Hughes et al. (2018) argued that determining whether the functioning result is innovative *after* its effect or impact is made known is neither helpful nor conducive to organizations attempting to improve their innovative processes. For this reason, I intentionally left out descriptive terms such as useful or beneficial in the definition of team innovation output because the current study's objective is to ultimately help organizations improve their innovative processes.

Up to this point, the current study utilized Curşeu's (2010) input-process-output (I-P-O) framework to break down the constructs of team creativity and team innovation. While the I-P-O framework effectively showed the primary components of team C/I, it also exposed the constructs' major weaknesses and gaps when attempting to separate creativity processes from innovation processes, which are summarized and listed below:

- Lack of consensus amongst researchers on what constitutes creativity or innovation (Anderson et al., 2014; Hughes et al., 2018).
    - Creativity and innovation are often confused with having the same constructs, although they are each supposed to have different structural meanings (e.g., creativity and innovation are both defined as generating new ideas) (Anderson et al., 2014; Hughes et al., 2018).
    - Experts disagree on whether classifying something as creative or innovative should be based on peoples' judgment of its utility output (Runco & Jaeger, 2012; Smith & Smith, 2017).
- Rosing et al. (2018) found that researchers disagree about creativity and innovation being linear or nonlinear processes and as a result:
    - The linear perception of innovative processes overemphasizes the sequential distinction between creativity and implementation whereas
    - The nonlinear or dynamic perspective on innovation processes neglects the need for some separation between creativity and implementation (Rosing et al., 2018, p. 812).

The following section provides a third alternative approach and model in which the constructs of team creativity and team innovation are combined into a single unit. In doing so, a modified I-P-E-O model is introduced that provides new (a) inputs for team C/I (C/I) as a combined unit, (b) team C/I linear and nonlinear processes, (c) team C/I processes emerging as complex adaptive systems (CAS), and lastly (d) outputs based on functioning results not beholden to their utility factor.

Team Creativity and Innovation (C/I) Combined

To better understand the contextual influence behind teams combining creativity and innovation, the current study continues with my agile MTS workplace's example. The new product development team finished adding the missing product feature. In the meantime, the change-management (CM) team (i.e., special-purpose team)—responsible for leading change and training delivery—has been working closely with the MTS boundary-spanners team and the product managers (i.e., multiteam). This multiteam collaborated in building a change-management strategy (i.e., search for inspiration and invention phase) and developing agile training solutions (i.e., search for inspiration and invention phase) that include the following main objectives:

- Drive awareness about the new customer product to the sales and service organizations.
- Motivate the sales and service organizations to market the product to existing and new customers.
- Teach the sales and service associates and managers the what, why, how, when, where, and whom to market the product.
- Conduct a "coach-the-coach" training program where the working-team learns to coach their associates on how to market the new product ethically and responsibly, under the organization's supervision and compliance rules.
- Launch a reinforcement initiative where in-house product coaches stay in touch and follow up with the management teams to effectively and ethically market the new product.

The CM team utilized the agile portfolio management approach so that the team members were working in several workstreams and projects simultaneously. There were five subteams within the CM team, each assigned to one of the five main objectives/workstreams (e.g., Subteams A, B, C, D, and E). Each subteam conducted daily 15-minute stand-up meetings, and then all five subteams reconvened in weekly one-hour meetings. Moreover, it was relatively common for two or three subteams to pair up (i.e., multiteams) on a single initiative since they share similar tasks and resources (e.g., partnerships between workstreams A & B and D & E). Team members display multiple creative and innovative behavioral processes that are both linear and nonlinear, working in tandem in those meetings: Help-seeking, help-giving, generating new and novel ideas, reflective reframing, identifying and solving problems, validating problems and solutions, reinforcing, and creative thinking.

In my real-life example at an NYSE financial services firm, team innovation is a complex and multidimensional process that encompasses both the idea generation (i.e., creativity) and the application of those ideas (i.e., innovation) (Kumar et al., 2019; Larrasquet et al., 2016; Paulus, 2002; Poutanen et al., 2016; Turner & Baker, 2020, pp. 8-9). The current study recognized that the team C/I combined process incorporates both the generation of novel ideas (creativity) and the implementation of those ideas (innovation) (Amabile & Pratt, 2016; Anderson et al., 2014; Somech & Drach-Zahavy, 2013; Turner & Baker, 2020; Wipulanusat et al., 2017). The team C/I combined process is a multidimensional process that involves both linear and nonlinear processes, muli-level processes, and social processes (Turner & Baker, 2020). As a linear process, generating novel ideas (i.e., creativity) must precede implementing those same ideas (i.e., innovation) (Rosing et al., 2018). As a nonlinear process, team C/I work in tandem and do not follow a straight line (Paulus, 2002); they can occur at multiple points throughout the process where creativity can occur during innovation and innovation can occur during creativity (Kumar et al., 2019; Rosing et al., 2018). Adding to the complexity is that team C/I refuse to fall in a straight and orderly line where initial ideas will often digress into non-conjunctive paths (Rosing et al., 2018). As a result, innovation cannot be readily divided into separate and sequential stages or phases, making it highly unpredictable (Rosing et al., 2011).

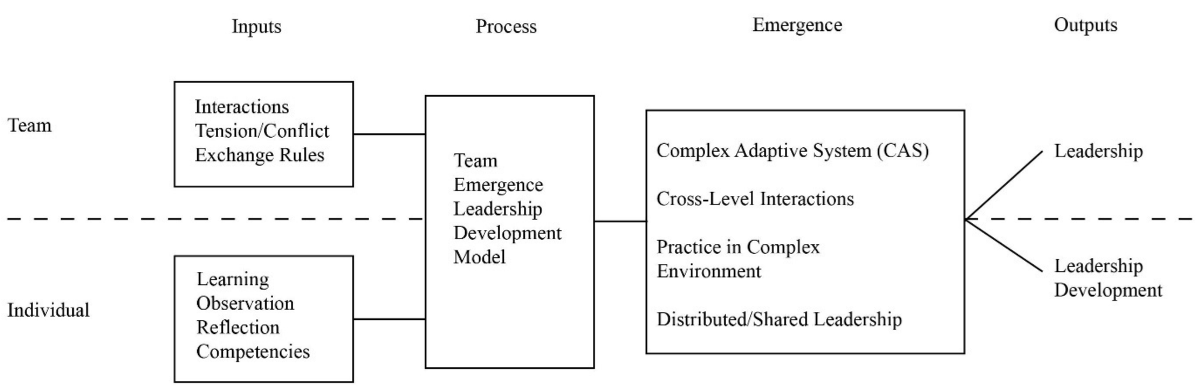
Unfortunately, creativity and innovation research has been piecemeal, resulting in fragmented, siloed models (e.g., total separation between creativity and innovation) and a lack of a unifying framework (Hughes et al., 2018) that fail to account for both linear and nonlinear perspectives (Rosing et al., 2018). Thus, the current study embraced Hughes et al.'s (2018) call to action for researchers to investigate old problems from a new angle or perspective that raises different questions and possibilities; more specifically, for researchers to

> think creatively to address the measurement, study design, and theoretical concerns discussed above, so that the field can build and examine theoretical propositions in a manner that produces accurate and reliable policy recommendations (p. 565).

In answering Hughes et al.'s (2018) call for a unifying framework, the current study modified the traditional input-process-output (I-P-O) model to an input-process-emergence-output (I-P-E-O) model (see Figure 6). The I-P-E-O model combines team creativity and team innovation inputs, encompasses team C/I's linear and nonlinear processes that subsequently emerge as complex adaptive systems (CAS), resulting in novel and functional outputs.

Figure 6

Illustration of the I-P-E-O Model



Source: Turner & Baker, 2017.

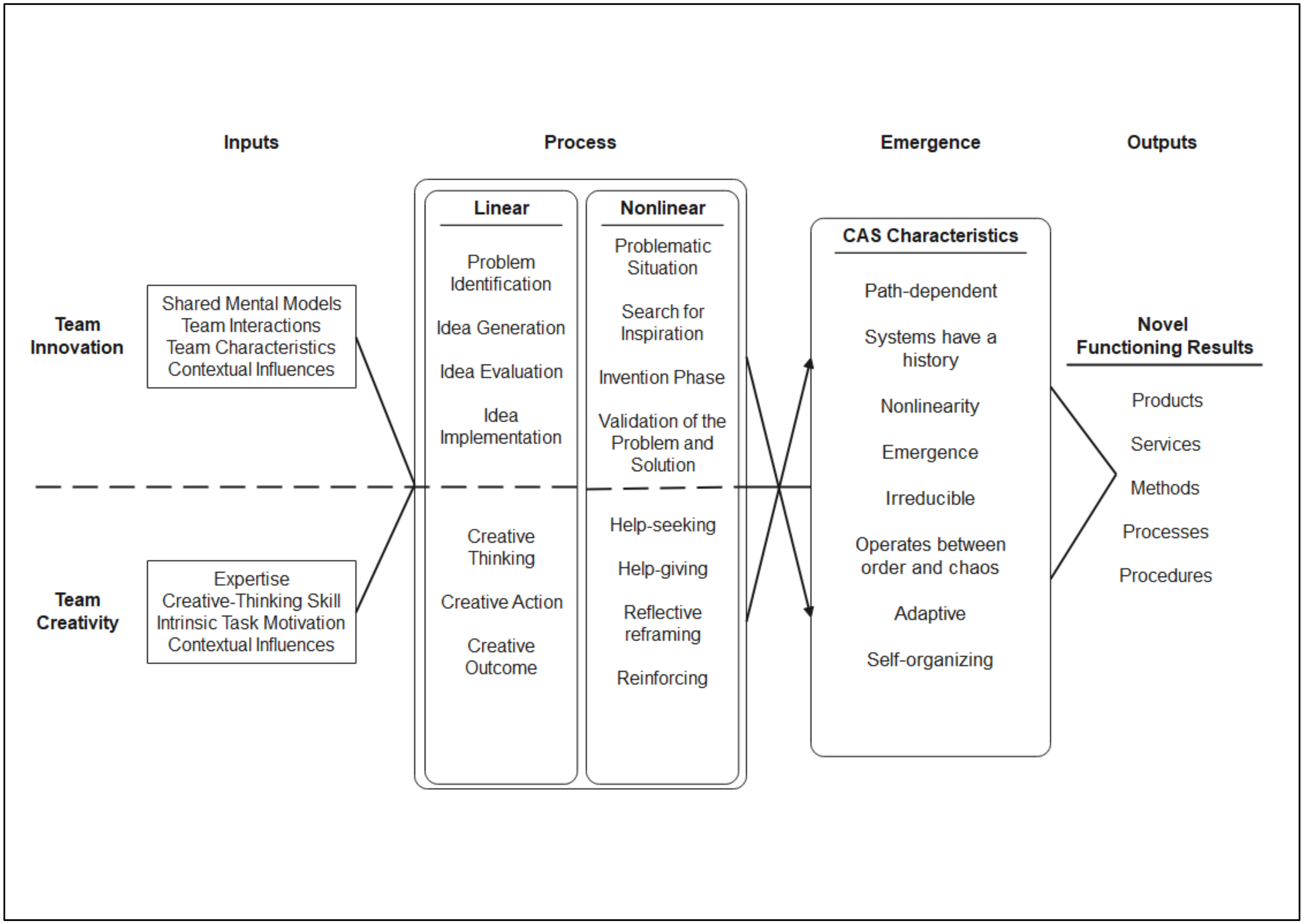
The current study's I-P-E-O model was modified from Turner and Baker's (2017) I-P-E-O multilevel—from individual to team—model based on complexity theory, which showed shared leadership as an output only after the team members practiced the shared leadership development model's processes in complex adaptive systems (CAS), complex environments, and cross-level interactions (see Figure 8). The I-P-E-O model's emergence stage is "a product of the process” from which the outputs are derived (Turner & Baker, 2017, p. 6). Turner and Baker’s (2017) I-P-E-O demonstrated that leadership on a team level, as the final output, subsequently came *after* the emergence state where the team practiced shared leadership processes via cross-level interactions in complex adaptive systems (CAS) and complex environments.

Building on that perspective, Figure 7 reveals that novel functioning results (e.g., products, services, and processes), as the output, subsequently come after the team C/I linear and nonlinear processes emerge as CAS via cross-level interactions; thereby making the team C/I processes as CAS. Figure 9 is a unifying framework in which the inputs of team creativity and team innovation are combined to become team creativity/innovation (C/I) as a single unit. Thus, team C/I inputs include expertise, creative-thinking skills, intrinsic task motivation (Amabile, 1997), contextual influences (Somech & Drach-Zahavy, 2013), shared mental models, team interactions, team characteristics, and contextual influences (Somech & Drach-Zahavy, 2013; Sousa et al., 2012). Merging team creativity and team innovation solves the thorny issue of explaining and measuring two related constructs that many researchers have already concluded are synonymous (Hughes et al., 2018; Paulus, 2002; Poutanen et al., 2016; Turner & Baker, 2020) and highly correlated between multiple levels (i.e., individual, teams, and organization) (Harari et al., 2016).

After combining team creativity and team innovation inputs to become team C/I, Figure 9 incorporates linear and nonlinear processes of team C/I because both processes are essential for producing creative and innovative outcomes (Rosing et al., 2018). Figure 8 then reveals how the linear and nonlinear processes cross-interact that then evolve into CAS within the emerging state, defined here as “constructs that develop over the life of the team and impact team outcomes” (Turner et al., 2019, p. 4).

Figure 7

Team Creativity and Innovation (C/I) Processes as Complex Adaptive Systems (CAS) I-P-E-O Model



For example, Subteam C was responsible for creating the asynchronous and synchronous training content for the new product, created functional prototypes and simulations of training practice modules in tandem with storyboarding the learning content. In past projects, the CM team traditionally used the cascading or "waterfall" linear approach when creating training modules, where task ownership ran like an assembly line. It started with the subject-matter-experts (SME) who storyboarded all of the training content. The SMEs would then hand off the completed storyboard to instructional designers who designed and developed the asynchronous e-learning solution (i.e., invention phase) via an e-learning authoring software (e.g., Adobe Captivate).

However, advanced technology has enabled the SMEs themselves, with minimum to no instructional design experience, to create the training storyboard and functional e-learning solutions (i.e., creative outcome) concurrently with in-app training, prefabricated templates, and easy-to-follow prototypes (e.g., Articulate 360). Eventually, instructional designers broadened their competencies by becoming SMEs on the new product (i.e., creative thinking, creative action) so that they also were storyboarding and creating e-learning solutions simultaneously (i.e., creative action, creative outcome). In short, the several CM team members became adaptive in their creative and innovative processes transitioned from linear to nonlinear (e.g., jumping back and forth from storyboarding to creating the e-learning solution and vice versa). Subsequently, both SMEs and instructional designers supported each other in learning how to use the new e-learning authoring software (i.e., shared mental models, help-seeking, help-giving, reflective reframing, and reinforcing). The training content was also stored in the organization's cloud-server so that any approved individuals could easily access and edit it on their work laptops/terminals (i.e., shared mental models, help-seeking, help-giving).

This example illustrates how the agile approach inspires team C/I linear and nonlinear processes to overlap and intersect to emerge as CAS via cross-level interactions. As a result, team C/I processes as CAS should theoretically be more easily identified and empirically measured with a greater degree of reliability and validity that were missing in other team C/I scales that Hughes et al. (2018) analyzed. Figure 10 concludes with the I-P-E-O model outputs that are defined here as final functioning results. The words "useful" and "beneficial" were replaced with "functional," which is defined as "used to contribute to the development or maintenance of a larger whole" (Merriam-Webster, n.d.–a). By replacing "useful" with "functional," it made the definition of "output" more objective rather than subjective, thus making it easier to observe, measure, and evaluate. After Figure 10, I proceed with covering complexity theory and its subset theory, complex adaptive systems theory, which are the theoretical foundation behind the I-P-E-O model.

Theoretical Foundation

This next section covers complexity theory and complex adaptive system (CAS) theories as the theoretical foundation to explain the interactions between and throughout the processes and the emergence stage of the current study's I-P-E-O model, illustrating how team C/I processes are CAS. When investigating team C/I processes, recent research employed complexity theory to illuminate the complex interactions between creativity and innovation (Cirella et al., 2014; Jiang & Zhang, 2014; Poutanen et al., 2016; Turner & Baker, 2019b, p. 42). In fact, "complexity is the best theory to utilize when investigating the processes of creativity and innovation (Turner & Baker, 2019b, p. 42). Subsequently, CAS theory provides a microstructural framework for equating team C/I processes with CAS's eight unique characteristics, concluding that team C/I's processes are indeed CAS.

Complexity Theory (CT)

Complexity theory, synonymous with complexity science, is best summarized as follows:

> Complexity science targets a sub-set of all systems; a sub-set which is abundant and is the basis of all novelty; a sub-set which is evidenced in biology, chemistry, physics, social, technical and economic domains; a sub-set which coevolves with its environment; a sub-set from which structure emerges. That is, self-organization occurs through the dynamics, interactions and feedbacks of heterogeneous components . . . . This sub-set of all systems is known as complex systems (Strathern & McGlade, 2014, as cited in Turner & Baker, 2019a, p. 9)

Complex systems are comprised of numerous adaptive, non-decomposable elements interacting nonlinearly with other unpredictable and self-organizing elements, continually evolving or emerging into distinct and competitive systems (Richardson, 2010; Turner & Baker, 2019b). From a macro perspective, complexity theory provides a dynamic framework that explains the nonlinear, random, unpredictable, and chaotic interplay between creativity and innovation (Borzillo & Kaminska-Labbé, 2011; Poutanen et al., 2016; Speakman, 2017; van de Wetering et al., 2017), which allows researchers to better explain today's complex problems (Turner & Baker, 2019a). Creativity and innovation are complex processes because they involve uncertainty, ambiguous interpretations, and are subject to challenges, objections, and differing opinions that can create conflict for the individual who produced the innovative idea (Larrasquet et al., 2016). The nonlinear interplay between creativity and innovation includes complexity that involves experimentation without following a direct path for achieving desired results (Sarooghi et al., 2015).

Poutanen et al. (2016) summarized the three most important components of a complex system as being:

1. Agents make up the complex system's basic individual actors and represent people, organizations, objects, and even concepts. The current study's agent is the concept of the team C/I processes.

2. Interactions capture the mutually adaptive behaviors of agents and are the most commonly observed structures in complex systems" (p. 193). For this study, the interactions of the team C/I *processes* are adaptive, nonlinear, and unpredictable.

3. Finally, Environment is the medium where agents operate and interact (p. 193). The current study's environment is a professional workplace in which the team C/I processes occur.

To continue the real-world example: The change-management (CM) team launched several innovative training initiatives that were considered ground-breaking at that time for the NYSE financial services firm (i.e., professional workplace environment), including the following:

- On-demand new product learning aids that sales and service associates could quickly access on their computer while talking to the customer in real-time so that they could appear competent and knowledgeable while avoiding loss of productivity caused by putting the customer on hold or, worse still, telling the customer that they have to end the call to find the answer and then call them back. The production of these on-demand learning aids (i.e., C/I processes as agents) required the CM team to adapt to ongoing demands from other key stakeholders such as the management team, compliance team, and sales & service pilot teams. The CM team also worked collaboratively with those same teams to deliver reliable and accurate learning content, often in nonlinear interactions (e.g., meeting with multiple stakeholders at different times, with no linear path to completion since everyone is working around each other's often unpredictable schedules).

- Mobile training modules accessible on personal smartphones, which had never been done before for security reasons. However, this time, CM overcame the past security obstacles by being involved early on in the agile MTS project and working in tandem with the management team, sales and service pilot groups, compliance team, and the new product development team (i.e., nonlinear team C/I processes and interplays between multiple teams).

- Just-in-time training solutions where the turnaround time from development to delivery took on average less than two business days (pre-agile projects took 7-14 business days). This achievement required self-organizing, adaptive, and continually evolving behaviors because the CM team members all became adept at creating just-in-time training solutions by utilizing advanced e-learning authoring software (i.e., team C/I processes).

None of these innovative solutions were in the initial training strategy and plan (i.e., there was no direct path leading to these results). These innovations came about when the teams' C/I processes behaved as complex systems during the agile MTS project.

For further exploring these complex system's elemental interactions and patterns, complexity theory includes two additional sub-theories: chaos and complex adaptive systems (CAS) theories. Turner and Baker (2019a) differentiated the two by explaining that "complexity theory applies mathematical modeling of linear and predictable states when viewing chaos, where it employs CAS to view unpredictable, non-linear systems. Using mathematical modeling, chaos identifies the global patterns from the components' interactions in self-organizing systems, while CAS identifies the interactions from these components" (p. 11). Thus, the current study only focuses on CAS theory because its objective is to focus solely on the non-linear systems and their components' unpredictable and complex interactions.

Complex Adaptive Systems (CAS)

CAS is defined using the following seminal definition:

> A network of many agents acting in parallel, where control is highly dispersed, where coherent behavior in the system arises from competition and co-operation among the agents themselves, where there are many levels of organization, with agents at one level serving as the building blocks for agents at a higher level, where there is constant revising and rearranging of their building blocks as they gain experience, where the agents constantly test the implicit or explicit assumptions about the environment (Waldrop, 1995, pp. 145–146).

This definition highlights the interactions of the CAS agents, which, as stated earlier, can be represented by various entities such as human beings, groups of people, organizations, communities, societies, or "even concepts" (Poutanen et al., 2016, p. 193). Whereas chaos theory focused on the resulting patterns of agents' interactions, CAS theory was more concerned with the agents' interactions themselves (Turner & Baker, 2019a). This distinction is especially important because while chaotic states do not have cause-and-effect relationships, CAS agents' interactions often do.

As such, CAS emerged as the recommended theory for addressing today's complex issues, such as climate change, technological advancements, changes in the political landscape, and continuously changing organizational innovation (Turner & Baker, 2019a), because it provides a framework for illuminating the interplay between a system and its environment (Akgün et al., 2014; Sweetman & Conboy, 2018). Researchers have argued that CAS allows for a more "coherent strand of research" ((Poutanen et al., 2016, p. 192) compared to complexity theory, leading to a broader range of practical applications (Ramos-Villagrasa et al., 2018).

While complexity theory "sets the basic set of principles through which such complex interactions can be examined" (van de Wetering et al., 2017, p. 75), CAS theory provides a framework for explaining the emergence of system-level order arising from the interactions of the system's interdependent agents (i.e., people, departments, ideas, information, resources). CAS focus on the interplay between a system and its environment (Akgün et al., 2014). Put simply, participants or agents of a system continually seek to adapt to their environment while minimizing the risks and maximizing the rewards in terms of self-interest (van de Wetering et al., 2017). For example, CAS holds three actors in work teams: deciders, thinkers, and doers (Foster et al., 2015), who continuously adapt to the circumstances they find themselves in (Poutanen et al., 2016).

Contrary to the criticisms of complexity thinking, viewing teams as CAS is much more than a metaphor to explain team functioning or a nonlinear tool to analyze team behavior; it allows researchers and scholar-practitioners to create better practical applications for real-life scenarios (Ramos-Villagrasa et al., 2018). Understanding teams as CAS can facilitate change in the epistemology of teams, allowing researchers to "(a) adopt a different logic of inquiry, (b) to deal with temporal issues, (c) to raise the level of theoretical sophistication, and (d) thus to lead to better practical applications" (Ramos-Villagrasa et al., 2018, pp. 136–137). As a result, the theoretical framework of CAS enabled researchers and scholar-practitioners alike to develop application-based models that led to changes in both the epistemology and functionality of teams (G. Chen et al., 2013; Foster et al., 2015; Ramos-Villagrasa et al., 2018; Turner & Baker, 2019b).

Teams as Complex Adaptive Systems (CAS)

Complex adaptive systems (CAS) emphasize team functioning rules and reveal what bends these rules. In that sense, CAS simplifies teams' science, making it more natural and closer to how phenomena happen (Anderson, Meyer, Eisenhardt, Carley, & Pettigrew, 1999; McGrath et al., 2000). For example, my agile MTS project provides evidence of this phenomenon where CAS theory makes team science more applicable to real-life scenarios, which in this case, the agents will be multiteams. To do so, Table 5 provides real-life examples next to their respective parts of the CAS definition stated earlier.

Table 5

Definition Characteristic Matched with Real-life Examples

Definition Characteristic	Example
A network of many agents	Multiteams of an NYSE financial services firm for an agile project
Acting in parallel	The change management team, new product development team, compliance team, management team, parallel teams of external product experts, and sales and service pilot teams were all collaborating at the same time towards a common organizational goal
Control is highly dispersed	All of the agile teams were either fully or partially self-organized; the change management team, the new product development team, and the parallel team were all self-directed teams; the change management team are composed of mostly volunteers with a few that their managers endorsed

(table continues)

Definition Characteristic	Example
Coherent behavior in the system arises from competition and cooperation among the agents themselves	The change management team collaborated with the management team, new product development team, compliance team, and the sales & service pilot teams
There are many levels of organization	The multiteams come from all different organizational levels ranging from front-line associates to mid-level management to executive-level leadership
Agents at one level serving as the building blocks for agents at a higher level	The sales & service pilot teams provided the knowledge needed for the CM team to create the training solutions; all of the production multiteams reported to the boundary-spanners team composed of senior business leaders who coordinated the multiple workstreams and reported the results to the executive leadership team
Constant revising and rearranging of their building blocks as they gain experience	Team members were often promoted or rotated into other work streams as they gained agile experience; work procedures and processes were continuously getting adjusted, removed, added and refined after teams conducted "sprint reviews" on a bi-weekly basis to examine their workstream productivity
Agents constantly test the implicit or explicit assumptions about the environment	All the multiteams conducted bi-weekly sprint reviews and monthly sprint retrospectives to examine and assess their production outputs, resource usage, work processes, and productivity

As mentioned previously, CAS agents can be represented by many entities, such as groups and concepts. In the last example, the current study demonstrated how teams and multiteams could be CAS. The next section explains how team C/I processes equate to CAS.

Team Creativity/Innovation (C/I) Processes as Complex Adaptive Systems (CAS)

Referring back to Figure 7, the current study's I-P-E-O model shows the team C/I processes, linear and nonlinear, cross-interacting to emerge as CAS. Reaching this conclusion requires a body of literature to support that team C/I processes have the same characteristics as CAS; thus, team C/I processes are CAS. Hence, I deferred to Turner and Baker's (2020) content analysis of eight different creativity and innovation theories (see Table 6), in which they identified and then classified numerous C/I processes that were characterized as CAS (see Appendix B).

Table 6

Turner and Baker's (2020) Creativity & Innovation Theories and Their Environments

Title of Theory	Environment(s)
(1) The Componential Theory of Organizational Creativity and Innovation (Amabile, 1997)	Individual, Team, Organization
(2) Interactionist Perspective of Organizational Creativity (Woodman et al., 1993)	Individual, Team, Organizations
(3) Theory of Individual Creative Action (Ford, 1996)	Individual
(4) Model of Paternalistic Organizational Control and Innovation and Group Creativity (Zhou, 2006)	Individual, Team, Organization, Society
(5) Theory of Team Climate for Innovation (West, 2002)	Individual, Team, Organization, Society
(6) Ambidexterity Theory (Bledow et al., 2009) & Leadership for Innovation Theory (Rosing, Frese, and Bausch, 2011)	Individual, Team Organization
(7) Theoretical Framework of Individual Innovation (West & Farr, 1989)	Individual, Team Organization
(8) Contextual Model of Creativity (Csikszentmihalyi, 1996)	Individual, Team Organization
Theory of Creativity and Innovative Processes as Complex Adaptive Systems (Turner & Baker, 2019b, 2020)	Individual, Team Organization

Note: The assigned numbers in front of the theories' titles are for coding purposes only.

Utilizing Turner and Baker's (2020) classification table (Appendix B), I then conducted focused coding to correspond each of the 63 TCI-scaled items with its respective team C/I processes as CAS. There is a brief overview of each of the eight theories to help the reader better understand my coding process, as it relies heavily on Turner and Baker's (2020) more in-depth literature review. Therefore, the next section briefly recaps each of the eight creativity and innovation theories, which Turner and Baker (2020) reviewed in their study, including three creativity theories, two innovation theories, and three creativity/innovation theories that view creativity and innovation as single units. For a further in-depth review of these eight theories, please refer to Turner and Baker's (2020) in-press manuscript titled "Creativity and innovative processes as complex adaptive systems: A multilevel theory."

Further, each theory is accompanied by a table with its respective CAS team C/I processes, based on Turner and Baker's (2020) classification table (Appendix B). For instance, under the Path-Dependent category, a code of (1) was assigned to the subcategory "Organizational resources must be available," signaling that its corresponding theory was Amabile's (1997) componential theory of organizational creativity and innovation. A (2) meant that the team C/I agent/subcategory was related to Woodman et al.'s (1993) theory of the interactionist perspective of organizational creativity, and so forth.

Finally, to bring the theories to life, I added my personal experiences in the agile MTS project at an NYSE financial services firm in each of the theories where I surmised they best fit.

Creativity Theories

The three creativity theories that Turner and Baker (2020) reviewed are Ford's (1996) theory of individual creative action, Csikszentmihalyi's (2013) contextual model of creativity, and Woodman et al.'s (1993) interactionists perspective of organizational creativity.

Theory of Individual Creative Action (Ford, 1996)

The theory of individual creative action (Ford, 1996) involves multiple social domains and stems from psychology and sociology; the theory holds that people tend toward habitual behavior and that organizations do not want or require pervasive creativity. Returns on creativity are less certain and more removed from the source of action that are more routine and habitual behaviors (Ford, 1996). However, creative behaviors are important, and organizations can contain much creative talent. Creativity challenges to managers include consistently promoting procedures that enhance creativity while staving off habitual behavior and identifying and using the selection processes from various domains to the advantage (Ford, 1996).

Table 7

Theory of Individual Creative Action: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Path-Dependent	The standards of success set by organizations and groups can positively affect team C/I (Ford, 1996; Glover et al., 2020)
Systems Have a History	Team C/I may be influenced by past successes and failures of the organization and the group (Keenan & Henriksen, 2017; Skilton & Dooley, 2010; Turner & Baker, 2019b; Vaan et al., 2015)
Irreducible	One failure or negative influence may stop team C/I from moving forward (Turner & Baker, 2020)
Adaptive	Team C/I relies on the teams' ability to adapt and respond to change (Cirella et al., 2014; Edmondson, 2012; Ramos-Villagrasa et al., 2018)
Operates Between Order and Chaos	Team C/I is fostered when team members engage between creative (i.e., non-routine) and routine behavioral options (Hoogeboom & Wilderom, 2020; Khedhaouria & Ribiere, 2013)
Self-organizing	Team members must develop schemas and mental interpretations that are aligned and understood to achieve meaningful team C/I (Santos et al., 2015; Turner & Baker, 2020)

Additionally, employees must choose between being creative and being routine, and according to the framework of individual creative action, factors that affect this decision include the process of sensemaking, motivation, and knowledge and skills (Ford, 1996). Creativity on an individual level stems from the combined influence of these factors (Ford, 1996). Factors such as "receptivity beliefs (e.g., expectations that creativity is valued – creative actions are rewarded), capability beliefs (e.g., expectations that one is capable of being creative or confident in creative ability), and emotions (e.g., interest and anger as facilitators of creativity, whereas anxiety constrains creativity)" (Anderson et al., 2014, p. 1300) also influence creative and habitual behavior. For example, from my experience with the agile MTS project, I witnessed this firsthand when the subject matter experts (SME) and instructional designers were asked to swap roles where the SME became instructional designers, and instructional designers became SME. A few SMEs strongly felt that they were not the creative type and were disinclined to create asynchronous learning solutions. The instructional designers reacted the same when asked to become an SME on the new product because they felt the ask was outside their job scope. However, their managers influenced most of them to experiment with the role swaps and fortunately, all of them expressed the satisfaction of learning new skills. Researchers have not paid as much scholarly attention to the individual creative action model as they have componential or interactionist frameworks, perhaps because the model is complex and challenging to empirically test holistically (Janssen, 2005; Unsworth & Clegg, 2010; Anderson et al., 2014).

Contextual Model of Creativity (Csikszentmihalyi, 1996)

Csikszentmihalyi's (1996) model of creativity allows researchers to examine and explain creativity in terms of the interactions between individuals and their contexts. The components of this model include the field, the domain, and the person. The *person* refers to the individual creator or innovator; the *field* refers to those people or things affected by the creation; and the *domain* refers to the environment or context, especially in terms of cultural norms and rules.

Csikszentmihalyi (1996) described that creativity is a process that causes a cultural change in any one domain, such as new songs, new ideas, and new machines. Creativity takes effort and time to take place, especially in cultural domains such as cultural traditions.

Arguably, Csikszentmihalyi's (1996) most significant contribution to creativity literature is the concept of *flow,* in which he described what people feel when things are going so well that the activity becomes "an almost automatic, effortless, yet highly focused state of consciousness" (p. 110); the following nine elements of the flow experience include:

1. There are clear goals every step of the way.
2. There is immediate feedback to one's actions.
3. There is a balance between challenges and skills.
4. Action and awareness are merged.
5. Distractions are excluded from consciousness.
6. There is no worry of failure.
7. Self-consciousness disappears.
8. The sense of time becomes distorted.
9. The activity becomes autotelic (pp. 111-113), which is interpreted in Greek as something that is "an end in itself"; in other words, the activity itself is enjoyable for no other reason than to "feel the experience they provide" (p. 113)

Happy is a person's life whose work and family becomes autotelic, "then there is nothing wasted in life, and everything we do is worth doing for its own sake" (p. 113). For example, many CM team members, myself included, experienced flow while working on the agile MTS project. The SMEs who became instructional designers told me how quickly time lapsed when engaging with the advanced e-learning authoring software.

Table 8

Contextual Model of Creativity: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Emergence	Flow, the feeling of intense concentration and enjoyment when working on a satisfying task (Botticchio & Vialle, 2009)

Interactionist Perspective of Organizational Creativity (Woodman et al., 1993)

The interactionist perspective of organizational creativity states that creativity in individuals is a function of preceding conditions, cognitive abilities, personality, motivational factors, and knowledge (Woodman et al., 1993). Contextual factors and individual factors are mutually influential: groups represent the immediate social context of individual creativity, and individuals' creativity promotes the group (Woodman et al., 1993). From an interactionist perspective, creativity involves a complicated relationship between people and their work environments at different organizational levels (Woodman, Sawyer, & Griffin, 1993). In my real-world example, my agile MTS project interactions involved numerous, complicated relationships between various coworkers across different organizations, departments, and locations. The multiteams were distributed throughout the country, including Texas, Missouri, California, Michigan, Omaha, and New Jersey. Each office location had its own unique culture and norms, but all team members felt connected to the broader organization, which was significant because the firm had recently acquired a competitor where many of the multiteams were located.

Individual creativity stems from antecedent conditions (e.g., demographic factors), cognitive abilities (e.g., divergent thinking), personality (e.g., self-esteem), relevant knowledge, motivation, social influences (e.g., rewards), and environmental factors (e.g., physical environment; Woodman, Sawyer, & Griffin, 1993). Team creativity stems from individuals' creative input, the interaction between group members (e.g., group composition), group characteristics (e.g., norms, size), team procedures, and environmental factors (e.g., organizational culture, reward systems; Woodman, Sawyer, & Griffin, 1993). For organizations, innovation is a product of the interaction of group and individual creativity (Woodman et al., 1993). A multidimensional theory allows individual, group, and organizational analysis (Woodman et al., 1993). The interactionist model of creativity is an often-used framework that highlights the interaction between individual and environmental factors that can facilitate or impede the workplace (Shalley, Gilson, & Blum, 2009; Yuan & Woodman, 2010; Zhou & Shalley, 2010).

Table 9

Interactionist Perspective of Organizational Creativity: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Systems Have a History	• The experiences of team members influence team C/I (Hargadon & Bechky, 2006; Vaan et al., 2015) • Team C/I demands the team members reflect upon their past experiences (Turner & Baker, 2019b)
Emergence	Team creativity is a composite of individual creative behavior, the interaction between team members, team characteristics, team processes, and contextual influences (Turner & Baker, 2017)
Irreducible	Group norms that mandate high conformity reduce team C/I production (Miron-Spektor et al., 2011). Conversely, team C/I is heightened by an organizational culture that supports risk-taking behaviors and group diversity (Wipulanusat et al., 2017).
Operates Between Order and Chaos	Team C/I can be amplified by the uncertainty that compels organizations and teams to reconfigure old problems and discover new ideas (Anderson et al., 2014; Sung et al., 2017)
Self-Organizing	Team C/I is a complex interaction between the individual and his or her team members along with different working circumstances and organizational levels (Ford, 1996; Hargadon & Bechky, 2006; Turner & Baker, 2017)

Innovation Theories

The two innovation theories that Turner and Baker (2020) reviewed are West and Farr's (1989) theoretical framework of individual innovation and West's (2002) theory of team climate for innovation.

Theoretical Framework of Individual Innovation (West & Farr, 1989)

The theoretical framework of individual innovation (West & Farr, 1989) is a multidimensional individual innovation model in organizational settings. Innovation at work involves organizational and job characteristics, relationships with leaders, group dynamics, social factors, and individual factors (Yuan & Woodman, 2010). For example, the agile MTS project was then considered the biggest, most ambitious and complex project because it was the first agile project outside of the IS organization that involved the sales and service retail organizations. With an annual budget of $50 million and over 50 teams from all different organizational levels working concurrently, the boundary-spanners team (management team) felt immense pressure to succeed. Several on-site and off-site gatherings were held for the multiteams to keep everybody reengaged and focused on the bigger picture while building and maintaining crucial working relationships between all the different team members.

Although the model focuses on individual innovation, it is multidimensional because it allows researchers to identify factors beyond and outside of the individual that affects innovation at the individual level. West and Farr (1989) defined individual innovation as “the implementation of new and different objectives, methods, procedures, working relationships and skills” (p. 23), as well as factors that facilitate individual innovation were identified. For example, factors that promote innovation at the individual level include confidence, motivation, past successes, and management (West & Farr, 1989).

Table 10

Theoretical Framework of Individual Innovation: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker’s (2020) Team C/I Processes
Systems Have a History	Clear organizational vision and goals can inspire team C/I (Amabile, 1988; Cirella et al., 2014; Somech & Drach-Zahavy, 2013)
Irreducible	Team C/I thrive in an empowering culture that encourages and celebrates innovation (Barczak et al., 2010; Turner & Baker, 2020)

Theory of Team Climate for Innovation (West, 2002)

Stable group integration and high intra-group comfort are needed for creativity and the implementation to come from group contexts. Such an approach requires that team members integrate into teams and build a safe and comfortable group environment that encourages participation, production controversy, reflexivity, and innovation support (West, 2002). These situations can lead to high group innovation and well-being, indirectly supporting creativity and innovation (West, 2002). In my real-world example, psychological safety was very high in most multiteams on the agile MTS project. One of the underlying tenets of the agile approach is psychological safety amongst the team members and leaders. In fact, all team members were told that job titles were left at the door at our first kickoff meeting for the project. The boundary-spanners team, composed of high-ranking leaders, avoided attending the production meetings, which helped maintain psychological safety among lower-ranking team members.

Table 11

Theory of Team Climate for Innovation: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Path-Dependent	Team C/I are enhanced in supportive environments free from evaluative pressure that causes fear of being criticized or ostracized (Harvey, 2014; Miron-Spektor et al., 2011). Team C/I increases when group psychosocial and psychological safety exists between team members (Han et al., 2019; Turner & Baker, 2020)

The team climate for innovation theory includes four components related to innovation: vision, participative safety, task orientation, and support for innovation (West & Farr, 1989). West and Farr's (1989) theory of team climate for innovation is multidimensional. It involves consideration of individuals, teams, organizations, and society: "Innovation is the intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit role performance, the group, the organization or the wider society" (West & Farr, 1989, p. 16).

Creativity/Innovation Theories

The three C/I theories that Turner and Baker (2020) reviewed are Amabile's (1997) componential theory of organizational creativity and innovation, Zhou's (2006) paternalistic organizational control and innovation and group creativity, and the combination of Bledow et al.'s (2009) and Rosing et al.'s (2011) leadership for innovation theory.

The Componential Theory of Organizational Creativity and Innovation (Amabile, 1997)

Traditionally, creativity was thought of as something done by creative people. For several decades, the conception guided creativity researchers, who focused primarily on individual differences, such as what creative people are like and how they are different from people who are not creative (Amabile, 1997). The person-centered approach generated insights; however, the approach was limiting and provided little to practitioners to help people work creatively (Amabile, 1997). The approach also did not allow researchers to account for the social environments' role in creativity and innovation (Amabile, 1997). In contrast to this traditional, individualistic approach, the componential theory of creativity holds that people with standard capacities can generate at least moderately creative work in a particular area, some of the time; the componential theory of creativity also holds that the social or work environment can affect the levels and the frequency of creative behaviors (Amabile, 1997).

The componential theory of creativity includes three components of individual and small team creativity: expertise, creative-thinking skill, and intrinsic task motivation (Amabile, 1997). Amabile (1997) spoke of the creativity intersection that can occur among components and teams: creativity is most likely to occur when individuals' skills overlap with their strongest interests and passions. Additionally, the higher the level of each of the three components, the higher that creativity will be (Amabile, 1997).

The componential theory of creativity also holds that work environments impact creativity by influencing creativity sources, which are sources for organizational innovation

(Amabile, 1997). The main components of work environments, which affect employee creativity, include motivation to innovate at the organizational level, resources (including finances, time availability, personnel resources), and managerial strategies, such as facilitating challenging work and encouragement from supervisors (Amabile & Conti, 1999). In my real-world example, many team members felt that the work environment during the agile MTS project greatly influenced their motivation to be creative and innovative. More specifically, team surveys revealed that the boundary-spanners team's senior leadership significantly influenced the multiteams' morale, more so than any other variable.

Some empirical research has supported the theory, explaining the motivation component's role in terms of a psychological mechanism that influences employee creativity (Shalley, Zhou, & Oldham 2004; Zhou & Shalley, 2010). However, researchers have not paid as much attention to the other components (e.g., expertise and creative-thinking skills) as the motivation component (Anderson et al., 2014).

Table 12

The Componential Theory of Organizational Creativity and Innovation: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Path-Dependent	Employees must have organizational resources at their disposal for team C/I to occur (Amabile, 1997; Sarooghi et al., 2015; Sousa et al., 2012)
Emergence	A mixture of intrinsic motivation, expertise, and creative-thinking skills fosters team C/I (Amabile, 1997; Anderson et al., 2014; Ford, 1996)
Irreducible	Focus on team C/I from senior management (Amabile, 1997; Rong et al., 2019): Workgroups should be composed of individuals with diverse backgrounds and competencies to achieve optimum team C/I (Amabile, 1997)
Operates between order and chaos	Team C/I is enhanced when team members feel the work is sufficiently challenging (Anderson et al., 2014; Pei, 2017)

Paternalistic Organizational Control and Innovation and Group Creativity (Zhou, 2006)

Creativity differences concerning culture have implications for organizations (Morris & Leung, 2010; Zhou & Su, 2010), with much-needed theories lagging behind practical needs in this area (Anderson et al., 2004; Shalley et al., 2004; Zhou & Shalley, 2003). Researchers looked at cultural differences and individual creativity, including how task and social contexts moderate the relation between individuals' cultural values (e.g., individualism/collectivism, power distance, and uncertainty avoidance) and creativity (Erez & Nouri, 2010); how culture moderates influences of leaders, supervisors, coworkers, and social networks on creativity (Zhou & Su, 2010); how culture influences the assessment of creativity (Hempel & Sue-Chan, 2010); and how culture affects the entire process of creativity (Chiu & Kwan, 2010).

Zhou's (2006) model of paternalistic organizational control stemmed from research on cultural differences and work teams in Western and Eastern international contexts. Relative to workgroups, paternalistic organizational control refers to top management's influence over team members and processes in work teams (Zhou, 2006). Zhou (2006) argued that national culture influences control and intrinsic team motivation. For example, paternalistic organizational control facilitates motivation and creativity for work teams in the East, whereas organizational control can impede Western teams' motivation and creativity (Zhou, 2006). In my real-world example, morale among team members dropped dramatically during the rare times when the boundary-spanner team mandated changes without an apparent reason. During those times, rumors and hearsay spread quickly through the ranks, often false information when the real reason was later given.

Zhou (2006) was one of the first models to allow researchers to examine and understand creativity concerning culture; however, empirical analysis of the model lacks the challenge of studying and including international teams. Theoretical research on cultural differences and creativity (Stahl, Maznevski, Voigt, & Jonsen, 2009) generally holds that cultural diversity facilitates differences in teams, leads potentially to creativity (Anderson et al., 2014). The paternalistic organizational control model and innovation are at once a cultural theory and a theory for team or group interaction and creativity, which allows researchers to explain paternalistic control or organizational control and how it influences team creativity (Anderson et al., 2014). Paternalistic control, creativity, and innovative processes differ by national culture. Although the model is multidimensional, it has not been empirically tested enough to validate the theory (Anderson et al., 2014).

Table 13

Model of Paternalistic Organizational Control and Innovation and Group Creativity: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Irreducible	Team C/I is fostered when the group is culturally diverse (Alexander & van Knippenberg, 2014; Oedzes et al., 2019)

Ambidexterity Theory and Leadership for Innovation Theory

Ambidexterity and leadership for innovation theory refers to complex and adaptive systems that address conflicting challenges by engaging in different activities (Bledow et al., 2009; Rosing, Frese, and Bausch, 2011). Ambidexterity involves developing various internal procedures for different activities, and how ambidexterity is accomplished depends on how activities are separated and integrated, whether structurally or temporally based on different subsystems or across time (Gupta, Smith, & Shalley, 2006).

For example, for team product development, some members can focus on new ideas, while others can examine their usefulness and feasibility. Individuals can also move between activities, such as participating in unconstrained creativity and examining new ideas (Bledow et al., 2009; Rosing, Frese, and Bausch, 2011). Management and team-regulatory processes can help integrate different activities of subsystems at different times (Bledow et al., 2009, p. 320). Ambidexterity is concerned with the management of exploration and exploitation processes, where exploration is closely linked to creativity or idea creation, and exploitation is closely linked to innovation or the implementation of ideas (Turner & Baker, 2020). Teams that can generate new ideas and implement them would be considered ambidextrous, being that they can switch back and forth between creativity and innovation without constraints (Bledow et al., 2009). In my real-world example*,* the CM team became ambidextrous when the subject matter experts (SME) and instructional designers learned how to do each other's jobs via an advanced e-learning authoring tool, resulting in much faster turnaround times for delivering asynchronous learning solutions.

Table 14

Ambidexterity Theory and Leadership for Innovation Theory: Equating Team C/I Processes with CAS Characteristics

CAS Characteristic	Turner and Baker's (2020) Team C/I Processes
Path-Dependent	Team C/I is in a constant flux of exploration and exploitation, cycling between internal and external feedback (Anning-Dorson, 2016; Harvey, 2014)
Systems Have a History	Strong and effective leadership is required to drive team C/I within organizations and groups (Li & Yue, 2019b; Wipulanusat et al., 2017)
Emergence	Standardized routines and generalized heuristics can impede team C/I (Oedzes et al., 2019; Skilton & Dooley, 2010; Sung et al., 2017)

CAS Characteristics and Team C/I Processes

Introduction to CAS Characteristics

Complex adaptive systems theory offers a framework for understanding real-life complexity by focusing on the microstructures, unlike its parent, complexity theory, which focuses on the macrostructures (Turner & Baker, 2019a). This section outlines each of the eight CAS characteristics' definitions with "real-life" examples to create understandable schemas or "cognitive consensuality" (Boal & Schultz, 2007). The eight CAS characteristics that make up the team C/I processes are (a) path-dependent, b) systems have a history, (c) nonlinearity, (d) emergence, (e) irreducible, (f) adaptive, (g) operates between order and chaos and (g) self-organizing (Turner & Baker, 2019a). Again, to help bring the theory to life, I include my personal work experience in the agile MTS project at my previous employment with an NYSE financial services firm.

Path-Dependent

CAS systems are path-dependent in that they are sensitive to their initial conditions and, consequently, can react disproportionately to changes within their environments; albeit, the same force might affect similar systems differently where small changes can lead to big reactions, and significant changes can lead to small or negligible reactions (Turner & Baker, 2019a). Path-dependency is also known as the "butterfly effect," in which a less significant environmental event (e.g., butterflies flapping their wings) influences considerable and unpredictable environmental change (e.g., tornado path and size; Speakman, 2017). In my real-world example, the agile MTS project was riddled with path-dependencies, where initial conditions were critical for future outcomes. For example, the initial kickoff meeting spent over two hours discussing psychological safety, including small group exercises. This was unprecedented because psychological safety had never been discussed before at the firm, and many team members expressed gratitude for learning about it for the first time in their professional lives. From day one, all of the multiteams felt safe(r) to voice their opinions without the fear of repercussion from senior leaders. I have participated in too many projects where there was low psychological safety, and it was refreshing to see the game of politics decrease significantly since the launch of the agile MTS project. I genuinely believe that having the psychological safety conversation upfront resulted in disproportionate positive results in creative and innovative processes.

Systems Have a History

Turner and Baker (2019a) observed that a CAS has a history, meaning that their "future behavior…depends on their initial starting points and subsequent histories" (p. 7). For instance, Turner and Baker (2019b) studied professional painters and writers' creativity and innovation processes and found that these artists' behaviors were significantly connected to their history and early starting points (e.g., childhood). In my experience, I witnessed this CAS characteristic in the agile MTS project when several team members struggled to adapt to project management's agile approach. Their experience and history of working in "waterfall" projects often impeded them from adopting the behaviors needed for developing agile solutions. Some leaders struggled to not give orders or advice to allow team members to genuinely be self-directed. Conversely, some team members struggled with relying on their teammates for problem-solving when they preferred getting direct orders from the boundary-spanners team instead.

Nonlinearity

Nonlinearity refers to the "relationship between the components of CAS and its whole. When the relationship is nonlinear, a small change in a component can lead to a larger change in the whole" (Werder & Maedche, 2018, p. 820), thereby making CAS difficult, if not impossible, to predict (Turner & Baker, 2019a). Referring to the previous example of Turner and Baker's (2019b) study of professional artists, the study revealed how their brainstorming processes were nonlinear and unpredictable. In particular, one artist deliberately avoided any type of planning so that the nonlinear creative process did not get thwarted by the restrictive, linear-planning process. In my real-world example, the agile MTS project was brimming with nonlinear team C/I processes, such as having the CM team involved early on in the project. Typically, the CM team workstreams do not begin until the end of the project cycle; however, the agile approach involved them from the start. The transition from the end to the beginning of the project cycle was initially challenging because the CM team had never started this early on when the information level was relatively low. However, doing so paid big dividends because starting earlier allowed the team to overcome obstacles deemed insurmountable beforehand (e.g., delivering mobile training on personal devices). Starting earlier was a small "change" that had significant positive consequences for the CM team.

Emergence

Emergence occurs among CAS when at least two interdependent systems (or subsystems) emerge into a higher state and transform into something that did not exist before (Poutanen et al., 2016; Turner & Baker, 2019a). Hargadon and Bechky (2006) observed that emergence could occur in collective intelligence, when new ideas, new interpretations, and discoveries are made by a group of people that otherwise would have been impossible by individuals acting alone. For example, they shared a field case study involving Reebok, the shoe and apparel company, and Design Continuum, a design firm that Reebok hired to develop an innovative shoe to compete against the popular Nike Air's basketball shoes. The final product was the Reebok Pump shoe, "a form-fitting shoe that worked because of an inflatable air bladder built into its sides" (Hargadon & Bechky, 2006, p. 485). The final innovative product emerged from a cumulation of different team members' experiences, knowledge, and skills: some knew about Reebok's demands, some had experience with inflatable splints, others with medical IV bags, and others with pumps. As a result, a transformative product emerged from these team members' social interactions that would have been impossible to do individually. In my real-world example*,* the CM team saw emergence frequently occurring among its team members, especially when both SMEs and instructional designers learned each other's roles. Each team member became more ambidextrous to share ideas from multiple angles and perspectives that did not exist before.

Irreducible

Irreducible is when CAS cannot revert to its original state (i.e., lower state). For this reason, CAS is now irreducible, having lost the ability to return to its former self because the whole is now different (not greater) from the sum of its parts (Turner & Baker, 2019a). For instance, professional artists are always experimenting with innovative processes and techniques (i.e., higher states) and may never return to old ways (i.e., lower states) of doing things (Turner & Baker, 2019b). In my experience, the CM team members who were now ambidextrous could not revert to their former selves when they had lesser skills.

Operates Between Order and Chaos

Optimum CAS behaviors and performance occur between the edges of chaos and order due to the adaptive tension among the system and its environment (Speakman, 2017; Turner & Baker, 2020). The adaptive tension (aka region of complexity) “emerges from external constraints and corresponds to the energy differential between the system and its environment. Between the ‘edge of order’ and the ‘edge of chaos’” (Turner & Baker, 2019a, p. 7).

Having the ability to be adaptive, operating between chaos and order is one of CAS’s unique characteristics (Turner & Baker, 2019a). This balance is self-organizing and allows CAS to avoid the status quo while also avoid complete chaos (Boal & Schultz, 2007). Incidentally, the term “edge of chaos” can sound misleading as if it were a place to be avoided; however, it refers to the region or zone where CAS behaviors are most adaptive, flexible, and innovative

(Speakman, 2017). Within this zone or region of complexity, adaptive friction emerges (Turner & Baker, 2019a) when teams face unstructured problems (Chamakiotis & Panteli, 2017), nonroutine procedures (Hoogeboom & Wilderom, 2020), and uncertainty (Sung et al., 2017). Indeed, Ramos-Villagrasa et al. (2018) reported in their meta-analysis review of 92 articles published over 17 years that teams were more successful at reaching their goals *with* adaptive tension than without it. In my real-world example, the CM team experienced a lot of pushback and resistance when the team members were asked to become more ambidextrous in their roles. Naturally, tension rose amongst those team members who doubted their ability to change and learn new skills. Shortly after the retraining program started, the turnaround delivery time expectedly increased, making the management team nervous. The turnaround times dropped precipitously soon after the team members became more competent in their ambidextrous roles, approximately a month later.

Adaptive

CAS are adaptive systems because they require both order and disorder processes simultaneously, making the system components even more malleable and resilient (Turner & Baker, 2019b, p. 52). Adaptive organizations are typically not overly managed because, if they were, they could not respond to external changes quickly enough for the changes to be relevant (Turner et al., 2018). Adaptive leadership, for example, allows organizations to respond rapidly to external changes, facilitating approaches for leaders to assist followers to recognize and address issues in complex, changing environments (Turner et al., 2018). In my real-world example, by increasing the number of SMEs and instructional designers without adding headcount, the CM team became more adaptive to the business stakeholders' just-in-time requests. The ambidextrous team members helped bring down the turnaround training delivery time from over two weeks to 2-3 days by utilizing an advanced e-learning authoring tool.

Self-Organizing

CAS provides interdependency and interaction between its parts while maintaining diversity throughout the entire system (Turner & Baker, 2020). Similarly, self-organized CAS entities are composed of “simple individual behavioral characteristics” (Turner & Baker, 2019a, p. 6) that, when aggregated, produces “complicated coordinated patterns of group behaviors that change and adapt to environmental circumstances” (p. 6). To illustrate, Pype et al. (2017) described how in the medical field, specialized palliative nurses work with “general practitioners (GPs), community nurses, palliative care physicians, hospital-based specialist, as well as patients and their families.” (p. 2029). These CAS agents, consisting of diverse backgrounds and skills (i.e., “simple” individual behaviors), often interact while caring for patients whose health depends on their medical team’s interdependent behaviors (i.e., complicated coordinated group patterns). In my experience, multiple teams were self-organized, including the CM team. The CM team members voted on when and how often they wanted to meet; they were allowed to volunteer for specific tasks and deliverables. Also, they had the option of opting out of the ambidextrous training program, though only two people did. Diversity of backgrounds and skills increased amongst the team members; however, so did team relationship conflicts. Another unexpected side effect was that other team members not on the CM team became jealous and increased tension for CM team members.

The eight characteristics of CAS are summarized in Table 1, which are the same characteristics that make up creativity and innovation processes: (a) path-dependent, (b) systems have a history, (c) nonlinearity, (d) emergence, (e) irreducible, (f) adaptive, (g) operates between order and chaos, and (h) self-organizing (Turner & Baker, 2020).

Team C/I Processes and Scales as CAS

Hinkin et al. (1997) stated that the scale production method has two approaches to creating items for evaluating a construct under examination: inductive and deductive. The inductive approach is employed in studying an unfamiliar phenomenon where there is little theory to support it (Speakman, 2017). Usually, experts on the topic are asked to explain their organizations' feelings or explain certain types of actions (Hinkin et al., 1997). Responses are then categorized by content review based on keywords or themes into multiple categories; items are then extracted from these categorized answers (Hinkin et al., 1997). On the other hand, the deductive strategy begins with a theoretical description from which the items are then created (Hoyle & Panter, 1995). This method includes a comprehension of the related literature and the phenomenon to be explored and assures the final scale's adequacy (Creswell & Creswell, 2018). In cases where a theory exists, the deductive method would be considered most acceptable (Hinkin et al., 1997). Inductive and deductive methods were included in this analysis.

Phase 1: Inductive Approach

When Turner and Baker (2019b) first began their research, there were no known theories about creativity and innovation processes as CAS at that time. Therefore, Turner and Baker (2019b) turned to an inductive approach by asking experts (e.g., artists and writers) about their creativity and innovation processes. Using a case-study research method collecting information from various data sources to include multiple measurements of the same phenomenon (Hargadon & Bechky, 2006), they conducted in-depth interviews with five professional artists/writers who, in their creativity and innovation process of painting and writing, demonstrated the eight characteristics of CAS: path-dependent, systems have a history, nonlinearity, emergence, irreducible, adaptive, operates between order and chaos, and self-organizing. Afterward, Turner and Baker (2019) used focus-coding instead of open-coding, where they started with the categories already identified from the complexity theory rather than identifying the categories from the interview data. The researchers then categorized each transcriptional note under its matching CAS characteristic, contingent on meeting that characteristic's definition: data were coded per category, one participant at a time, then compared against the other participants (Hinkin et al., 1997). The focus was to identify any evidence for the pre-defined categories from the data (Turner & Baker, 2019). The information was only transferred to another category if both researchers agreed after finding evidence for or against re-categorization. As a result, the TCI-scale items were extracted from Turner and Baker's (2019b) inductive and qualitative approach supporting their new theory: "Creativity and innovative processes as complex adaptive systems: A multilevel theory."

Phase 2: Deductive Approach

Based on the case study's participants' responses and a review of the existing creativity and innovation literature, Turner and Baker (2019b) created the 63 final items that assessed team C/I processes as CAS. These finalized 63 items were created to represent team C/I processes matched against CAS characteristics.

The remainder of this subsection describes how the instrument items are deductively classified into their creativity and innovation theory, considering one or more of the eight CAS features and how the team C/I processes are derived. To do this, I used the built-in coding features of Citavi version 6.6, a reference management database, to extract the excerpted quotations from PDF and then classified both references and excerpted quotations with keywords, categories, and groups. I then employed interpretive coding, descriptive coding, and focused coding when analyzing the text or group of texts (Bernard, 2013; Hesse-Biber, 2016). The coding process included: (a) "Groups" to identify the theory or theories that my reading note supports using interpretive coding based on my "insights for drawing out interpretation" (Hesse-Biber, 2016, p. 318), (b) "Keywords" to 'tag' (Boal & Schultz, 2007) my reading notes (Hinkin et al., 1997) for finding associations between CAS characteristics and their corresponding team C/I processes by applying descriptive or literal coding where the "words appear within the text" (Hesse-Biber, 2016, p. 318), which then facilitated my ability to create (c) "Categories" or aggregates of patterned knowledge (Boal & Schultz, 2007) based on focused coding which Bernard (2013) described as "coding for categories" (p. 533). I used focus coding because 54 CAS team C/I processes have already been identified in Turner and Baker's (2020) theory. Thus, the objective is to recognize evidence for the pre-defined categories from my excerpted quotations or data. For this reason, focus coding was conducted by implementing the following three methods: groups, keywords, and categories.

The next several sections connect the relationships between the eight CAS characteristics, 54 CAS team C/I processes, and 63 TCI-scaled survey items from a micro perspective. First, each team C/I agent was supported by data collected from the focused coding results followed by classification tables that list the survey items with their assigned creativity and innovation theories. To conclude, this section demonstrates how and why team creativity and innovative processes are indeed complex adaptive systems.

Keyword Method: Identifying Team C/I Constructs to their CAS Characteristics and Team C/I Processes

Under their corresponding creativity and innovation theory (refer to Chapter 2), fifty-four team C/I processes were created for each of the eight CAS characteristics/categories based on

Turner and Baker's (2020) table of creativity/innovation from a complexity theory perspective (see Appendix D). As previously mentioned in the literature review, I conducted searches on keywords based on the constructs of Turner and Baker's (2020) Team C/I processes. For example, the Path-Dependent category included the team C/I processes of (a) Organizational resources must be available, (b) U-shaped relationship between knowledge diversity and integrating group processes, (c) Creativity requires an undemanding environment, while implementation requires precisely the opposite, and so on. I labeled any reading notes that contained the words "organizational resources" into the keyword field (see Appendix D). Creswell and Creswell (2018) recommended relating the variables to the instrument's specific questions or hypotheses by doing the following:

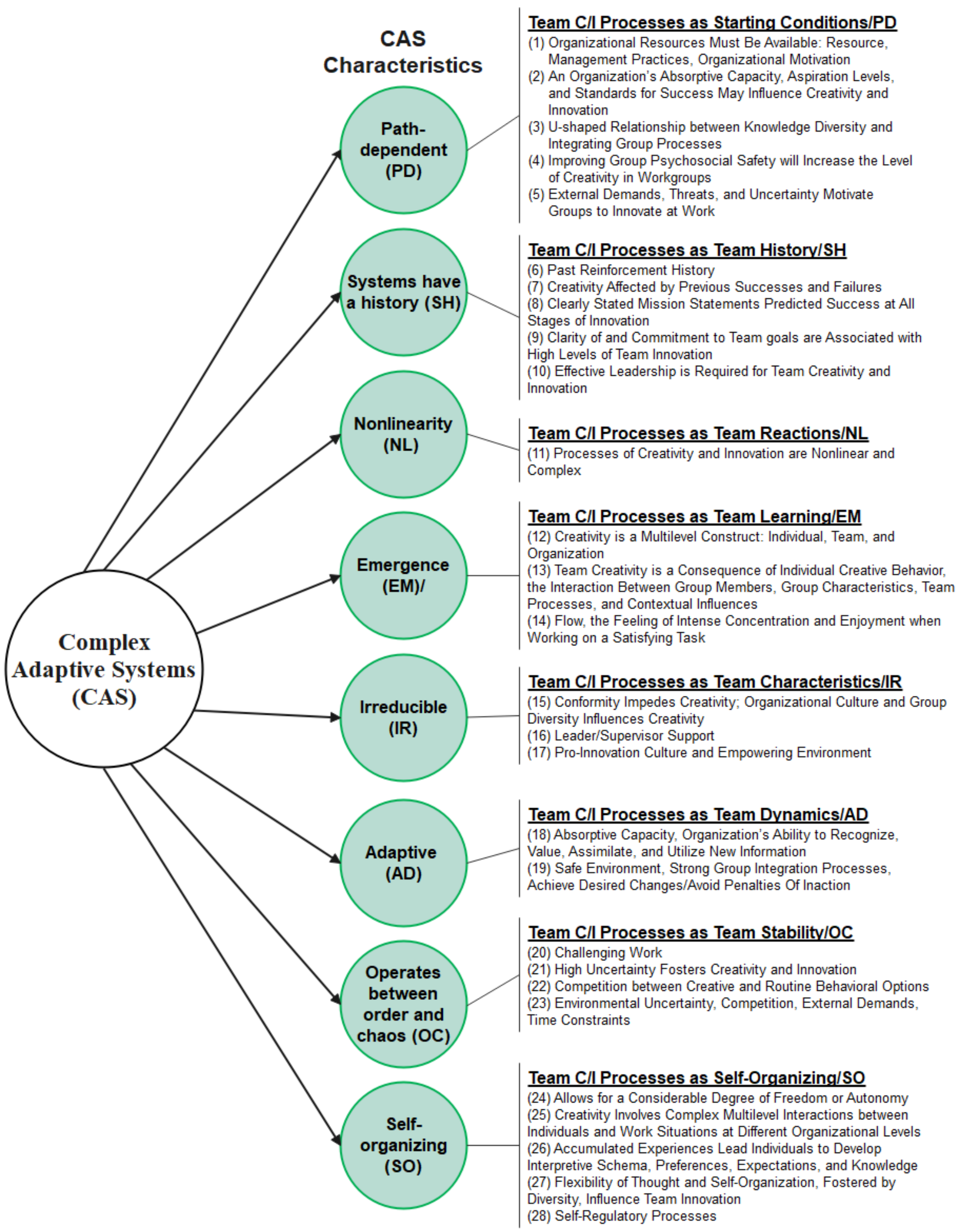
> One technique is to relate the variables, the research questions or hypothesis, and sample items on the survey instrument so that a reader can readily determine how the data collection connects to the variables in question/hypotheses. Plan to include a table in a discussion that cross-reference the variables, the questions or hypothesis, and specific survey items. This procedure is especially helpful in dissertations in which investigators test large-scale models or multiple hypotheses. (p. 154-155)

Although my study did not include research questions or hypotheses, I related the TCI-scale items to the CAS characteristics and team C/I processes in table form. I created categories in Citavi 6.6.0 for each of the TCI-scale items to contain my theoretical data that supported the TCI-scale items (Hinkin et al., 1997). I utilized Citavi's 6.6 robust search functionality to search through a collection of 150 references and over 2,200 annotated notes for matching keywords and descriptions to identify relationships between my notes, 63 survey items, eight CAS categories, and 54 CAS team C/I processes (see Appendix D). As a result, I was able to find sufficient evidence (reading notes and excerpted quotations) to support all 54 CAS team C/I processes. However, my focused coding revealed that just 28 out of 54 CAS team C/I processes were related to survey items. In other words, the final 63 survey items addressed only 28 out of

54 CAS team C/I processes. Figure 8 shows the final 28 team C/I processes associated with their respective CAS characteristics; thus, team C/I processes are CAS. Each team C/I process is also labeled with its alternative, lay title to make them understandable to survey respondents.

Figure 8

Concept Map Of Team C/I Processes as CAS Characteristics



As I have done with several previous sections, I continue contributing my personal experiences with the agile MTS project at an NYSE financial services firm to bring the theory and concepts to life. Each of the eight CAS characteristics was given an alternative lay title to make them understandable for survey participants.

CAS: Path-Dependent and Team C/I Process: Starting Conditions

Turner and Baker (2020) described path-dependent as systems tending "to be sensitive to their initial conditions. The same force might affect systems differently" (p. 14). This section covers the team C/I processes that are path-dependent, with some that are brought to life based on my experience with the agile MTS project at a financial services firm, which is followed by a table of the corresponding TCI-scale items.

Team C/I Process: Organizational Resources Must Be Available: Resource, Management Practices, Organizational Motivation

Organizational resources are critical for team C/I (Amabile, 1988; Sousa et al., 2012) so that the relationship among resources, organizational creativity, and innovation was stronger with the larger firms versus smaller firms (Sarooghi et al., 2015). The larger and more complex organizations are, the greater the challenge innovation can be due to slower decision-making (Foster et al., 2015). This is because creativity and innovation are often multilevel, cross-level occurrences (Anderson et al., 2014). In my real-world example, a great effort was made in the agile MTS project to flatten the hierarchical structure. Many of the teams, such as the new product development team and the CM team, were designated as self-directed teams to speed up decision-making. This meant that the teams were empowered to make many decisions without having to ask for permission. The risk of acting prematurely or hastily was significantly mitigated with daily and weekly stand-up meetings. The creation of the boundary-spanners team, composed of senior business leaders who coordinated the multiple workstreams while communicating directly with the executive leadership team, had the most impact on improving decision-making and problem-solving. As a result, the teams and multiteams promptly received organizational resources, which was significant because it exceeded the budget by a few million dollars. However, the typical hand-wringing and pleading were mostly absent because the boundary-spanners did an excellent job of staying in front of the executive team, so that nothing was a total surprise when asking for additional resources. Besides, resources are a moot point unless the team members know that the resources are available (Cirella, 2016) because team C/I may be impeded by their ignorance of the obtainable resources, which would hamper their starting conditions (Amabile, 1988).

Team C/I Process: An Organization's Absorptive Capacity, Aspiration Levels, and Standards for Success May Influence Creativity and Innovation

Team C/I can be positively influenced by a supportive organizational climate (Bam et al., 2019; Gong et al., 2013) in which team members are not punished for taking risks and sharing ideas (Miron-Spektor et al., 2011, p. 742). An organizational climate of innovation facilitates team C/I in which creative ideas and innovation are celebrated (Glover et al., 2020) and "failure is not fatal" (Amabile, 1988, p. 135). In my real-world example, the agile MTS project was exemplary in this aspect, of allowing mistakes or "failing fast," which did occur by various teams throughout the project life cycle. The biggest influencer that allowed for this type of climate was the Chief Technology Officer, who brought the agile methodology over from Ford, Inc., the auto company. He instilled a climate where psychological safety was taken very seriously amongst the senior leaders. He instructed them to "chalk it up" as a learning moment and that it would only be a failure if the team did not learn from it.

Research showed that merely inspiring individual team members to work harder at being more creative and innovative does not yield desirable outcomes (C. X. Chen et al., 2012). On the other hand, performance assessments and incentive programs have played a critical role in fostering collective creativity by enabling people to share and draw on others' diverse ideas (C. X. Chen et al., 2012). Work evaluations and rewards outside of regular pay or salary act as beacons of aspirational levels and stand for organizational team members' success. In my experience, near the end of the project, the agile MTS project excelled at keeping track of performance, output, and productivity for the entire project and multiteams. All multiteams utilized Jira software, a project management system and tool designed exclusively for agile projects. It is important to note that the agile approach highly prizes transparency, visual management, and celebrating successes. For that reason, Agile's multiteams utilized digital work boards that use "task cards" to manage and track team members' deliverables and job tasks; the task cards' progress phase (e.g., To-do, In Progress, Done) dictates which "pile" they belong. Each team member's tasks are written out on the task cards, and during the daily 15-minute stand-up meetings, team members give an account of their tasks' progress and, if warranted, move their task cards from "one pile to the next." These moments were publicly celebrated while allowing the praised recipients to "show off" their work without appearing vain or braggadocious, which often motivated and inspired the team to continue their momentum.

Team C/I Process: U-shaped Relationship between Knowledge Diversity and Integrating Group Processes

Research showed that the overall diversity of team knowledge is positively correlated with organizational creativity and innovation (Men et al., 2020; Miron-Spektor et al., 2011; Sarooghi et al., 2015; Shin et al., 2012; Somech & Drach-Zahavy, 2013; Tang & Ye, 2015; Vaan et al., 2015). Having more team knowledge diversity does not automatically lead to greater creativity and innovation; instead, it could lower team cohesiveness, which leads to lower group processes and execution (Anderson et al., 2014; Turner & Baker, 2020). On the other hand, low diversity of team knowledge can cause groupthink in which team members are quick to reach common ground and consensus (Chamakiotis & Panteli, 2017; Dreu et al., 2011; Harvey, 2014). Furthermore, researchers found that extended team tenure – team members have been together for a long time – can diminish team C/I (Huo et al., 2019; Sarooghi et al., 2015; Skilton & Dooley, 2010), especially idea implementation or innovation (Sarooghi et al., 2015). For example, academic research teams with high collaboration levels for extended periods produce fewer publications (Skilton & Dooley, 2010). To overcome the adverse effects of extended team tenure, Skilton and Dooley (2010) recommended that teams should undergo, "difficult restructuring interventions repeatedly in order to keep creative abrasion vital" (p. 130).

Team C/I Process: Improving Group Psychosocial Safety will Increase the Level of Creativity in Workgroups

Team C/I requires psychological safety, which refers to a team climate wherein members feel free to express their related thoughts and opinions without fear of judgment or harm from others (Bam et al., 2019; Edmondson, 2012; Han et al., 2019). Psychological safety is critical for team performance because creativity and innovation often come from opposing views or dissent, ideas that are counter-intuitive to the majority of the team's typical schema (Cirella, 2016; Dreu et al., 2011; Oedzes et al., 2019).

Team members are more reluctant to share their creative ideas in the presence of more influential authority figures (Oedzes et al., 2019) because there is less risk of judgment in being silent than speaking out. Team innovation may also be adversely impacted if the higher-level authority is a working team member (Turner, 2019). To improve team C/I, Han et al. (2019) recommended "(a) addressing each member's concerns, (b) recognizing good performance, (c) promoting team cohesion, and (d) supporting each other when handling conflicts within the team" (p. 173). In my experience, the CM team made it a best-practice that when team members wanted to share something with the group—often ideas or opinions that went against group consensus or an influential member's opinion—without fear of being judged or perceived negatively, they would first headline their statement by saying "psych safety" and then proceed to share their contrary opinion or idea. Team members often told me behind closed doors how much they appreciated learning about psychological safety because it allowed them to be more creative and innovative without fear of repercussion.

Team C/I Process: External Demands, Threats, and Uncertainty Motivate Groups to Innovate at Work

Today's organizations are frequently under threat from external forces such as competitors and ever-changing customer demands that are ambiguous and unpredictable (Anning-Dorson, 2016; Soyadi, 2020). Organizations must anticipate future customer needs to stay viable, thus requiring teams to proactively seek customer feedback and reactions along with the product's creation lifespan (Rangus et al., 2016). Incidentally, real-time customer feedback can cause team C/I to be interrupted because it requires the team to go back to the drawing board to reconfigure previous ideas, resulting in positive and negative results (Anning-Dorson, 2016; Skilton & Dooley, 2010).

Many of the team C/I antecedents or inputs (i.e., starting conditions) listed in Figure 9 have a profound impact on its processes, ultimately leading to significant results. In my agile MTS project example, psychological safety allowed teams to be more creative and innovative because team members had more courage to share dissenting ideas. As a result, people felt more confident that a problem was viewed from multiple diverse perspectives, which created novel solutions such as mobile training, first deemed impossible, but pushed forward by those who refused to surrender to people who "knew better." Hence, psychological safety allowed the CM team to revamp the C/I process, which meant working closely with the compliance team (i.e., multiteaming) from the very start, rather than looping them in at the end development process.

The following summary table includes specific TCI-scales led by their corresponding teams' C/I processes and theories and CAS characteristics. For instance, Table 15 has 15 of the 63 TCI-scale survey items related to the path-dependent CAS characteristic.

Table 15

TCI-Scaled Items for CAS Characteristic: Path-Dependent/Starting Conditions

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
1	Path-Dependent: Access to Organizational Resources	My team had access to the resources required to complete its tasks
1	Path-Dependent: Access to Organizational Resources	A lack of resources hinder my team's creativity
5	Path-Dependent: Access to Organizational Resources	People outside of my team support my efforts
5	Path-Dependent: Access to Organizational Resources	To be creative, my team members must be able to set their schedule
3	Path-Dependent: An Organization's Absorptive Capacity, Aspiration Levels, and Standards for Success May Influence Creativity and Innovation	My team's standards for success enhance overall creativity
5	Path-Dependent: U-shaped Relationship Between Knowledge Diversity and Integrating Group Processes	Creativity only occurs in some teams
5	Path-Dependent: U-shaped Relationship Between Knowledge Diversity and Integrating Group Processes	A team's diversity of knowledge positively affects creativity.
5	Path-Dependent: U-shaped Relationship Between Knowledge Diversity and Integrating Group Processes	The more similar I am to my team members, the less creative I am.
5	Path-Dependent: U-shaped Relationship Between Knowledge Diversity and Integrating Group Processes	My team's creativity has improved as we have matured together
5	Path-Dependent: Improving Group Psychosocial Safety Will Increase the Level of Creativity in Workgroups	My team members support my contributions.

(table continues)

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
5	Path-Dependent: Improving Group Psychosocial Safety Will Increase the Level of Creativity in Workgroups	The free exchange of ideas among team members aids creativity.
5	Path-Dependent: Improving Group Psychosocial Safety Will Increase the Level of Creativity in Workgroups	Having management as a team member negatively influences my team's creativity
5	Path-Dependent: External Demands, Threat, and Uncertainty Motivate Groups to Innovate at Work	Influences outside of my team's control negatively affect my team's creativity
6	Path-Dependent: External Demands, Threat, and Uncertainty Motivate Groups to Innovate at Work	Team creativity is often interrupted due to customer feedback.

Note: 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

CAS: Systems Have a History and Team C/I Process: Team History

This section covers the team C/I processes that correlate with the CAS characteristic "Systems Have a History" in that a team's history can positively and negatively affect its processes and outputs. Some of those team C/I processes are accompanied by my experience with the agile MTS project at a financial services firm, which are then followed by a table of the corresponding TCI-scale items.

Team C/I Process: Past Reinforcement History

Turner and Baker (2020) found that past successes and failures influence team members' creativity. Past experiences can often influence team C/I positively (Hargadon & Bechky, 2006) and negatively (Skilton & Dooley, 2010). Hargadon and Bechky (2006) noted several studies on organizations relying on team members' history and experiences to solve complex problems and create innovative products (e.g., the Rebook pump shoe). Conversely, Skilton and Dooley (2010) found that "many creative projects are not insulated from the baggage of participants' shared history" (p. 119), meaning that repeated past experiences can suppress team creativity due to complacency and "resting on their laurels" (Huo et al., 2019; Skilton & Dooley, 2010). For example, Skilton and Dooley (2010) reported that publications went down amongst groups or teams that high levels of repeat collaboration and consultants working together repeatedly decreased performance. Even long team experience will affect the team's innovation and power because it can contribute to collective thinking, and the status quo be less likely to be called into question (Sarooghi et al., 2015). Thus, Vaan et al. (2015) suggest that organizations would benefit by having their work teams assemble, disassemble, and then reassemble based on the project's needs rather than the team members' desire to repeatedly work together.

Team C/I Process: Creativity Affected by Previous Successes and Failures

While past average successes may encourage creators to engage in more explorative and creative projects (Skilton & Dooley, 2010; Vaan et al., 2015), past failures that harm the creator, whether it is reputational or self-perceived, can cause the individual to avoid creative work that could potentially be more rewarding (Turner & Baker, 2020). In my real-world example, when first mentioned by a less senior team member, the mobile training solution was rejected immediately by the more senior team members because they had failed in the past. After much discussion, the two leading root causes were compliance issues and compensation for hourly service associates. Service associates paid hourly must be compensated if they are conducting anything business-related on any mobile device. This issue was only associated with the service organization, not with the sales organization. The final solution was to disallow the service organization access to the mobile training and work with compliance in the early stages versus late stages, which was the norm before the agile MTS project.

In their study of creative artists, Turner and Baker (2019b) found that past successes motivated the creators to continue working on their craft. Nevertheless, failure is a natural part of most creative processes because the final solution rarely develops from the first idea (Keenan & Henriksen, 2017). Team members can be susceptible to failure, to the point that thinking or imagining failure can impede overall team C/I (Turner & Baker, 2020). Therefore, organizations must create a climate where their members feel safe to voice their ideas without fear of losing face or being judged for failing (Edmondson, 2012).

Team C/I Process: Clearly Stated Mission Statements Predicted Success at All Stages of Innovation

Well-defined mission statements are predictors of organizational success throughout "all stages of the innovation process (conception, planning, execution, and termination)" (Turner & Baker, 2020, p. 27). After all, clarity in mission statements allows senior management to take responsibility for their organization's success and failure (Serrat, 2017). For this reason, team C/I of senior leadership teams and the success of the overall organization are linked together because creativity allows those teams to promote decision making, adapt to environmental changes, and achieve enterprise-wide innovative solutions (Rong et al., 2019). In my experience, the very first task for the CM team was to create a value statement for the new product that aligned with the firm's overall mission statement. Hence, I created a special-purpose team composed of the boundary-spanners team and the heads of the new product development team, marketing team, and compliance team. The team's objective was to create a value/mission statement that resonated with the sales and service organization to motivate the associates to market the new product ethically and effectively with their clients. It took two full meeting days at an off-site to create the value/mission statement and then a couple of weeks to get the executive leadership team's approval, but the trade-off was immediate. With just one sentence followed by a few supporting statements, the sales and service organization understood which of their clients stood to benefit the most from the new. We announced the new product's value/mission statement at the initial project kickoff meeting, and all of the teams rallied around the value/mission statement so that we all knew the purpose and goals of our work.

Team C/I Process: Clarity of and Commitment to Team Goals are Associated with High Levels of Team Innovation

Members' commitment to team goals positively influenced team C/I when the goals were clear and precise (Gong et al., 2013; Peralta et al., 2015; Serrat, 2017). Nevertheless, Han et al. (2019) failed to find a significant positive relationship, and in some cases, negative relationships were found between higher team C/I output and teams who closely monitored and tracked their goals with members' behaviors. This would imply that closely monitoring or controlling team members' behaviors during the creative process may inadvertently backfire and lower team C/I.

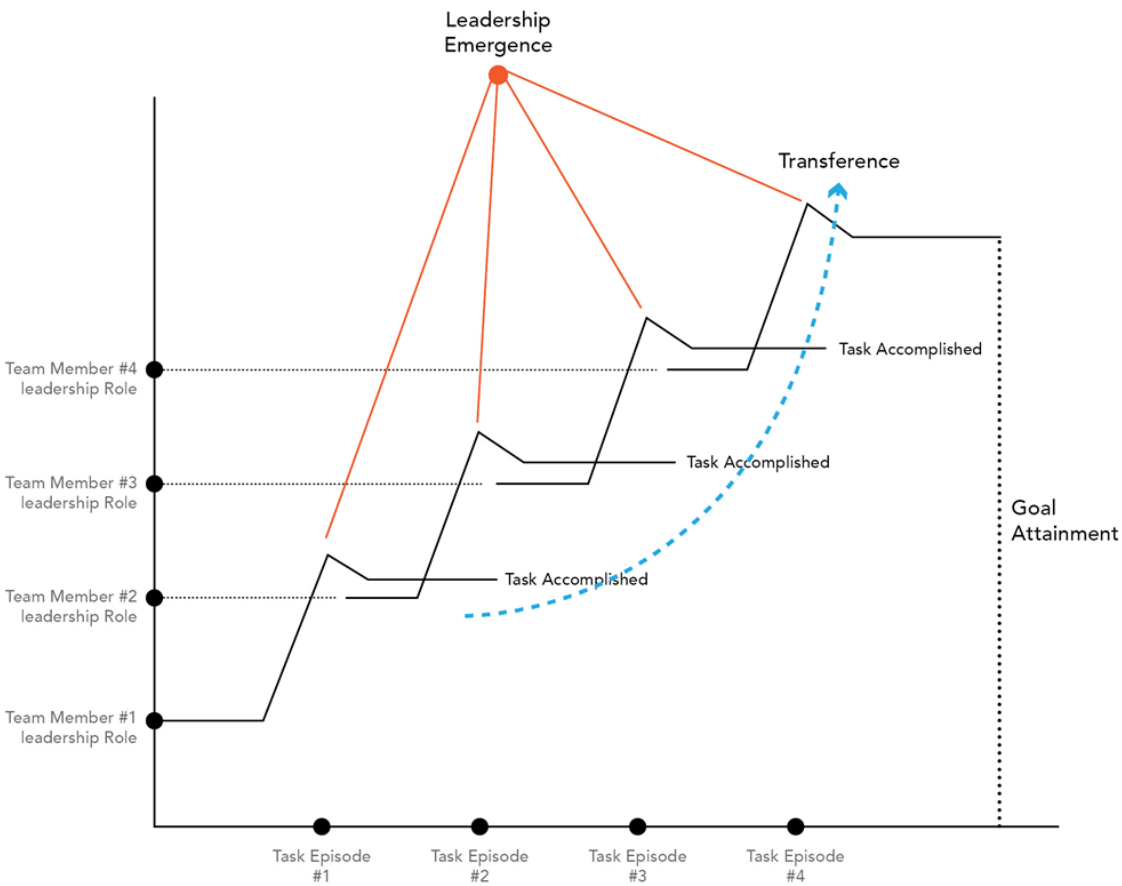
Team C/I Process: Effective Leadership is Required for Team C/I

Developing team C/I in both individuals and teams requires supportive and robust leadership (Li & Yue, 2019b; Wipulanusat et al., 2017). Generating novel ideas and solving complex problems require multiple people to leverage their strengths and different perspectives (Černe et al., 2013). Therefore, to maximize team C/I, leadership should constitute a shared leadership model wherein team members are empowered to lead the team when their competencies are best aligned with a particular stated work or project goal (Chamakiotis & Panteli, 2017). Such an approach involves different leadership behaviors at different times or phases of the work project (Chamakiotis & Panteli, 2017; Turner et al., 2018).

Turner and Baker's (2017) team leadership model illustrates how shared leadership can foster team C/I processes and vice versa in complex and dynamic environments (Figure 9).

Figure 9

Team Emergence Leadership Development Model



Turner and Baker recommended that teams tackle a complex team goal by breaking it down into task episodes or subtasks, and then team members take on a leadership role for that particular task episode. They concluded that shared leadership occurs when the task leader leads the team through the task episode while receiving feedback and support from the other team members. In my experience, the CM team had five different subteams assigned to different workstreams of the change management initiative. Subteam A, composed of two team members, owned driving awareness of the new product to the sales and service organization, which required several communication delivery pieces. As the subteam led those efforts, the rest of the subteams supported them by offering different perspectives from their task episodes (e.g., Subteam B gave the front-line associates perspective while Subteam D gave them the front-line management perspective). As a result, the collaborative rotational process built more robust shared mental models between the team members as all of their tasks were related in one form or another. These learning and coaching moments were developed during the daily and weekly team meetings. When a subteam completed their subtask goals, those team members could drop out of the project or join another subteam. Almost everyone volunteered to continue working on the agile MTS project by joining other subteams within the CM team.

Table 16 includes seven TCI-scaled items, each led by their corresponding teams' C/I processes and theories and the CAS characteristic "Systems Have a History."

Table 16

TCI-Scaled Items for CAS: Systems Have a History/Team History

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
2	Systems Have a History: Past Reinforcement History	Creativity requires team members to reflect on their past experiences.
2, 3	Systems Have a History: Past Reinforcement History	Other team members' past experiences influence creativity.
3	Systems Have a History: Creativity Affected by Previous Successes and Failures	My team's successes positively contribute toward its creativity.
3	Systems Have a History: Creativity Affected by Previous Successes and Failures	A team's failures negatively influence its creativity.
5	Systems Have a History: Clearly Stated Mission Statements Predicted Success at All Stages of Innovation	For team creativity to occur, the team must first have a mission or a goal.
5	Systems Have a History: Clarity of and Commitment to Team Goals is Associated with High Levels of Team Innovation	Having clear team goals leads to successful creativity.
6	Systems Have a History: Effective Leadership is Required for Team C/I	Creativity requires successful, shared leadership.

Note: 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

CAS: Nonlinearity and Team C/I Process: Team Reactions

The interaction between the system's components and its whole refers to nonlinearity (Werder & Maedche, 2018). A small change in a system's component can lead to a more considerable change resulting in more significant consequences; conversely, a large change can have little to no impact on the result (Turner & Baker, 2020). This phenomenon is the continual challenge that businesses face who operate with limited resources and calculate ROI on their projects (Sternberg & Lubart, 1991). For that reason, the agile approach provides a method for teams to qualitatively determine the ROI of each of its tasks during the planning phase called "task estimates" (Rubin, 2013). It is essentially a way for the team to collectively decide the effort required to complete the required tasks, further described in my agile MTS project example below.

Having the team do task estimates accomplishes several significant outcomes: (a) root out the linear and nonlinear activities required to complete the task, (b) extracts the diverse and collective knowledge, experience, and skills from the entire team, (c) enhances team C/I processes, (d) creates shared mental models and mutual understanding for the entire team, and finally (d), create group consensus on determining the qualitative ROI for any task. Put simply, estimating the effort needed to complete the tasks leverages the team reactions (i.e., team C/I processes) in a productive way.

This section covers the team C/I processes that correlate with the CAS characteristic "Nonlinearity," where small or large changes in a team C/I process can or does not significantly impact its output. Some of those team C/I processes are accompanied by my experience with the agile MTS project at a financial services firm, which is then followed by a table of the corresponding TCI-scale items.

Team C/I Process: Processes of Creativity and Innovation are Nonlinear and Complex

Team C/I processes are nonlinear and complex; creativity can occur during innovation, and innovation can occur during creativity (Kumar et al., 2019; Paulus, 2002). Team C/I processes are iterative processes full of uncertainty and paradoxical interactions. Creativity requires experimenting with random ideas, challenging the status quo, disrupting routines, with little to no consequences for failure. Innovation, the idea implementation stage, requires a disciplined process, routine execution, goal orientation, capping resources (i.e., being efficient), and potentially life-ending consequences (Sarooghi et al., 2015). As a result, creativity and innovation must work recursively and iteratively in parallel, making it challenging for organizations, which is why many innovation efforts often fail (Foster et al., 2015). In my real-world example, the agile method of estimating tasks as a team forces both creativity and innovation to work in tandem. However, the most important agile rule was that estimating tasks had to be an open, collaborative team process that allowed freedom of thought and opinions while mitigating initial biases. For instance, the CM team needed to determine the effort required to create an asynchronous training video tutorial. The first step to estimating tasks was to blindly get team consensus on the overall effort to create a 3-5 minute training video tutorial. To do so, the team used tee-shirt sizes ranging from very small to very large as a measuring stick that has been anchored to an example task for comparing and contrasting effort levels (e.g., a very small tee-shirt sized task would be editing an existing training document that can be done by one person in a short amount of time).

We utilized a software program to do the exercise virtually, aptly named "Task Estimate Poker," so that all three locations (Texas, Missouri, and Nebraska) could participate at the same time. After hearing what the task was, each team member picked a tee-sized card, which they “hid” from the rest of the team, and then everybody “flipped” their cards simultaneously to see the varying tee-shirt sizes. It was an eye-opening exercise for the participants as the cards inadvertently revealed the depth of knowledge and experience for each of the tasks. Each member then took turns to explain why they chose that tee-shirt size and, in the process, uncovered the linear and nonlinear subtasks and resources needed to complete the task. Out of those discussions came several creative and innovative solutions.

Meanwhile, all of the subtasks and ideas were captured in the Jira software during the discussion. At the end of the discussion, the team re-voted on the new tee-shirt size, which had to be unanimous and often was after the enlightening conversations. As for overcoming quarrels and strong disagreements, the team had created rules of engagement beforehand, which they agreed to if they wished to participate in the exercise.

Table 17

TCI-Scaled Items for CAS Characteristic: Nonlinearity/Team Reactions

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner’s (2021) Survey Items
6	Nonlinearity: Processes of Creativity and Innovation are Nonlinear and Complex	Chaos leads to successful team creativity.
6	Nonlinearity: Processes of Creativity and Innovation are Nonlinear and Complex	Lacking direction results in successful team creativity.
6	Nonlinearity: Processes of Creativity and Innovation are Nonlinear and Complex	The more uncertainty there is about the process, the greater the chance for successful team creativity.

Note: 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

After running through several tasks, the team became adept at sizing tasks quickly, resulting in shared mental models and team camaraderie. One of the more significant impacts of estimating tasks as a team was that the team had a more precise understanding of whether the “juice was worth the squeeze” or ROI. From these exercises, several team members volunteered to become more ambidextrous by becoming both the SME and instructional designer to maximize ROI on creating training content. The video production turnaround time went from 1-2 weeks to 2-3 days by the project's end.

In summary, team C/I processes are both linear and nonlinear, where small changes can significantly impact its output, as shown in the agile example of estimating tasks. Table 17 includes three TCI-scaled items, each led by their corresponding teams’ C/I processes and theories and the CAS characteristic “Nonlinearity.”

CAS: Emergence and Team C/I Process: Team Learning

Emergence occurs when the restructuring of two or more systems generates profoundly different outcomes that never existed before, nor were anticipated or predicted (Poutanen et al., 2016; Srinivasan & Mukherjee, 2018; Turner & Baker, 2017). Akgün et al. (2014) identified this phenomenon in the advent of innovative products resulting from people making shared decisions and learning from each other that required coordinated and interdependent behavior. This description of people making shared decisions, learning from each other, coordinating activities, and interacting in independent and interdependent tasks describes team learning components. Team learning is defined as a “dynamic, cumulative process involving interactions among the individual members aimed at a common goal or purpose” (Turner & Baker, 2017, p. 4). It is relevant to the C/I processes because team learning is the “best predictor of future team performance” (Ramos-Villagrasa et al., 2018, p. 148), which is critically important for most organizations since they rely on their teams for addressing innovation. Turner and Baker (2017) found that addressing complex problems requires the utilization of small, diverse teams working in short iterative cycles to learn from each cycle, adapt, and continue to the next iterative cycle.

Turner and Baker stated that a process similar to today's design thinking, creativity, and innovation requires teams to learn as a holistic unit, as a team. Thus, emergence is considered one of the most significant CAS characteristics, if not the most significant characteristic (Jiang & Zhang, 2014) of team C/I.

Team C/I Process: Creativity is a Multilevel Construct: Individual, Team, and Organization

For every novel idea that gets implemented within an organization, multiple social acts (such as enterprise-wide communication, multi-team interactions, and inter-organizational marketing) are required and promoted within an organization (Baer et al., 2014), which is why real innovation in companies is always a team effort (Sousa et al., 2012). Team creativity is not merely an aggregation or total sum of individual members' creativity in a team (Amabile & Pratt, 2016; Somech & Drach-Zahavy, 2013). Instead, team creativity is a construct composed of "individual creative behaviors, the interactions between the group members (e.g., group composition), group characteristics (e.g., norms, size), team processes, and contextual influences (e.g., organizational culture, reward systems)" (Anderson et al., 2014, p. 1300). Team creativity benefits from this emergence in which the team's creative abilities are accentuated by individual team members' self-efficacy, providing an isomorphic construct known as the team's collective self-efficacy (Dampérat et al., 2016).

Team C/I Process: Team Creativity is a Consequence of Individual Creative Behavior, the Interaction Between Group Members, Group Characteristics, Team Processes, and Contextual Influences

Team C/I is a multilevel construct that involves cross-level interactions between individuals and groups to generate novel ideas and innovative solutions (Anderson et al., 2014; Gong et al., 2013; Turner & Baker, 2020). Team C/I requires social interactions to make discoveries more than individuals acting alone (Cirella et al., 2014; Hargadon & Bechky, 2006).

When social interactions decline, the opportunity for team C/I also declines; group "closeness" is an antecedent to team creativity (Dreu et al., 2011). In my experience, the CM team learned the most from their teammates when they became ambidextrous by becoming both the SME and the instructional designer. The daily 15-minute stand-up meetings were often filled with team members sharing their best practices. It was not uncommon for them to pair up frequently throughout the day as they shared their learnings about the e-learning authoring process.

Team C/I Process: Flow, the Feeling of Intense Concentration and Enjoyment when Working on a Satisfying Task

Flow is a concept that stemmed from Csikszentmihalyi's (1990) research referring to feelings of focus and enjoyment by individuals when they are adsorbed in satisfying activities. Flow is "the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it" (Csikszentmihalyi, 1990, p. 4). Flow often results in work that exceeds original expectations or in outcomes that are unexpected or unpredicted (Turner & Baker, 2019b). In my real-world example, several CM team members experienced flow when creating bite-sized video tutorials. Many of them privately told me how "time flew by" when they were engrossed in the video recording and editing process. The CM team members also enjoyed working with the sales and service pilot teams, who relished being in the limelight by appearing on the videos. As a result, the formerly dreaded task of creating videos became fun and exciting to produce, which greatly exceeded the CM's team's initial expectations.

Table 18 includes six TCI-scaled items, each led by their corresponding teams' C/I processes and theories and the CAS characteristic "Emergence."

Table 18

TCI-Scaled Items for CAS Characteristic: Emergence/Team Learning

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
1	Emergence: Creativity is a Multilevel Construct	Team creativity is a total of individual activities.
2	Emergence: Creativity is a Multilevel Construct	Creativity is directly related to team member communication.
2	Emergence: Creativity is a Multilevel Construct	Working together among team members leads to successful team creativity.
6	Emergence: Team Creativity is a Consequence of Individual Creative Behavior, the Interaction Between Group Members, Group Characteristics, Team Processes, and Contextual Influences	Team creativity results from a shared focus.
8	Emergence: Team Creativity is a Consequence of Individual Creative Behavior, the Interaction Between Group Members, Group Characteristics, Team Processes, and Contextual Influences	Team creativity is based on your context/situation.
8	Emergence: Flow, the feeling of intense concentration and enjoyment when working on a satisfying task	Team creativity is achieved when the outcome is better than anticipated.

Note: 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

CAS: Irreducible and Team C/I Process: Team Characteristics

As a CAS characteristic, irreducible is a decomposable or irreversible process in which higher-level states cannot be reduced to their previous lower-level states (Turner, 2019). Turner and Baker (2019b) worked with creative artists; they uncovered that irreducibility occurred after the creators' work reached the emergence stage. In some cases, the creator reported discarding or throwing away their creation altogether because it was better to start over from scratch than retracing their steps. Fixing the complexity in the lost creation seemed futile, and any attempt to "fix" it created more complexity; they achieved a state of no-return, a state of irreducibility.

For instance, Hillenbrand et al. (2019) reported that several parent companies are buying or creating new core businesses outside of the legacy organization to scale up their new team C/I processes for the following four reasons: (a) the new team C/I processes were too different and complex to integrate with the parent companies' legacy processes, (b) parent companies hindered the team C/I processes with internal policies and hierarchical practices, (c) parent companies limited team members' freedom from making decisions, and (d) lastly, parent company's leadership failed to give adequate ongoing support and resources for the new team C/I processes because it was viewed as a threat to their business, to their expertise, and the legacy culture. Hillenbrand et al. also reported that many organizations, unfortunately, only learned this lesson after attempting to merge the new core business with the legacy organization, which often caused millions of dollars to disentangle and separate the two organizations. Hence, Turner and Thurlow (2020) argued that those organizations could have avoided making such costly decisions if their leaders understood the nature of new and legacy organizations' problems.

Figure 10

Cynefin Framework

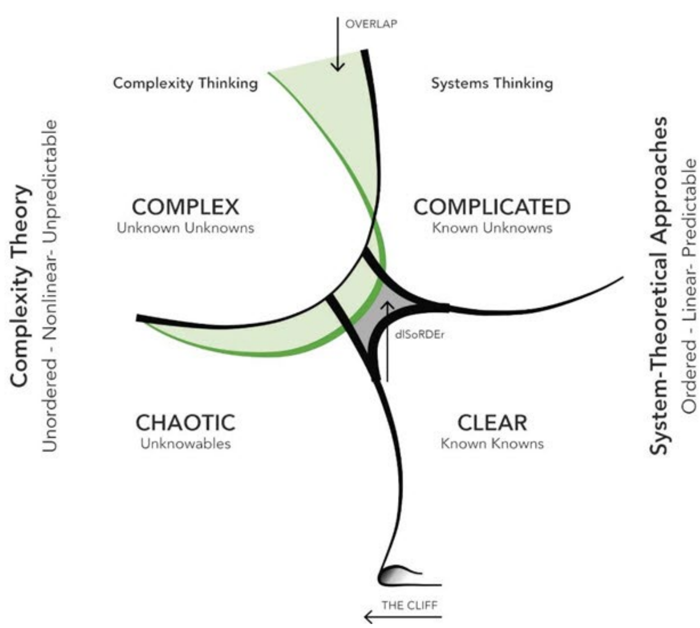


Figure 10 is a Cynefin, a key framework as what is known as “naturalizing self-making” that organizations can use to make sense of the natural world, or in this context, make sense of the differences between complex, complicated, chaotic, and simple problems (Snowden, 2020). In other words, the Cynefin framework would have helped executive leadership and organizations understand *why* it would be better to separate the new core business from the legacy organization.

Turner and Thurlow (2020) suggested that if the leaders understood the Cynefin System, it would help them recognize the types of issues and challenges they face in today's dynamic, disruptive and ambiguous climate. Essentially, Turner and Thurlow (2020) asserted that only by first understanding the problem could they take the best course of action. By referring to the framework, leadership would have understood that the new core businesses had team C/I processes that were irreducible for managing complex problems while their legacy organization’s team C/I processes were for solving complicated yet reducible processes. Thus, they would have realized that merging the two companies would have been a mistake.

System Dynamics

I would be remiss if I failed to address systems thinking and system dynamics, especially in the context of the Cynefin framework. System dynamics (aka systems thinking) has been dominant in management thinking for the past 50 years, treating organizations as machines and predictable strategic paradigms (McCrone & Snape, 2020). Vennix (1995) explained that “system dynamics was originally founded as a method for modeling and simulating the behavior of industrial systems” (p. 335). Treating organizations as machines results in system dynamic statements and phrases such as “‘levers for change,’ ‘drivers for growth,’ ‘alignment,’ ‘optimization,’ etc.” (McCrone & Snape, 2020, Strategy in the Ordered Domains section).

System dynamics also refers to technologies for modeling complex systems and a way of thinking about complex systems (Spector, 2021). McCrone and Snape (2020) found that system dynamics believe that most of the future system's landscape is known or knowable through analysis. Thus, mental models are essential in system dynamics because they explain how a system works, how it evolves, and how it behaves over time. (Sterman, 1994).

The Cynefin framework places system dynamics/systems thinking in the upper right-hand quadrant under “COMPLICATED” rather than “COMPLEX.” For this reason, CAS theory is the more appropriate theory to explain team creativity and innovation processes as it belongs in the complexity thinking arena, according to the Cynefn framework.

Team C/I Process: Conformity Impedes Creativity; Organizational Culture and Group Diversity Influences Creativity

Three primary components that promote individual and team creativity are creative-thinking (i.e., cognitive style), expertise, and intrinsic motivation (Anderson et al., 2014). In particular, Miron-Spektor et al. (2011) identified three different creative-thinking types of team members: creative members, conformists, and attentive-to-detail members. Miron-Spektor et al. maintained that creative members favor thinking outside of the box, which lets them identify and reframe problems to generate novel solutions that others may perceive as too radical or revolutionary. On the other hand, they discovered that the disadvantage of creative members is that they tend to neglect operative details or are not detail-oriented.

Miron-Spektor et al. (2011) observed that conformists prefer to follow the rules while striving for group consent and harmony, proposing ideas that are likely to achieve group and organizational consensus. They also noticed that attentive-to-detail members are meticulous and excel at translating ideas into dependable processes, yet they have little patience with errors and mistakes (Miron-Spektor et al., 2011). They also found that the conformists contribute to team

C/I because they “hindered task conflict, enhanced adherence to standards, and strengthened their team’s belief in its effectiveness (i.e., team potency). Hence, these processes help maintain team norms and provide a team with the structure needed for innovation” (Miron-Spektor et al., 2011, pp. 753–754)

On the other hand, Miron-Spektor et al. (2011) discovered that the attentive-to-detail members hindered team C/I. They also acknowledged that conformity alone could impede creativity; however, it can be offset when conformists work closely with other highly creative individuals. They also affirmed that culture and team diversity, identified in this example as having a high number of creative and low-attentive-to-detail members, influence creativity.

Team C/I Process: Leader/Supervisor Support

Leadership can affect team creativity (Boies et al., 2015; Carmeli et al., 2014). Guanxiong (2017) found that structuring leadership is functional and positively affects team creativity, in that the leaders set realistic yet high-performance goals for teams and push for consistent teams’ improvement, thus facilitating teams’ creativity. The structuring leadership style is follower-oriented, in which the leaders help followers prevent mistakes, thereby decreasing uncertainty among team members regarding their tasks, which helps team creativity (Pei, 2017).

Team C/I Process: Pro-Innovation Culture and Empowering Environment

Pro-innovation cultures and empowering environments facilitate the consideration of new ideas, create organizational environments of collaboration and cooperation that span organizational levels, develop settings in which innovation is lauded, and make failure seem as sometimes necessary for innovation (Amabile, 1988). Pro-innovation cultures and empowering environments are ones in which team members are encouraged “to think differently, take calculated risks, and challenge the status quo" (Serrat, 2017, p. 909). Other important organizational components, including leadership, approaches to risk-taking, budgets, performance measures, and recruiting, maybe marshaled to support pro-innovation and empowering philosophies (Serrat, 2017). These cultures are designed for and are looking for emergence through experimentation by applying/testing new ideas and techniques. Many experiments are irreducible but are captured when they result in a new idea when emergence occurs. In my experience, the agile MTS project allowed me and the CM team to be creative and innovative in training our service and sales organizations' leadership and associates.

Table 19

TCI-Scaled Items for CAS Characteristic: Irreducible/Team Characteristics

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
2	Irreducible: Conformity Impedes Creativity. Organizational Culture and Group Diversity Influence Creativity	Diversity among team members fosters creativity.
2	Irreducible: Conformity Impedes Creativity. Organizational Culture and Group Diversity Influence Creativity	Team creativity improves when the team's culture allows risk-taking behaviors.
2	Irreducible: Conformity Impedes Creativity. Organizational Culture and Group Diversity Influence Creativity	Lack of team member debate/discussion stops team creativity.
6	Irreducible: Leader/Supervisor Support	Shared leadership is essential for successful team creativity.
6	Irreducible: Leader/Supervisor Support	Team creativity requires strong leadership.
7	Irreducible: Pro-Innovation Culture, Empowering Environment	A culture of creativity is necessary for team creativity to be successful.
7	Irreducible: Pro-Innovation Culture, Empowering Environment	Team creativity can be stopped with one team failure

Note: 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

For instance, the boundary-spanners team supported my decision to purchase an in-app training solution that cost north of $200k, enabling on-demand tutorials built right into the new product.

Once I made the purchase, I knew there was no turning back, so I had to make sure that there was immediate value from the purchase. However, I felt very confident in my decision because I knew it was the best solution for building flexible and adaptive training solutions for agile products. The new product would be rolled out in phases with multiple updates and revisions along the way so that the training solution could be just as reflexive. This new training solution would allow for more individual and team learning and coaching opportunities (i.e., emergence) than the typical pedagogical training sessions.

Table 19 includes seven TCI-scaled items, each led by their corresponding teams' C/I processes and theories and the CAS characteristic "Irreducible."

CAS: Adaptable and Team C/I Process: Team Dynamics

Complex adaptive systems are adaptive systems because they both have order and disorder co-occurring simultaneously, which allows them to be even more malleable and resilient (Turner & Baker, 2019b). They are more malleable and resilient because they pursue "short-term exploitation activities as required and invest in longer-term exploration as needed" (Poutanen et al., 2016, p. 202), thus increasing their survival odds. In my real-world example*,* the estimating task poker activity had arguably the most significant impact on the CM team's CI processes. Reason being that it forced the team to take a more ambidextrous perspective on each of the tasks, weighing their short-term and long-term goals. The team's decision to become both the SMEs and instructional designers was a direct result of the poker exercise. Looking at the long game, the actual instructional designers created multiple job aid templates and additional e-learning authoring branded templates that the other non-instructional designers could use and make slight modifications, saving several hundreds of working-hours. These two time-savings activities alone made the CM team more adaptable for meeting business needs. They could be counted on to produce and deliver top-quality training and change-management deliverables in record times by halfway through the project lifecycle. The CM team’s short-term and long-term work processes accommodated frequent staffing changes, a common occurrence for agile projects. As a result, the team was awarded and honored with being the top-performing team after the project ended because of their work processes' efficiency. The following Turner and Baker’s (2020) adaptive CAS team C/I processes describe how team C/I processes have adaptive characteristics.

Team C/I Process: Absorptive Capacity, Organization’s Ability to Recognize, Value, Assimilate, and Utilize New Information

Turner et al. (2018) declared that adapting to external factors is required when working in open systems; for systems to self-organize, change course, and reorganize, they must be adaptable. Turner et al. (2018) also affirmed that adaptive systems are intensely attuned to their contexts and display the ability to adapt internally. As such, they concluded that such adaptability includes teams and members’ abilities to adapt to external factors (intergroup conflict) and internal factors (intragroup conflict; Turner et al., 2018).

Team members must be enthusiastic and motivated to perform their work, helping them address the adverse effects of uncertainty and stress (Anderson, 1999). Larger teams contain more team members and potentially have more energy to counter adverse effects than smaller teams (Werder & Maedche, 2018). Additionally, team members’ characteristics and decision-making processes require consideration because they can affect the system (Werder & Maedche, 2018).

Team C/I Process: Safe Environment, Strong Group Integration Processes, Achieve Desired Changes/Avoid Penalties of Inaction

Psychologically safe environments (Han et al., 2019) can facilitate team C/I, wherein team members feel free to share their thoughts and opinions without fear of being judged disapprovingly by others (Edmondson, 2012). For organizations to adapt to change more effectively, they must create a safe and sound environment where team members can share ideas (Anderson et al., 2014; Giberson & Miklos, 2013) and effectively communicate to avoid conflict and wasteful actions that impede productivity (Soyadi, 2020). In my experience, the second most impactful activities that the CM did for the agile MTS project were the 15-minute stand-up meetings and the weekly team meetings. As mentioned previously, psychological safety was established right from the start so that the team members were emboldened to share their ideas without fear of repercussions. During these meetings, the team members shared and critiqued each other's work, along with raising their hands to ask for help or giving help. These interactions molded the team to become more adaptive and resilient when challenging issues came along.

Table 20 includes five TCI-scaled items, each led by their corresponding teams' C/I processes and theories and the CAS characteristic "Adaptive."

Table 20

TCI-Scaled Items for CAS Characteristic: Adaptive/Team Dynamics

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
3	Adaptive: Safe Environment, Strong Group Integration Processes, Achieve Desired Changes/Avoid Penalties of Inaction	Forcing external change hampers a team's creativity
3	Adaptive: Safe Environment, Strong Group Integration Processes, Achieve Desired Changes/Avoid Penalties of Inaction	Team creativity is dependent upon a teams' ability to be responsive to change
3	Adaptive: Safe Environment, Strong Group Integration Processes, Achieve Desired Changes/Avoid Penalties of Inaction	Team members who are more responsive to change are less creative

(table continues)

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
5	Adaptive: Safe Environment, Strong Group Integration Processes, Achieve Desired Changes/Avoid Penalties of Inaction	Listening to the opinions of other team members is critical for successful team creativity.
5	Adaptive: Safe Environment, Strong Group Integration Processes, Achieve Desired Changes/Avoid Penalties of Inaction	Adapting to change requires communication among team members

Note. 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

CAS: Operates between Order and Chaos and Team C/I Process: Team Stability

The edges of chaos and order are described as a "transition zone between stable equilibrium points and complete randomness" (Boal & Schultz, 2007, p. 413). Optimum team C/I processes occur between the edges of chaos and order due to the adaptive friction among the system and its environment (Speakman, 2017; Turner & Baker, 2019b). As previously described in the nonlinearity CAS characteristic section, team C/I processes are complex and paradoxical because of the constant shifting between the unbridled passion of creativity and the disciplined and ordered innovation process. Therefore, the following team C/I processes explain the team activities and behaviors that cause team C/I to operate between order and chaos.

Team C/I Process: Challenging Work

Team members characterize their work as challenging when the nature of the problem is intriguing and that the organization feels that finding a solution is essential and urgent for its survival and culture. Team C/I are greatly enhanced when team members find the work challenging and urgent, requiring out-of-the-norm thinking and problem-solving (Amabile, 1988; Chamakiotis & Panteli, 2017; Jiang & Zhang, 2014; Li & Yue, 2019a). "Complex tasks usually stimulate team discussion about work-related problems; engaged and skilled members will provide insights that stimulate the process of co-construction, meaning and forming a shared understanding of the need for change" (Lantz Friedrich et al., 2016, p. 563).

Virtual team environments introduce additional challenges for workers. Chamakiotis and Panteli (2017) discovered that these challenges required more creativity and innovation processes from team members. Despite these challenges, creative teams effectively solve problems in complex environments, leading to quality innovation. In my example, the CM team had the difficult challenge of capturing a video of a sales or service pilot team member who worked in a different location. While the usual workaround was to use a CM team member who worked in the same location as the pilot member, this was impossible at times. Equally problematic was that not all offices had sound-proof rooms for video recording purposes, and even if they did, it was not convenient for most pilot members to work in those rooms.

Even with these challenges, the CM team came up with a novel solution where they figured out how to record the pilot member from their work desk, and more impressively, how to record and edit the video concurrently so that the video was 90% completed by the end of the shoot. In short, they used the e-learning authoring software to record both video and audio on top of the virtual meeting. They also recorded the video in short takes, which allowed them to cut and splice the video in real-time while also reducing pressure on the pilot team member to not have to be perfect in one single take.

The trade-off was that the video and audio quality were not the very best, but the team called these videos "vodcasts" to imply that they were more local productions versus the high-gloss productions expected from the marketing group. Both the CM team and the sales and service pilot groups enjoyed dealing with the challenges of recording videos at their desks. They had to manage audio distractions, other non-participants accidentally/deliberately inserting themselves into the video shoot, and the mess-ups and bloopers that naturally come with the recording territory. Overcoming these challenges gave rise to creative and innovative solutions that the CM team members shared in the daily and weekly meetings. Another unintentional win was that the less formal video production allowed for more humor and personal stories that resonated well with the service and sales organizations. As a result, the vodcasts were hugely popular with the sales and service organizations because they featured their peers sharing their best practices, often humorously and with light fun that made the lessons stick in peoples' minds.

Team C/I Process: High Uncertainty Fosters Creativity and Innovation

Proactive creativity can be useful when individuals or teams operate in uncertain contexts to identify adaptive solutions for loosely structured or unstructured problems (Sung & Choi, 2012). Implementing creative ideas is complex because creativity and innovation do not always proceed linearly (Anderson et al., 2004) but may instead take a recursive route, potentially leading to undesired results. The lack of correlation between creativity and innovation may result from processes that can sometimes oppose generating ideas and implementing ideas (Rosing et al., 2011). Tensions (Lewis et al., 2002), paradoxes (Miron et al., 2004), and dilemmas (Benner & Tushman, 2003) characterize the creation and implementation of new and useful ideas. Idea creation, for example, requires experimenting, disrupting routines, challenging assumptions (Rosing et al., 2011), and is aligned with idea exploration (March, 1991). On the other hand, idea implementation involves processes, efficiency, goal orientation, and routine performance, which are exploitative in nature (March, 1991).

Novelty and usefulness, two key components of creativity, do not mesh and maybe inversely related (Rietzschel et al., 2009). Useful ideas usually have value (Sanchez-Burks, 2005), but novel ideas raise regarding practicality, reproducibility, and reliability (Amabile, 1996), which can heighten uncertainty in decision-makers and leaders who allocate resources and implement creative ideas (Baer, 2012).

Team C/I Process: Competition between Creative and Routine Behavioral Options

Team C/I flourish in environments where team members engage in non-routine tasks to yield creative results (Khedhaouria & Ribiere, 2013). Simultaneously, research has shown that routine procedures can harm team C/I (Hoogeboom & Wilderom, 2020; Oedzes et al., 2019; Skilton & Dooley, 2010; Sung et al., 2017). In my real-world example, the 15-minute daily stand-up meetings were beginning to become too routine and stale when I was always leading them. To mix things up a bit and bring variety, the CM team members volunteered to take a turn leading the daily meetings. The impact on team C/I was immediate, as each team member brought their perspective and personality to the meetings. The team challenged each other on making the daily meetings as different as possible, with some dressing up in costumes when it was their turn to lead. Others would play music intermittently throughout the meeting, depending on the tasks' progress. It eventually turned into a sort of radio talk and variety show with much jockeying back and forth between the team members, and always funny as several of them had a great sense of humor. This approach allowed the team to stay on top of their toes as the daily meetings felt fresh every day, operating between chaos and order and doing wonders for the team C/I processes.

Team C/I Process: Environmental Uncertainty, Competition, External Demands, Time Constraints

Organizations seeking group creativity may facilitate intergroup competition (Chen et al., 2012). Innovative companies, including Johnson & Johnson and Procter & Gamble, are strongly invested in competition to spur creativity, rewarding innovative teams with increased funding and more pay (Simons 2000; Nussbaum 2005). Universities and research teams rely more on competitive funding for innovative projects (Geuna 2001). Crowdsourcing is another way organizations rely on creative solutions to problems and compensate groups with the most creative solutions (Chen et al., 2012). For instance, Eli Lilly funded and helped launch InnoCentive, a forum for companies to communicate their research and development challenges to the scientific sector, including compensation to teams with innovative solutions (Brabham 2008).

It is also essential to better understand the connections between performance evaluation, reward systems, and group or team creativity. Extant knowledge of the connections stems from research on singular settings, where creativity does not change with rewards (Chen et al., 2012). Chen et al. (2012) found that trying to get team members to be more creative may not result in wanted outcomes.

Table 21 includes six TCI-scaled items, each led by their corresponding teams' C/I processes and theories and the CAS characteristic "Operates between Order and Chaos."

Table 21

TCI-Scaled Items for CAS Characteristic: Operates between Order and Chaos/Team Stability

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
1	Operates Between Order and Chaos: Challenging Work	Team creativity comes from the team being challenged.
2	Operates Between Order and Chaos: High Uncertainty Fosters Creativity and Innovation	Uncertainty among team members leads to non-normal team behavior.
3	Operates Between Order and Chaos: Competition Between Creative and Routine Behavioral Options	Team creativity results from following a routine.
5	Operates Between Order and Chaos: Environmental Uncertainty, Competition, External Demands, Time Constraints	Increasing team conflict leads to better team creativity.

(table continues)

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
5	Operates Between Order and Chaos: Environmental Uncertainty, Competition, External Demands, Time Constraints	Team creativity requires team members to operate 'out of the norm.'
5	Operates Between Order and Chaos: Environmental Uncertainty, Operates Between Order and Chaos: Competition, External Demands, Time Constraints	Competition among team members enhances team creativity.

Note. 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity

CAS: Self-Organizing and Team C/I: Self-Organizing

Complex adaptive systems provide interdependency and interaction between their parts while maintaining diversity throughout the entire system (Turner & Baker, 2020). Turner and Baker (2019b) proposed that self-organizing—which allows for a considerable degree of freedom or autonomy—becomes automatic only after the creativity and innovation processes allow team members to work on their desired projects. The following CAS team C/I processes describe the self-organizing characteristics of team C/I processes as CAS.

Team C/I Process: Allows for a Considerable Degree of Freedom or Autonomy. Research showed that autonomy and freedom are correlated with greater team C/I where individuals and teams are free to choose what and how they accomplish a task, thus empowering them to control their own work and ideas (Amabile, 1988; Černe et al., 2013; Chamakiotis & Panteli, 2017; Wang, 2016). Amabile's (1988) research found that interviewees rated self-autonomy or freedom in day-to-day work as the most critical factor in influencing their creativity.

If organizations wish to increase their employees' creativity and innovative efforts, one of the first recommended steps is to give their employees more operational autonomy or freedom to choose what they do daily (Černe et al., 2013; Chamakiotis & Panteli, 2017).

Team C/I Process: Creativity Involves Complex Multilevel Interactions between Individuals and Work Situations at Different Organizational Levels

Team C/I is a multilevel phenomenon wherein cross-level relationships and communication between teams, individuals, and organizations facilitate novel ideas and competitive advantage (Chamakiotis & Panteli, 2017; Cirella et al., 2014; Gong et al., 2013; Serrat, 2017). Experts found that social links crossing inter-organizational boundaries contribute to a higher likelihood of producing new ideas (Cirella et al., 2014).

Team C/I Process: Accumulated Experiences Lead Individuals to Develop Interpretive Schema, Preferences, Expectations, and Knowledge

Team C/I is further advanced when team members can successfully communicate their beliefs and schemas to achieve mutual understanding more easily (Ford, 1996). Communication approaches include object visualizations (Blazhenkova & Kozhevnikov, 2016), use of analogies (Harvey, 2014), and mind-mapping interventions where team members present shared mental representations on a whiteboard or through virtual collaboration software (Santos et al., 2015). In my experience, referring to the task estimating poker example, the CM team was able to self-organize around each task, where team members volunteered to take ownership of the different deliverables. Self-organizing became easier after the team had developed shared mental schemas discussing each task's process and the reason or intention behind them. Consequently, the team was able to brainstorm for different solutions and processes once they understood the intent. With minimal guidance from leadership, the team self-organized around the tasks and determine for themselves the best practices and procedures because they were the ones who created them.

Team C/I Process: Flexibility of Thought and Self-Organization, Fostered by Diversity, Influence Team Innovation

As an ambidextrous construct, team C/I is both an explorative and exploitative process where exploration is linked to creating new products (i.e., creativity), and exploitation is associated with the production of those new products (i.e., innovation) (Anderson et al., 2014; Turner & Baker, 2020). Cognitive team diversity is another term for a diversity of thought amongst team members; cognitive team diversity was significantly correlated to individual creativity only when self-efficacy was high (Anderson et al., 2014). Moreover, cognitive team diversity was found to be the most relevant variable that influences team creativity. (Shin et al., 2012).

As a result of the flexibility of thought and cognitive team diversity, team members are more likely to see others' perspectives and thus more likely to implement innovative solutions that they otherwise might not (Dreu et al., 2011). This is best done organically in self-organizing teams rather than in top-down or controlled groups.

Team C/I Process: Self-Regulatory Processes

Poutanen et al. (2016) indicated that self-organization stems from the notion that entrepreneurial enterprises are part of larger systems that involve complex networks, laid the groundwork for characteristics to emerge beyond the system's properties. Poutanen et al. maintained that these characteristics are the results of self-organization. They also asserted that self-organization stems from an actor's action in a local context, wherein there is no crucial controller, and the actor does not have total knowledge of the local context concerning their action. Hence, they concluded that interactions among individuals within a system could lead to new and unpredictable, emergent patterns.

Srinivasan and Mukherjee (2018) reasoned that agile procedures necessitated agile teams as critical units around which work revolved. Srinivasan and Mukherjee claimed that agile teams' essential qualities led to successful project outcomes and were increasingly important. Thus, they contended that regarding teams and CAS, the "traditional command and control mindset" needs to be rethought, emphasizing self-organization and purposeful autonomy.

Creative project teams can be temporary and self-managed, consisting of two or more people tasked with producing creative solutions, often through non-routine activities (Whitley, 2006). Such teams succeed compared to routine work teams or groups because team members are temporary and self-regulated. Creative procedures may differ from routine regulated procedures and often result in more creative outcomes (Skilton & Dooley, 2010).

Table 22 includes seven TCI-scaled items, each led by their corresponding teams' C/I processes and theories and the CAS characteristic "Self-Organizing."

Table 22

TCI-Scaled Items for CAS Characteristic: Self-Organizing/Self-Organizing

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
1	Self-Organizing: Allows for a Considerable Degree of Freedom or Autonomy	Team creativity occurs when teams schedule their own activities.
1	Self-Organizing: Allows for a Considerable Degree of Freedom or Autonomy	Team creativity requires team member autonomy.
5	Self-Organizing: Allows for a Considerable Degree of Freedom or Autonomy	Team creativity requires team member independence
2	Self-Organizing: Creativity Involves Complex Multilevel Interactions Between Individuals and Work Situations at Different Organizational Levels	Team members operating interdependently leads to creativity.
3	Self-Organizing: Accumulated Experiences Lead Individuals to Develop Interpretive Schema, Preferences, Expectations, and Knowledge	Team creativity requires team members to develop mental pictures.

(table continues)

Team C/I Theory	CAS Characteristics & Team C/I Processes	Corresponding Turner's (2021) Survey Items
5	Self-Organizing: Flexibility of Thought and Self-Organization, Fostered by Diversity, Influence Team Innovation	Teams must be flexible and able to change during the creative process.
6	Self-Organizing: Self-Regulatory Processes	A team's ability to manage itself leads to successful team creativity.

Conclusion

Team creativity and team innovation have traditionally been identified as similar but separate constructs in current literature. However, more researchers discovered that there are wide disparities and overlap between the two constructs in several empirical studies in the past decade (i.e., creativity is confused for innovation and vice versa) (Anderson et al., 2014; Hughes et al., 2018; Potočnik & Anderson, 2016; Turner & Baker, 2020). Consequently, there is a lack of a unifying framework and practical measurements, impeding theoretical advancement in a critical research area for today's organizations' survival (Hughes et al., 2018). Moreover, team creativity and innovation scales in several current empirical studies are poorly constructed because the scaled items attempt to measure all or combinations of persons, processes, and products, resulting in a lack of structural analysis (i.e., factor analysis). Therefore, the current study provided a timely unifying framework in which team creativity and innovation (C/I) processes are combined as a single unit based on current literature within the past decade. Based on the theoretical foundation of complexity theory and complex adaptive systems (CAS), Chapter 2 revealed that team C/I are both linear and nonlinear processes that cross-interact to emerge as CAS characteristics. This is significant because it offers a new unifying framework that disentangles the two constructs and clarifies whether creativity or innovation is linear or nonlinear processes or which one comes first. The answer is all of the above. Figure 3, the path-analysis model, demonstrated how the unifying theoretical framework now allows for more clear facet-level measurements and scales, which involves measuring the constructs of team C/I processes as CAS. Chapter 3 covers how the current study aimed to test the instrument that measures the combined processes of team C/I as CAS, and equally important, establish structural or factorial analysis for assessing its construct validity.

CHAPTER 3

RESEARCH METHODS

This study aimed to validate a survey instrument used to measure team C/I processes. With 91% of 1000 Fortune companies in 2018 using team-based structures to conduct business ("Teamwork in Business," 2018), team C/I are more critical for organizational survival in today's complex and unpredictable business environment (Khedhaouria & Ribiere, 2013; van de Wetering et al., 2017; Wipulanusat et al., 2017) driven by evolving technology (Turner et al., 2019) and capricious customer demands (Anning-Dorson, 2016; Im et al., 2013). However, the literature on creativity and innovation showed a relative lack of theoretical progress over the last decade (Anderson et al., 2014), which may contribute to why organizations struggle to develop team C/I (Edmondson, 2012; Khedhaouria & Ribiere, 2013). Also, the literature highlighted a lack of quantitative strategies (Anderson et al., 2014; Poutanen et al., 2016) that, if remedied, could inspire new perspectives on innovation (Larrasquet et al., 2016). Thus, this research advances the multilevel theory of creativity and innovation by developing an instrument that measures team C/I.

Creativity and innovation are nonlinear systems that do not obey a chronological pattern: creativity may occur during innovation and vice versa (Jiang & Zhang, 2014; Paulus, 2002; Rosing et al., 2018). This study's theoretical underpinnings are best suited by complexity theory and complex adaptive systems (CAS). Complexity theory investigates nonlinear system dynamics' properties and behaviors while providing an integrative and dynamic *macrostructure* to understand interdependent agent networks' patterns that engage and are bound by their shared needs or goals (Turner & Baker, 2019b). The theory of CAS studies complex *microstructures:* systems of individual agents free to act in ways that are not always entirely predictable and whose actions are interconnected to change the context for other agents (Turner & Baker, 2019b, p. 42). As such, research has identified behavioral trends or characteristics that make it easier to identify CAS agents (Hoogeboom & Wilderom, 2020; Srinivasan & Mukherjee, 2018). Not incidentally, Turner and Baker (2019b) found that creativity and innovation processes are supported as being a CAS, represented by the eight CAS characteristics: (a) path-dependent, (b) systems have a history, (c) nonlinearity, (d) emergence, (e) irreducible, (f) adaptive, (g) order and chaos, and (h) self-organizing. These eight characteristics found support from qualitative data, recognizing that the creativity and innovation processes CAS (Turner & Baker, 2019b). The next step is to do a quantitative check to verify if there is adequate consistency in reflecting theoretical principles and whether the elements on a scale measure the constructs in a meaningful way (Wipulanusat et al., 2017).

As a result, this study followed a quantitative design to test a survey instrument's reliability and validity, measuring team C/I a CAS (Creswell & Creswell, 2018). Accordingly, this was a cross-section study, where the data being collected at one point in time (Hoch, 2013). Another benefit of using the survey design approach is the design's economy of scale and fast data collection turnaround (Creswell & Creswell, 2018). An experimental design was not considered for the following two reasons:

(a) Asking participants to focus on their creativity and innovation processes could unintentionally create response bias and demand characteristics: "A research project cues that may influence or bias participants' behavior such as suggesting the outcome or response that the experimenter expects or desires" (American Psychological Association, n.d.).

(b) Conducting experiments during the ongoing Coronavirus 2019 (COVID-19) pandemic where people practice social distancing may be infeasible.

In this chapter, the methodology for the study is described. Next, the study's research design is presented, including comparisons of other methods that highlight why the chosen method was the best design. Hinkin et al.'s (1997) seven-phase approach was followed for validation of the scale, excluding the seventh phase of replicating the scale-testing process with new samples because it fell outside the scope of this study:

1. The process of scale development begins with the creation of the items.
2. Next, content adequacy is assessed to verify the conceptual consistency of the survey items.
3. The third phase consists of administering the questionnaire, which involves determining adequate sample size and identifying the items' scales.
4. The fourth phase involves using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to reduce items and test the hypothesized scales' significance.
5. The fifth phase involves testing the instrument's reliability through Cronbach's alpha test of internal consistency.
6. The sixth phase validates the construct validity by determining the convergent and criterion-related validity.
7. The seventh and final phase replicates the study by repeating the scale-testing process with the new scales. However, as mentioned previously, the seventh step was excluded because it falls outside this study's scope and purview.

Finally, the chapter concludes with ethical considerations.

Phase 1: Inductive and Deductive Approach

As a reminder, Phase 1, which included inductive and deductive approaches were covered in Chapter 2 under "CAS Components" because that content was more appropriate for the literature review. Chapter 3 continues with "Phase 2: Content Adequacy," starting in the next paragraph.

Phase 2: Content Adequacy

Assuring content adequacy before the final creation of the questionnaire offers support for construct validity since it allows the deletion of items that might be conceptually inconsistent (Hinkin et al., 1997). Content validity is characterized as the degree to which the test measures the intended content (Thorn & Deitz, 1989). A detailed and systematic analysis of the literature and consultation with subject-matter experts precedes the test development (Thorn & Deitz, 1989). Expert judgment is the most straightforward and most frequent form of evidence offered in support of content validity (Polit & Beck, 2006). Thorn and Deitz (1989) recommended at least two content experts for particular tests to (a) review the domain definitions and (b) determine the relevance of each item to the domain-addressed content.

For these reasons, the initial 70 survey items were validated by a four-member expert panel chosen for their team C/I expertise. The panel of experts' comments and responses provided both face and content adequacy. Based on the experts' suggestions, 63 items were retained after the item reduction and several items were modified to be more explicit and readable.

Phase 3: Administration of Survey

The 63 items were then introduced to an appropriate sample to analyze how well those items confirmed conclusions about the new measure's psychometric properties (Hinkin et al., 1997). The sample for the current study are working professionals who work in the technology industry. Further details about survey participant qualifications are given in the subsection: *Procedures for Recruitment, Participation, and Data Collection*. In that section, I justify why I chose to distribute the survey via third-party online survey panels. Thereby, the participants to be surveyed in the current study were sampled through online survey questionnaires.

Sample Size

A convenience sample was used for the current study, in which respondents were chosen based on their convenience and availability (Creswell & Creswell, 2018). A convenience sample is a non-probability sampling technique, and it is the most applicable and widely used sampling method used in social and clinical research (Elfil & Negida, 2017). A convenience sample may provide more useful data that would not have been accessible through probability sampling techniques, requiring random selection (Jager et al., 2017). Upon determining the sample type, the next step is to determine how to calculate the proper sample size to detect a significant effect (Hancock et al., 2018).

Statistical power refers to the likelihood of detecting a significant effect (Coolican, 2014). The statistical power is best considered during the methodology phase to determine the sample size requirement (Tabachnick et al., 2019). Scale development typically requires large sample sizes due to factor analyses primarily using a series of correlation coefficients (Costello & Osborne, 2005). Monte Carlo simulations and the rules-of-thumb are often used to determine the minimum sample size requirement (Kyriazos, 2018). Monte Carlo simulations refer to methods using random sampling and computer simulation to statistical problems (J. Wang & Wang, 2012). Rule of thumb corresponds to pre-determined sample sizes based on the number of factors and indicators (Nicolaou & Masoner, 2013). For instance, Bentler and Chou (1987) indicated that a minimum of 10 observations should be collected per observed variable. With a total of 62 individual survey items and eight latent factors, following Bentler and Chou's (1987) guidelines would require 620 participants. Moreover, Kelloway (2015) suggests that factor analyses involving small samples ($N < 100$) caused failures of convergence and improper solutions with models containing less than two indicators per latent construct; on the other hand, a sample size greater than 200, with at least three indicators per latent construct, led to zero convergence issues and no improper solutions. Instead, Yong and Pearce (2013a) recommended that the sample be at least 300 participants to ensure data error.

Granted that these rules-of-thumb are more guidelines than hard-fast rules, this study relied on an empirical method using power analysis. A power analysis was used because this study's analysis plan consists of detecting a significant association between interest variables (Creswell & Creswell, 2018): TCI-scaled items and CAS characteristics. Creswell and Creswell (2018) explained how power analysis requires three pieces of information:

1. An estimation of the correlation size(r)" (p. 150), where a conventional method is to find a correlation between studied variables amongst other similar studies. Admittedly, this approach is problematic because no published studies explore this relationship or because the relevant published studies do not have a correlation coefficient.

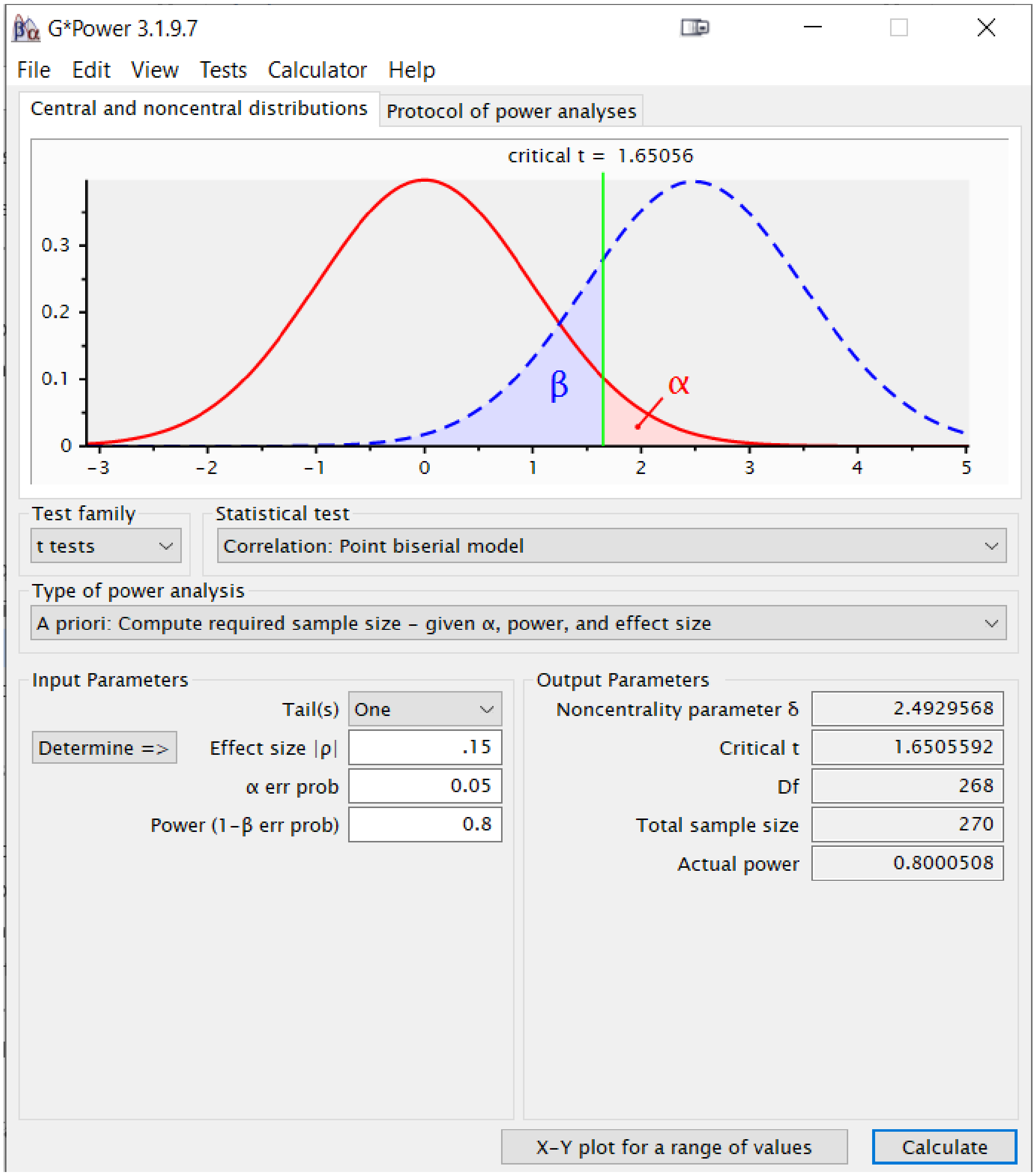
2. A two-tailed alpha value (α)" (p. 151) in which this value is referred to as the type I error rate and refers to the risk in having a "real nonzero correlation" (p. 151) when instead, this effect is false and has occurred by chance (aka a false positive effect). An alpha value of .05 is generally accepted, which means a five-percent probability exists that the occurrence or relationship could be due to chance.

3. A beta value (β). This value is a Type II error rate" (p. 151) and represents the risk of having a non-significant effect when, in actuality, a significant relationship does exist (aka a false negative effect). Researchers usually accept a beta value of .20 when balancing the risk between Type I and Type II errors. "Power analysis calculators [e.g., G-Power 3.1) will commonly ask for estimated power of .80, which is calculated by subtracting one from beta (1 - .20 = .80).

Creswell and Creswell (2018) recommended running power analysis during the study planning process. I inputted Turner's (2014) recommended parameters via the G-Power 3.1.9.7 online power calculator (www.gpower.hhu.de) of a one-tailed test including the "medium effect size of 0.15, an alpha of 0.05, to achieve a power of .80" (Turner, 2014, p. 130), the required sample size came back as 270 (Figure 11). Because the TCI-scales are directional with the underlying assumption that either they are or they are not CAS characteristics, I used a one-tailed test, which is primarily concerned that the observed affected falls in the expected direction (Huck, 2012). If the expected direction occurs, the one-tailed test is more powerful than a two-tailed test (e.g., a one-tailed test with an alpha set of .05 has approximately the same power as a two-tailed test with an alpha set at .10); whereas the power is nil if it does not (Faul et al., 2009), which is entirely appropriate for the current study. Based on the general rules-of-thumb and the power analysis calculation, this study rounded up the 270 sample size to 300 and thus, utilize 300 participants for the EFA and 300 participants for the CFA, for a total sum of 600 participants.

Figure 11

*G*Power Sample Calculation*



The current study also stratified the population before selecting the sample: Particular characters of individuals (e.g., gender: male and female) are reflected in the sample where the sample represents the right proportion of the individual population with specific characteristics (Creswell & Creswell, 2018). For example, out of the 600 survey participants, the sample was stratified based on the following parameters (Wipulanusat et al., 2017):

- Gender: Female (50%) and Male (50%)
- Age Range:
  - 18 – 34 (~33%)
  - 35 – 55 (~33%)
  - 55+ (~33%)
- Race:
  - Non-Hispanic White (~66%)
  - Non-Hispanic Black (~12%)
  - Hispanic (~12%)
  - Other (~10%)

This subsection covered the quantitative method used to calculate the required and stratified sample size to balance Type I and II errors. The following subsection describes this study's procedures for recruiting participants to complete the survey.

Procedures for Recruitment, Participation, and Data Collection (Primary Data)

I obtained Internal Review Board (IRB) approval from the University of North Texas (see Appendix A). I chose to use a third-party survey panel, Qualtrics (www.qualtrics.com), to gather a convenience sample since it is "useful for exploratory research and to get a feel for what's going on out there" (Bernard, 2013, p. 167). Moreover, in the ongoing outbreak of Coronavirus Disease 2019 (Covid-19)—a highly infectious respiratory disease—social distancing measures are causing large populations to avoid coming within six feet of each other (Fauci et al., 2020), furthering the benefit of hiring a third-party survey panel to conduct convenient sampling. An online panel is identified as: “a sample of persons who have agreed to complete surveys via the Internet” (American Association for Public Opinion Research, 2020). Qualtrics is a private research software company that partners with over 20 web-based platform providers to supply diverse participants (Ibarra et al., 2018). In exchange for a form of compensation (small amounts of money; reward points), participants complete surveys for research and educational purposes.

The inclusion criteria for participation included (a) being at least 18 years of age, (b) working full-time in the technology sector (40 hours or more per week, and (c) experience being on a work team. Survey participation was not allowed if the participants did not currently work in the technology field or have experience working on a team. The participants who passed the inclusion criteria and agreed to participate were directed to a consent form, which outlined the questionnaire’s goals and purpose. The estimated time for completion, risks, and benefits for participation was identified in the consent form. Participants were required to read and complete the consent form to ensure they understood the research objectives and their involvement. Participants were asked a question at the end regarding their participation with two options: “I agree to participate” and “I do not agree to participate.” Participants were required to provide consent to continue with the survey process. If participants did not consent, they were redirected to an exit page.

Upon indicating consent, the participants were directed to a demographics form. Based on Wipulanusat et al.’s (2017) instrument validation study, I patterned my demographic questions with a few alterations to account for the studying of work teams in business organizations [italicized items are the adjusted demographic questions]: (a) gender type, (b) race, (c) age range, (d) to which technology industry their business belongs, (e) *type of team*: working team, special-purpose team, multifunctional team, self-directed team, and management team, (f) period spent working on *that particular team*, (g) job role *on that team*, (h) education level, and (i) the size of their business in which they were employed *on that team*. The term "team" is defined in bold letters at the beginning of the demographic question as: "*multiple agents working both independently and interdependently toward a common goal*." Participants were then instructed to base their responses on their most *recent* work team experience.

The type of teams was defined in the survey as the following:

- Working teams: Traditional work teams are directed by supervisors who make most decisions and are typically stable and well-defined to any organization (e.g., IT, sales, service, marketing, HR, finance) (Hollenbeck et al., 2012).
- Special-purpose teams: Usually, these teams are time-limited and focused on fulfilling a particular purpose and producing one-time outputs (Hollenbeck et al., 2012).
- Multifunctional teams: These teams are often structured as working groups that pull together people from different work units or jobs to perform functions that the regular organization is poorly equipped to perform well (Hollenbeck et al., 2012).
- Self-directed teams: These are self-managing teams that do not have a designated leader where leadership decisions, work responsibilities and rewards are shared among team members. (Hollenbeck et al., 2012).
- Management teams: Management teams are made up of managers and leaders responsible for a business unit's total results whose authority is derived from its members' hierarchy (Hollenbeck et al., 2012).

Accordingly, one panel of participants was utilized for the EFA, and a second panel was utilized for the CFA (Bandalos & Finney, 2018a). The samples were split because the CFA repeats some of the relationships formed in the EFA. One sample response to the questionnaire could provide some independent results compared to a second sample (Knekta et al., 2019).

After completing the demographic survey, the participants were directed to the TCI-scale item instrument. Each survey item on the questionnaire had a mandatory response option to ensure that participants did not skip items. The survey tool for this research used Likert-type scales for each of the survey questions frequently used in quantitative studies due to numerical measurements (Boone & Boone, 2012). Upon completing the data collection, the survey data were uploaded into SPSS version 27.0 for Windows.

Missing Data

Frequencies and%ages were run to identify the number of non-responses to each of the survey items. Three types of missing data are missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR; (Fielding et al., 2009). Data that are MCAR is when there is no relationship between the missingness of data and observed values, essentially meaning that there is no systematic cause for why some data are more likely to be missing than others (Josse et al., 2012). The MAR means that the probability that a value is missing is not related to the value itself but is related to observed values on the other variables (Josse et al., 2012). The MNAR data refers to the probability that a value is missing concerning its value (Josse et al., 2012). Each survey question had a mandatory response option; therefore, it was not anticipated to have missing cases. Furthermore, Qualtrics is contracted to remove the surveys with missing data and promptly replace them with new responses completed in full. Therefore, listwise deletion removed participants who do not complete the questionnaire (Creswell & Creswell, 2018). When all data were removed to account for missing cases, descriptive statistics—analysis that indicates the means, standard deviations, and range of scores for the demographics data—were calculated to identify anomalies that may indicate missing data (Creswell & Creswell, 2018). Frequencies and%ages were used to identify the distributions of participants' demographics: (a) gender type, (b) race, (c) age range, (d) to which technology industry their business belongs, (e) type of team, (f) period spent working on *that particular team*, (g) job role *on that team*, (h) education level, and (i) the size of their business in which they were employed *on that team*.

Phase 4: Factor Analysis

Factor analysis was conducted to evaluate the factor structure of the TCI-scale. Factor analysis is a method of modeling covariance among a set of observed variables as a function or more latent constructs (Bandalos & Finney, 2018a). According to Knekta et al. (2019), two approaches for factor analysis should be followed: (1) Exploratory Factor Analysis (EFA) and (2) Confirmatory Factor Analysis (CFA). The first is called exploratory and is generally used when a researcher wants to determine the factors that influence variables and examine which variables belong together (Hinkin et al., 1997; Yong & Pearce, 2013a). Henson (2010) also noted that EFA is used to look for potential latent constructs among the variables, with no or minimal theory of what those variables might be. An EFA was conducted to identify latent constructs among the 63 items or variables within the TCI-scale (Bandalos & Finney, 2010).

The second is identified as confirmatory since, as Wipulanusat et al. (2017) pointed out, CFA is used to reinforce the EFA findings by confirming the measurement scale's validity by supporting the recognized factor structures found from the EFA method. Therefore, a CFA was sequentially conducted to further evaluate the hypothesized structure of the TCI-scale and develop a better understanding of the factor structures. Huck's (2012) six steps for conducting EFA statistical analysis and six steps for conducting CFA statistical analysis were used in this study (these steps are provided in their respective sections: EFA, or Exploratory Factor Analysis, and CFA, or Confirmatory Factor Analysis). To note, where Hinkin et al.'s (1997) seven phases center around validating an instrument—from creating the items to replicating the scale-testing processes with new samples—Huck's (2012) multiple EFA and CFA steps focuses exclusively on those two statistical analyses. Consequently, a few (sub)topics overlap between Hinkin et al.'s

(1997) seven phases and Huck's (2012) multiple steps for EFA and CFA, such as sample sizing and missing data.

Assumption Testing

Each of the survey items was explored for normality through an examination of skewness and kurtosis. Kline (2016) indicated that to meet the normality assumption, skewness of $\pm$ 2.00 and kurtosis of $\pm$ 7.00 are needed. Multivariate normality was tested with Mardia's normalized multivariate kurtosis. Bandalos & Finney (2010) indicated that multivariate kurtosis should be less than 3.00 to meet the multivariate assumption. Bandalos & Finney (2010) recommend running a proceeding with factor analysis with and without outliers to compare for differences. If there is little difference in the results and factor structure, then outliers do not need to be deleted.

EFA or Exploratory Factor Analysis

An EFA is used to discover the number of indicators or observed variables that influence latent factors or constructs and analyze which variables 'go together' to summarize latent constructs (Henson, 2010). The indicator variables in this study correspond to the 63 items on the TCI-scale. The latent factors correspond to the unobserved variables in the model (Henson & Roberts, 2006). In the current research, there were eight latent factors or constructs: path-dependent, systems have a theory, nonlinearity, emergence, irreducible, adaptive, operates between order and chaos, and self-organizing. A primary hypothesis of EFA is that there are common latent factors to be discovered in the dataset, and the goal is to find the smallest number of common factors that will account for the correlations (Henson & Roberts, 2006). Another objective of the EFA is to simplify the survey instrument by reducing the number of survey items needed to utilize the instrument (Henson & Roberts, 2006).

To help simplify the EFA process, Huck (2012) gave an overview of six general steps that a typical researcher can take in conducting an EFA: (1) Checking the suitability of data for a factor analysis, (2) selecting a method of factor extraction, (3) deciding how to rotate factors, (4) determining the number of useful factors, (5) determining the variable make-up of each factor", and the last step of (6) naming the factors in exploratory factor analysis. Therefore, this study utilized Huck's (2010) six EFA steps, described in detail in the following subsections.

Step 1: Data Suitability

The initial phase in any factor analysis involves testing whether certain essential features of the dataset meet the necessary criteria for this type of statistical analysis. For instance, a small sample size is a fundamental feature that can make data unsuitable for factor analysis (Huck, 2012). This study relied on its power analysis calculations of 300 participants per EFA and CFA analyses, respectively, for assuring sufficient data. It is also recommended to compute the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and apply Barlett's chi-square test of sphericity to determine whether the correlation matrix is different from the identity matrix (Pettit, 2015). According to Pettit (2015), a correlation matrix is a matrix of Pearson correlations between the survey items, while the identity matrix is a matrix in which all diagonal values are one, and other values are zero. The data is deemed adequate if the "KMO measure of sampling adequacy is greater than .60, and if Barlett's test of sphericity is greater than .5" (Huck, 2012, p. 487). Multicollinearity, where two or more of the original variables are too strongly associated, is tested, and any problematic variables are discarded and re-checked for suitability (Huck, 2012; Yong & Pearce, 2013a).

Step 2: Factor Extraction

Using factor extraction, a decision is often made about how many factors to initially examine. Extraction refers to the procedure in which a factor solution's parameters are estimated, including factor pattern matrix and the structure matrix (Bandalos & Finney, 2010). The factor pattern matrix contains the coefficients for the linear combinations among the variables of interest, while the structure matrix represents the correlation between the variables and factors (Bandalos & Finney, 2010).

The current research employed principal axis factoring (PAF) as the most suitable tool for evaluating latent constructs when conducting EFA (Henson, 2010). Principal components analysis (PCA) was not considered because, as Henson and Roberts explained, PCA focuses on simply summarizing "many variables into fewer components, and the latent constructs (i.e., factors) are not the focus of the analysis" (p.398). Whereas PAF explicitly focuses on the common variance among the items (i.e., latent factors) (Henson & Roberts, 2006), the current study's focal point when measuring the eight CAS characteristics as latent factors.

Eigenvalues correspond to the measure of how much variance a factor can explain within the data (Hancock et al., 2018). A standard procedure for identifying the number of factors to retain is based on the number of eigenvalues greater than one (Costello & Osborne, 2005). Moreover, when an eigenvalue is greater than one, "it represents more summative than a single item and thus may represent a factor" (Henson, 2010, p. 10). Hence, the higher the eigenvalue, the greater the variance can be explained by the factors (Costello & Osborne, 2005).

Step 3: Factor Rotation

Bryant F.B. and Yarnold (1995) indicated that factor rotation is a procedure in which factors are rotated to obtain a new set of factor loadings or achieve a more straightforward structure. For example, unrotated variables could take four variables to account for 90% of the variability in the data set; whereas, only two variables could reach the same degree of explanatory power after rotation (Huck, 2012). Factor rotation is a process utilized to clean the data by maximizing the factor loadings onto specific factors (Brown, 2015). Two common factor rotation methods are oblique rotation and orthogonal rotation (Jackson et al., 2009). Oblique rotation is utilized when there is an underlying assumption that factors may correlate (Henson & Roberts, 2006). Oblique rotations are optimal when analyzing measures of human behavior and/or psychology (Hinkin, 1998).

Bandalos & Finney (2010) indicated that oblique rotations generally result in more accurate representations when there is an absence of theory to guide the data. Orthogonal rotation is appropriate when it is assumed that the factors extracted are independent from one another (Huck, 2012). A component correlation matrix was conducted to examine the strength of the associations between the components (Jolliffe & Cadima, 2016).

Because EFA is an exploratory operation, Bandalos and Finney (2018b) suggested obtaining both orthogonal and oblique rotations and comparing the results so that the solution is more interpretable and technically justifiable. Subsequently, "the solution that is more interpretable and theoretically justifiable can then be chosen" (p. 105). Thus, I conducted both orthogonal and oblique rotations. However, since the dimensions underlying constructs in the social and behavioral sciences are typically associated, I suspected that oblique rotation would result in more acceptable data representations (Bandalos & Finney, 2018b). Either way, it is not unusual for similar results to be obtained when the same data is computed for orthogonal and oblique rotations (Bandalos & Finney, 2018b; Huck, 2012).

Step 4: Factor Determination

There will be as many factors as variables before and after rotation; but, certain factors will be greater than others in accounting variability between the initial variables (Huck, 2012).

To distinguish between useful and non-useful variables, Huck (2012) recommended applying the following four strategies: (a) Kaiser's criteria, (b) analyzing a scree plot, (c) performing a parallel analysis, or (d) applying the 5% rule.

First, when researchers apply Kaiser's criterion, only those with eigenvalues greater than 1.0 are retained, implying that those factors are more useful than those with less than 1.0 eigenvalues (Hinkin et al., 1997; Huck, 2012).

The second and third methods for evaluating useful factors are similar since they both use a graph. An example of this kind of visual aid in Figure 12. A scree plot, shown as jagged lines and labeled "Actual data" in Figure 12, visualizes how much variance is explained by the factors (Tabachnick et al., 2019). A scree plot is also visually assessed, which corresponds to a line plot representing the eigenvalues of factors in an EFA (Huck, 2012). Through a visual examination of the scree plot, the conventional method is to identify the point in the scree plot where the data in the graph flattens or levels off at a uniform height (Henson, 2010), also called the "elbow" (Huck, 2012, p. 492) of the scree plot. Ideally, there will be convergence between the scree plot's plateauing and the number of eigenvalues greater than 1 (factors; Tabachnick et al., 2019). Factor loadings are examined next to identify which survey items are loading onto the representative factors (Bandalos & Finney, 2010).

In Figure 12, parallel analysis is shown as the second non-jagged line labeled "Random data," derived from a new collection of random numbers set up to have the same sample size and the number of variables as the study's original data (Schultheiss et al., 2009). Because this second "parallel" factor analysis uses random data, the eigenvalues should be low since the correlations between variables are due to chance; where the jagged scree plot line labeled "Actual data" and the non-jagged parallel analysis line labeled "Random data" cross determines the number of useful factors (Huck, 2012). For instance, there are three useful factors in Figure 14 based on where the scree plot line intersected with the parallel analysis line (Huck, 2012).

Figure 12

Scree Plot and Parallel Analysis

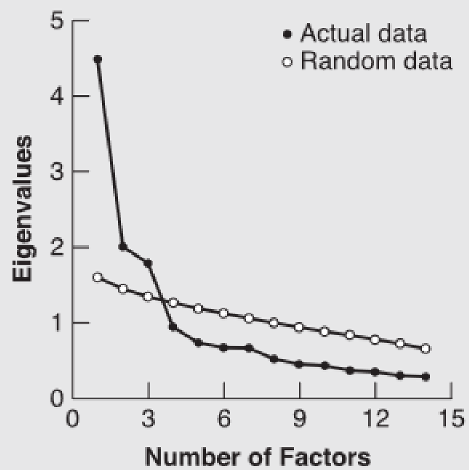


FIGURE 1 ***Plot of eigenvalues from principal components analysis of the actual questionnaire version of the Picture Story Excercise data versus the 95th percentile of eigenvalues derived from a parallel principal components analysis of random data.***

Source: Schultheiss, O. C., Yankova, D., Dirlikov, B., & Schad, D. J. (2009). Are implicit and explicit motive measures statistically independent? A fair and balanced test using the Picture Story Exercise and a cue- and response-matched questionnaire measure. *Journal of Personality Assessment*, *91*(1), 72–81.

Lastly, Huck (2012) explained that the five-percent rule says to “maintain any factor so long as its eigenvalue represents no less than five% of the total eigenvalue ‘pie’” (p. 492). He gives an example of a “factor analysis of four variables that produced factors with eigenvalues equal to 2.0, 1.5, .4, and .1. The last of these eigenvalues is smaller than 5% of all four added together[2.0 + 1.5 + .4 +.1 = 4 * .05 = .2]; accordingly, its factor would be deemed too weak [.1 is less than the .2 of the total eigenvalue pie] to be retained” (p. 492).

To summarize, I used all three of Huck's (2012) recommended strategies—Kaiser's criterion, a scree plot, and parallel analysis—to determine the number of useful factors for my study.

Step 5: Factor Loadings

After determining a subset of factors, my next task was to examine which of the original variables or items are correlated with those factors, known as factor loading (Huck, 2012). Factor loading identifies how much the variable or item contributed to those factors (Yong & Pearce, 2013a). There are two types of factor loadings, each corresponding to structure coefficients and pattern coefficients (Bandalos & Finney, 2010). Structure coefficients correspond to zero-order correlations between the variables and the factors. Pattern coefficients correspond to the unique effect of variables on factors, with the effects of other factors partialed out (Bandalos & Finney, 2010). Factor loadings were suppressed to identify the factors more clearly for interpretation (Kline, 2016). Only factor loadings greater than .40 were identified, according to Hinkin's (1988) recommendation for the minimal cut. Items with factor loadings lower than .40 do not have a strong association with the latent factor (Gorsuch, 1997). Items that do not have a factor loading above .40 were removed due to not having an association with the latent factors, and the PCA was recomputed until an optimal factor structure is developed (Yong & Pearce, 2013b).

Step 6: Factor Naming

When factors are interpreted, the factor's name is most frequently used to communicate the factor's identity rather than the variables or items themselves (Huck, 2012). Hence, Bandalos and Finney (2018b) stressed the importance of naming the factors and that the process of naming them should be clearly communicated. (Bandalos & Finney, 2018b). Thus, I describe the reasoning for giving the names that I did in greater detail.

CFA or Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is similar in many ways to exploratory factor analysis (EFA): both have calculated variables, an initial intercorrelation matrix between certain variables, loading factors and factors (Hinkin et al., 1997). However, there are two main differences between CFA and EFA:

(1) Whereas EFA can be conducted without knowing how the analysis will turn out, CFA is used when an established expectation for what factors should exist in a data set based on a given theory or scientific evidence (Hancock et al., 2018). In fact, CFA requires that theory govern the way the data is analyzed (Huck, 2012).

(2) CFA allows researchers to statistically test the fit of any proposed model(s), whereas EFA fails to have the analytic procedure necessary to test those models (Huck, 2012).

These two distinctions make it valid to believe that EFA is an operation-producing theory, while CFA attempts to test it (Huck, 2012). Along with the general steps outlined for EFA, Huck (2012) proposed the following six steps for conducting a broad CFA:

Step 1: Hypothesis and Model

A researcher starts a CFA based on previous research or current theory by defining the latent and observable variables, in which the observed variables are often the individual survey items (Huck, 2012). The investigator's next task includes constructing a model that predicts which of the variables observed will be loaded on the hypothesized factors (Getty & Thompson, 1994). In an EFA, the pairing of observed variables to factors happens after obtaining data (Huck, 2012). Conversely, in a CFA, this paring is performed within the model that is expressed before any data collection (Huck, 2012).

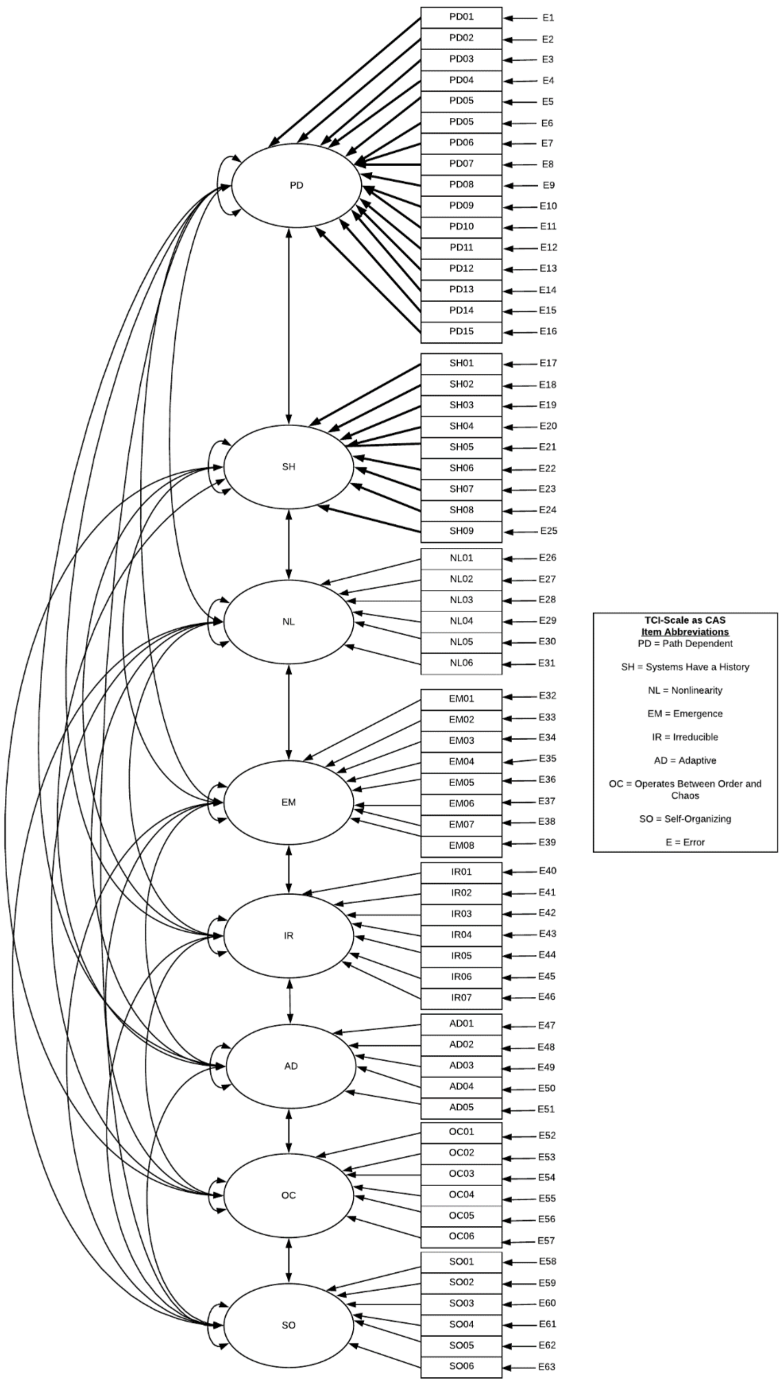
Whereas EFA seeks to uncover intricate patterns by exploring the dataset and checking hypotheses, CFA uses path analysis models to represent variables and factors to test hypotheses (Yong & Pearce, 2013a). In this case, the TCI-scale tests the hypothesis that creativity and innovation processes are the same as CAS characteristics; Figure 3 shows the TCI-scale path analysis model in which eight CAS characteristics are labeled as the following latent variables: path-dependent (PD), systems have a history (SH), nonlinearity (NL), emergence (EM), irreducible (IR), adaptive (AD), operates between order and chaos (OC), and self-organizing (SO). Moreover, the TCI-scale will be testing the 63 observable variables (i.e., items) listed to the right of the eight latent CAS variables and labeled as the following:

- PD01-PD15 are the 15 TCI-scale items identified as representing the CAS Path-Dependent.
- SH01-SH09 are the nine TCI-scale items identified as representing the CAS Systems Have a History.
- NL01-NL06 are the six TCI-scale items identified as representing the CAS Nonlinearity.
- EM01-EM08 are the eight TCI-scale items identified as representing the CAS Emergence.
- IR01-IR07 are the seven TCI-scale items identified as representing the CAS Irreducible.
- D05 are the five TCI-scale items identified as representing the CAS Adaptive.
- OC01-OC06 are the six TCI-scale items identified as representing the CAS Operates Between Order and Chaos.
- SO01-SO06 are the six TCI-scale items identified to represent the factor as representing the CAS Self-organizing.
- E1-E63 are the 63 the residual terms or "errors" that "represent variance not explained by the factor that the corresponding indicator is supposed to measure" (Kline, 2016, p. 13) since the unexplained variance is due to random measuring error or unreliability.

The path analysis model in Figure 13 (duplicated from Chapter 1, for convenience) illustrates how the relationships between the eight latent variables (i.e., CAS characteristics) and the 63 observable variables (i.e., TCI-scale items) are directionally observed theoretical to the theoretical latent variables. The relationships are directional because I have the EFA results and know how many factors to test and which items represent those factors at this point in the analysis.

Figure 13

Path Analysis Model: TCI-Scales as CAS



As a reminder, the eight factors presented in this proposal are theoretical. The actual analysis conducted was a CFA based on the EFA results, resulting in fewer factors than the theoretical 8, quite possibly 3 or 4.

Step 2: Data Collection

Data collection requires collecting data on the variables observed; small samples do not fit well in this form of statistical analysis, so the researcher must collect a sufficient amount of data (Osborne & Costello, 2004). A separate sample was gathered for the CFA to account for sampling error and potential variance in survey responses (Bandalos & Finney, 2018). As such, this study gathered a sample size of 300 participants for the CFA based on the power analysis described earlier in Phase 3 of Hinkin et al.'s (1997) survey administration.

Step 3: Missing Data

After data become available, the researcher's next step is to screen it for missing observations (Huck, 2012). As Hinkin et al.'s (1997) Phase 3 of the survey administration mentioned, I did not anticipate any missing observations because Qualtrics recruits a new participant to complete the survey in its entirety. However, if there had been missing data, I would have deleted the study's participants as CFA is problematic when there are missing data (Hinkin et al., 1997; Huck, 2012).

Step 4: Model Fit

The outcomes of CFA allow the researcher to determine how well the model matches the results. This is not done by separately testing the variables, as is done in an EFA. Instead, the whole set of relationships between the observed variables and the hypothesized latent factors is analyzed holistically (Huck, 2012). This is done by the simultaneous examination of many goodness-of-fit indices (Hooper et al., 2008). Absolute fit identifies how well an a priori model fits the sample data and demonstrates which proposed model provides the most optimal fit (Mcdonald & Ho, 2002). Incremental fit and relative fit compare the chi-square value of model fit to a baseline model (Bentler, 1990). Most experts agree that fit should be assessed by applying many different criteria (Bandalos & Finney, 2018b; Huck, 2012).

The data from the second panel were uploaded into AMOS 27.0 for Windows. Error terms were assigned to each observed variable. Multiple indices were utilized to interpret the adequacy of model fit in addition to the chi-square goodness-of-fit test ($\chi 2$). A non-significant chi-square statistic (e.g., $\geq .05$) identifies an acceptable fit (Kline, 2016), which is why the chi-square statistic is "often referred to as either a 'badness of fit' or a 'lack of fit' measure" (Hooper et al., 2008). Other fit indices assessed included the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA) (Hancock et al., 2018). Values greater than .90 for the CFI and TLI identify a good fit (Hooper et al., 2008). Values lower than .08 for the RMSEA correspond to a reasonable fit, and RMSEA values lower than .05 indicated a good fit (Hu & Bentler, 1999).

Additionally, the direct relations between the factors and the observed variables (pattern coefficients) were reported in a standardized form. If an observed variable serves as an indicator of only one factor, the standardized coefficient can be squared to represent the variable's variance by the factor. Given the variables were chosen explicitly as manifestations of these factors, it is hoped that the variance explained would be high or at least .50. If not, then this study follows the procedures outlined in step 6: model modification.

Step 5: Factor Loadings and Correlations

In addition to evaluating a model's fit, researchers often analyze factor loading and correlations among factors to determine whether the results support the hypotheses (Creswell & Creswell, 2018). Convergent validity—to test comparable constructs (Hinkin et al., 1997)—is shown when the indicator variables of the factor loadings for a given latent variable are high (Huck, 2012) are. Conversely, discriminant validity—testing whether unrelated concepts or measurements are in fact related (Danks, 2016)—is shown when the factor loadings are small for other indicator variables on that latent variable (Huck, 2012). The average variance expected (AVE) and composite reliability (CR) tests will also provide additional evidence for the convergent validity of each construct, the AVE and squared interconstruct correlations (SIC) will be used to compare AVE to determine divergent validity (Danks, 2016). AVE is the sum of the squared standardized factor loadings, or item reliability, divided by the number of items, and "is expected that each latent construct will exceed 0.50, meaning that on average, the factor explains at least 50% of the variance in the variables that represent the factor" (Bandalos & Finney, 2018b, p. 120).

Step 6: Model Modification

Sometimes, the fit of the initial model is insufficient. This condition could be induced by an observed factor loading on more than one factor equally or because the model itself has too many (or not enough) factors. In such instances, the researcher often modifies the model by deleting one or more of the observed problematic variables ("trimming"; Huck, 2012). However, Bandalos and Finney (2018b) reject this practice because (a) it capitalizes on sample error, which decreases the chance of replication, (b) the model is driven by data than theory, and (c) it can mislead readers to think that the "respecified models are often presented as though they were a priori theoretically based models," (p. 117) when that is no longer the case after the modification.

Instead, they recommended that those researchers should perform the minimum following actions:

"(1) clearly present results from the a priori specified model before any paths are removed (including fit indices, parameter estimates, and standard errors); (2) present the full set of results (fit indices, all parameter estimates, and standard errors) from the modified model, making a clear statement that fit index cutoffs and p-values associated with the parameter estimates do not apply to modified models estimated on the same data; (3) provide a thoughtful explanation for the lack of empirical support for that path (e.g., low variability associated with the variables due to the population under study; data collection issues that impacted the variable's validity); (4) provide a clear statement regarding capitalization on chance and the possibility of lack of power (i.e., a path may not be significant because sample size was small but the same path could be found significant if a larger sample was used); and (5) call for replication given the exploratory nature of the model modification. Often researchers delete indicators that have non-significant or weak relations with their intended factors, rather than simply deleting the path from the factor to the variable" (p. 117). As such, rather than trimming the variables, I followed Bandalos and Finney's (2018b) recommendations of following their minimum five action steps when I encounter problematic variables.

Phase 5: Internal Consistency Assessment

To test the scales' internal consistency and reliability, Cronbach's alpha was conducted on the factors generated on the CFA. Cronbach's alpha represents the mean association between each pair of survey items and the number of items comprising a total factor (Brace et al., 2012). The alpha values were assessed and interpreted using the guidelines suggested by George & Mallery (2016), in which α = .900-.999 Excellent, α = .800-.899 Good, α = .700-.799

Acceptable, α = .600-.699 Questionable, α = .500-.599 Poor , α < .5 Unacceptable. A high alpha coefficient of .70 shows strong covariance or homogeneity of the item and indicates that the sampling domain has been adequately captured (Hinkin et al., 1997). If the number of retained items is sufficiently large, the researcher may want to eliminate those items that do not share equally in the common core dimension by deleting items that will improve or not negatively impact the scale's reliability (Hinkin et al., 1997). This step is justified because individual scales' unidimensionality has been established through the factor analyses previously conducted (Hinkin et al., 1997). The Cronbach alpha was reassessed after each modification to the proposed model. If items were removed or transferred to alternative factors, the Cronbach alpha was retested.

Phase 6: Construct Validity

At this point, the TCI-scales should demonstrate content validity and reliability of internal consistency, supporting evidence of construct validity (Hinkin et al., 1997). As discussed previously in Huck's (2012) step 5 of CFA factor loadings and correlations, convergent validity and discriminant validity can further support evidence of construct validity (Danks, 2016; Hinkin et al., 1997; Huck, 2012; Wipulanusat et al., 2017). Therefore, this study applied the methods of convergent validity and discriminant validity in determining construct validity.

Phase 7: Replication

After verifying construct validity, Hinkin et al. (1997) recommend collecting more data from a suitable sample and repeating the scale-testing process with the new scales. As mentioned at the beginning of this chapter, replicating the scale-testing process is outside of this study's scope. However, if the study's results showed a poor fit, I avoided trimming the variables and instead followed Bandalos and Finney's (2018b) advice by reporting the poor fit results and requesting other researchers to replicate my study.

Ethical Procedures

Researchers have an ethical necessity to protect and inform participants involved in survey research. The study complied with the guidelines established by the Institutional Research Board (IRB) at the University of North Texas. The study involved minimal risk to the participants. All participants were notified that their participation was voluntary and were permitted to leave the survey at any time. Research participants were given an informed consent form to acknowledge the research project's information and potential risks. Survey subjects were required to indicate their consent for participation in the study. All data were de-identified, and no characteristics such as name, phone number, or email address were reported to ensure confidentiality. The data were stored on a flash drive in the researcher's residence.

Summary

This study aimed to validate a survey instrument used to measure team C/I processes. Team C/I has never been more critical than now (Edmondson, 2012) as organizations are fighting for their existence in today's complex and ultra-competitive landscape (Anning-Dorson, 2016; Somech & Drach-Zahavy, 2013; Wipulanusat et al., 2017). This study was significant because a) it answered Anderson et al.'s (2014) call to further advance the theory of creativity and innovation, and b) it provided a quantitative analysis of the multilevel team C/I interactions between individuals and teams (Anderson et al., 2014; Poutanen et al., 2016). Because the sooner the complex process of team C/I is understood and applied, "the easier it would be to enable wider innovation to take place" (Larrasquet et al., 2016, p. 134). In this chapter, the methodology for the proposed study was described. The research design was identified and justified. The population and sampling procedures were described. Procedures for recruitment and the instrumentation were explained. The data analysis plan described the procedures for conducting the exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and instrument reliability. In the next chapter, the findings of the data collection and analysis is presented.

CHAPTER 4

RESULTS

The current study's primary objective was to validate a survey instrument that measures team creativity and innovation (C/I) processes as complex adaptive systems (CAS). The investigation employed Huck's (2012) six steps of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) that included data screening inter-item correlations, factor analytic methods, and estimates of internal consistency.

Administration of Survey

I patterned my study's demographic questions with a few modifications (e.g., included work team types and tenure) after Wipulanusat et al.'s (2017) demographic questions for their team innovation study. Table 23 shows the breakdown of the participants' demographics.

Table 23

Frequency Table for Nominal Variables

Variable		Sample 1 *n*	Sample 1 %	Sample 2 *n*	Sample 2 %
Gender	Male	300	72.99	149	49.67
	Female	111	27.01	150	50.00
	Other	0	0.0	1	0.33
Race	White (Caucasian)	352	85.64	221	73.67
	Black or African American	26	6.33	40	13.33
	Native Hawaiian, Pacific Islander	2	0.49	2	0.67
	American Indian or Alaska Native	9	2.19	6	2.00
	Two or more of the above races.	2	0.49	6	2.00
	Some other race	20	4.87	25	8.33
Hispanic	I am Hispanic.	31	7.54	36	12.00
	I am not Hispanic.	380	92.46	264	88.00
Age	18-34	140	34.06	109	36.33
	35-55	200	48.66	154	51.33
	55+	71	17.27	37	12.33

(table continues)

Variable		Sample 1		Sample 2	
		n	%	*n*	%
Education	High School diploma, GDE, or no High School diploma.	9	2.19	12	4.00
	Some college but no degree.	31	7.54	24	8.00
	I have an associate degree.	33	8.03	24	8.00
	I have an undergraduate degree.	79	19.22	61	20.33
	I have a graduate degree.	259	63.02	179	59.67
Which of the following industries most closely matches the one in which you are employed?	Information Technology	411	100.00	300	100.00
Indicate which work team type based on your most recent or previous team experience:	Working Team (i.e., traditional workgroups led by managers)	189	45.99	128	42.67
	Management Team (i.e., oversee and guide the sub-units under their hierarchical command)	130	31.63	96	32.00
	Self-Directed Team (i.e., do not have a designated leader, members exercise self-discretion)	21	5.11	14	4.67
	Special-Purpose Team (i.e., formed to fulfill a particular objective or a one-time-off project)	23	5.60	19	6.33
	Multifunctional Team (i.e., groups of people drawn from various work units or roles)	40	9.73	43	14.33
	Missing	8	1.95	0	0.00
Approximately how long have you worked with/on the team type selected in the previous question?	Less than 1 year.	30	7.30	26	8.67
	More than 1 year and less than 2 years.	62	15.09	110	36.67
	More than 2 years and less than 5 years.	144	35.04	63	21.00
	More than 5 years and less than 10 years.	102	24.82	57	19.00
	More than 10 years.	73	17.76	44	14.67

Note. Due to rounding errors,%ages may not equal 100%.

Assumption Testing

Each of the survey items was examined for normality through an examination of skewness and kurtosis. Kline (2016) indicated that to meet the normality assumption, skewness of ± 2.00 and kurtosis of ± 7.00. In SPSS, the individual items were inputted into a descriptive statistics function with Minimum, Maximum, Mean, Standard Deviation, Skewness, and Kurtosis all provided. After examining the descriptive statistics, all of the survey items fell within the acceptable ranges for skewness and kurtosis (see Table 21).

Multivariate normality was tested with Mardia's normalized multivariate kurtosis. Bandalos & Finney (2010) indicated that multivariate kurtosis should be less than 3.00 to meet the multivariate assumption. Bandalos & Finney (2010) recommended running a proceeding with factor analysis with and without outliers to compare for differences. The Mardia's multivariate kurtosis statistic findings were statistically significant (sample 1: $z = 109.13$, $p < .001$; sample 2: $z = 66.36$, $p < .001$), indicating that the data did not satisfy the multivariate normality assumption. Howell (2013) stated that violations of normality are not problematic when the sample size exceeds 50 cases.

Table 24 shows the descriptive statistics, including the means, standard deviations, minimums, and maximums of the individual items on the Team Creativity and Innovation (C/I) Processes as Complex Adaptive Systems (CAS) instrument.

Table 24

Descriptive Statistics of Survey Items (Sample 1)

Survey Item	Min	Max	*M*	*SD*	Skewness	Kurtosis
PD1	1	7	5.89	1.225	-1.819	4.386
PD2	1	7	4.60	1.903	-0.451	-0.969
PD3	1	7	5.72	1.202	-1.096	1.520
PD4	1	7	5.65	1.383	-1.284	1.458
PD5	1	7	5.83	1.180	-1.103	1.215
PD6	1	7	5.01	1.646	-0.655	-.318
PD7	1	7	5.89	1.199	-1.380	2.261

(table continues)

Survey Item	Min	Max	*M*	*SD*	Skewness	Kurtosis
PD8	1	7	4.53	1.844	-0.407	-0.908
PD9	1	7	5.88	1.176	-1.313	2.380
PD10	1	7	5.89	1.155	-1.298	2.039
PD11	1	7	5.96	1.177	-1.713	4.103
PD12	1	7	5.97	1.107	-1.281	2.239
PD13	1	7	4.49	2.031	-0.312	-1.226
PD14	1	7	4.59	1.786	-0.432	-0.799
PD15	1	7	4.63	1.841	-0.444	-.888
SH1	1	7	5.74	1.262	-1.306	2.273
SH2	1	7	5.67	1.153	-1.139	1.848
SH3	2	7	5.99	1.049	-1.133	1.649
SH4	1	7	4.76	1.774	-0.533	-0.717
SH5	1	7	5.82	1.202	-1.181	1.549
SH6	1	7	5.96	1.143	-1.333	2.007
SH7	1	7	5.88	1.109	-1.255	2.274
NL1	1	7	4.29	2.130	-0.154	-1.404
NL2	1	7	4.04	2.121	-0.016	-1.463
NL3	1	7	4.23	2.037	-0.177	-1.312
EM1	1	7	5.29	1.632	-0.970	0.148
EM2	1	7	5.86	1.157	-1.416	2.868
EM3	1	7	6.02	1.058	-1.512	3.743
EM4	1	7	5.95	1.050	-1.431	3.495
EM5	1	7	5.51	1.271	-0.958	0.984
EM6	1	7	5.66	1.189	-0.858	0.606
IR1	1	7	5.80	1.303	-1.448	2.479
IR2	1	7	5.69	1.145	-1.048	1.690
IR3	1	7	5.52	1.324	-1.102	1.313
IR4	1	7	5.72	1.221	-1.095	1.369
IR5	1	7	5.88	1.138	-1.053	1.135
IR6	1	7	5.87	1.079	-1.186	2.276
IR7	1	7	4.67	1.828	-0.447	-0.883
AD1	1	7	5.05	1.537	-0.669	-0.043
AD2	2	7	5.76	1.086	-0.993	1.202

(table continues)

Survey Item	Min	Max	*M*	*SD*	Skewness	Kurtosis
AD3	1	7	4.32	1.943	-0.140	-1.271
AD4	1	7	5.82	1.234	-1.272	1.858
AD5	1	7	6.06	1.041	-1.380	2.630
OC1	1	7	5.79	1.159	-1.226	1.911
OC2	1	7	5.23	1.353	-0.689	0.192
OC3	1	7	5.08	1.601	-0.650	0-.345
OC4	1	7	4.63	1.929	-0.399	-1.084
OC5	1	7	5.12	1.481	-0.745	-0.038
OC6	1	7	5.55	1.412	-1.084	0.883
SO1	1	7	5.46	1.428	-0.860	0.266
SO2	1	7	5.31	1.354	-0.739	0.137
SO3	1	7	5.38	1.352	-0.813	0.494
SO4	1	7	5.47	1.316	-0.969	1.022

Results: Factor Analysis

Exploratory Factor Analysis (EFA) – PAF with Orthogonal (Varimax) Rotation

Step 1 Results: Data Suitability

Kaiser-Meyer-Olkin (KMO) and Bartlett's test of sphericity were applied to measure the sampling adequacy. The variables' KMO value was .960, which indicated that underlying factors may cause 96% of the survey items' variance. Bartlett's test of sphericity was statistically significant ($p < .001$), indicating that the correlation matrix is significantly different from the identity matrix, and an EFA is an appropriate analysis of the data.

Multicollinearity was tested by looking at the Squared Multiple Correlation (SMC) (Tabachnick et al., 2019) and examining a Pearson correlation matrix between the survey items. Correlations greater than .80 indicate the presence of multicollinearity (Vatcheva et al., 2016). None of the correlation coefficients between the survey items were greater than .80, indicating that the assumption was met.

Step 2 Results: Factor Extraction

An eigenvalue represents the amount of variance the factor "can reproduce out of all the variance present within and between the items in the matrix of associations" (Henson, 2010, p. 18). Therefore, when an eigenvalue is greater than one, "it represents more summative power than a single time and thus may represent a factor" (Henson, 2010, p. 18). Table 25 presents the findings of the initial eigenvalues and the% of variance explained by the factors.

Table 25

Number of Eigenvalues and Total Percentage of Variance

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19.497	34.816	34.816	19.063	34.041	34.041
2	7.156	12.779	47.595	6.767	12.085	46.126
3	2.154	3.847	51.441	1.742	3.110	49.236
4	1.435	2.563	54.004	1.031	1.840	51.076
5	1.421	2.538	56.542	.964	1.721	52.797
6	1.229	2.194	58.736	.797	1.424	54.221
7	1.096	1.958	60.694	.682	1.217	55.438
8	1.011	1.806	62.500	.534	.954	56.392

Note. Extraction method: principal axis factoring.

Step 3 Results: Factor Determination

Kaiser's criterion and screen plots were examined to identify the number of potential factors. Applying Kaiser's criterion, a total of eight factors had an eigenvalue greater than 1, indicating that a total of eight factors could be retained. A scree plot was utilized to examine the eigenvalues visually (see Figure 14). A scree plot is a visual representation of the eigenvalues of factors in an EFA (Huck, 2012). The scree plot levels off around 3-4 factors, in which the first break at four factors corresponds with the eigenvalues after extraction shown in Table 26.

Figure 14

Scree Plot for Factors and Eigenvalues

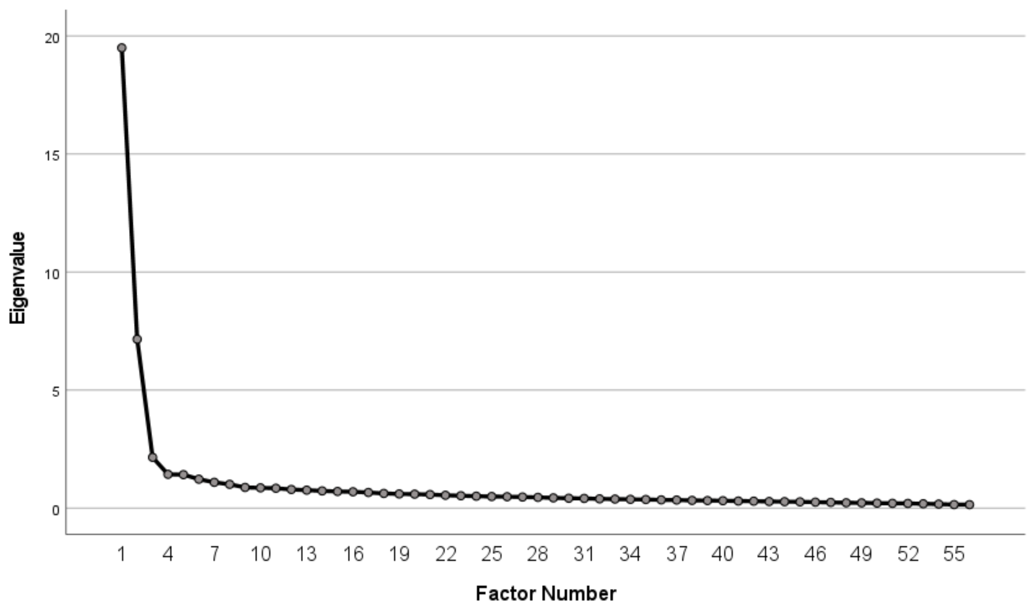


Table 26

Comparison between Initial Eigenvalues and Parallel Analysis Eigenvalues

Factor	Initial Eigenvalues	Parallel Analysis Eigenvalues
1	19.497	1.04
2	7.156	0.93
3	2.154	0.88
4	1.435	0.82
5	1.421	0.77
6	1.229	0.73
7	1.096	0.68
8	1.011	0.65

Note: Extraction method: principal axis factoring.

A parallel analysis was conducted to compare the eigenvalues of the observed data to eigenvalues of random data. Due to random data examination, the eigenvalues should be low because the correlations between the variables are due to chance. Parallel analyses of adjusted correlation matrices indicate more factors than warranted (Buja & Eyuboglu, 1992). The parallel analysis's eigenvalues were all lower than the initial eigenvalues calculated through the raw data; therefore, eight factors were selected for potential retainment.

Step 4 Results: Factor Loadings

To assess how much the variables contributed to the factor, factor loading was calculated; the greater a factor's loading, the more significant the variable's contribution is to the tested factor. Based on Hinkin's (1988) recommendation, the current study chose .40 as the items' minimum loading, which is greater than the 10% overlapping variance with the other items in that factor. Table 27 presents all of the variables with a minimum of .40 factor loadings, showing an initial three factors. However, Factor 2 was eliminated because 14 of 15 items were crossloading. Factor 3 was also removed because it had only one variable that met the minimum criteria for factor loadings resulting in an insufficient amount to be a valid factor.

Table 27

Factor Matrix

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
PD1	.613							
PD2	.459	.412						
PD3	.600							
PD4	.657							
PD5	.666							
PD6	.466	.414						
PD7	.516							
PD8	.409	.533						
PD9	.637							
PD10	.589							

(table continues)

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
PD11	.608	-.417	.414					
PD12	.546	-.439						
PD13	.400	.596						
PD14		.563						
PD15	.499	.516						
SH1	.720							
SH2	.603							
SH3	.599							
SH4	.445	.481						
SH5	.660							
SH6	.674							
SH7	.713							
NL1	.482	.613						
NL2	.408	.644						
NL3	.421	.666						
EM1	.532							
EM2	.686							
EM3	.611							
EM4	.657							
EM5	.613							
EM6	.680							
IR1	.570							
IR2	.594							
IR3	.455							
IR4	.646							
IR5	.636							
IR6	.661							
IR7	.486	.541						
AD1	.567							
AD2	.683							
AD3	.454	.665						
AD4	.525							

(table continues)

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
AD5	.618							
OC1	.667							
OC2	.560							
OC3	.544							
OC4	.478	.594						
OC5	.532							
OC6	.635							
SO1	.676							
SO2	.609							
SO3	.581							
SO4	.612							

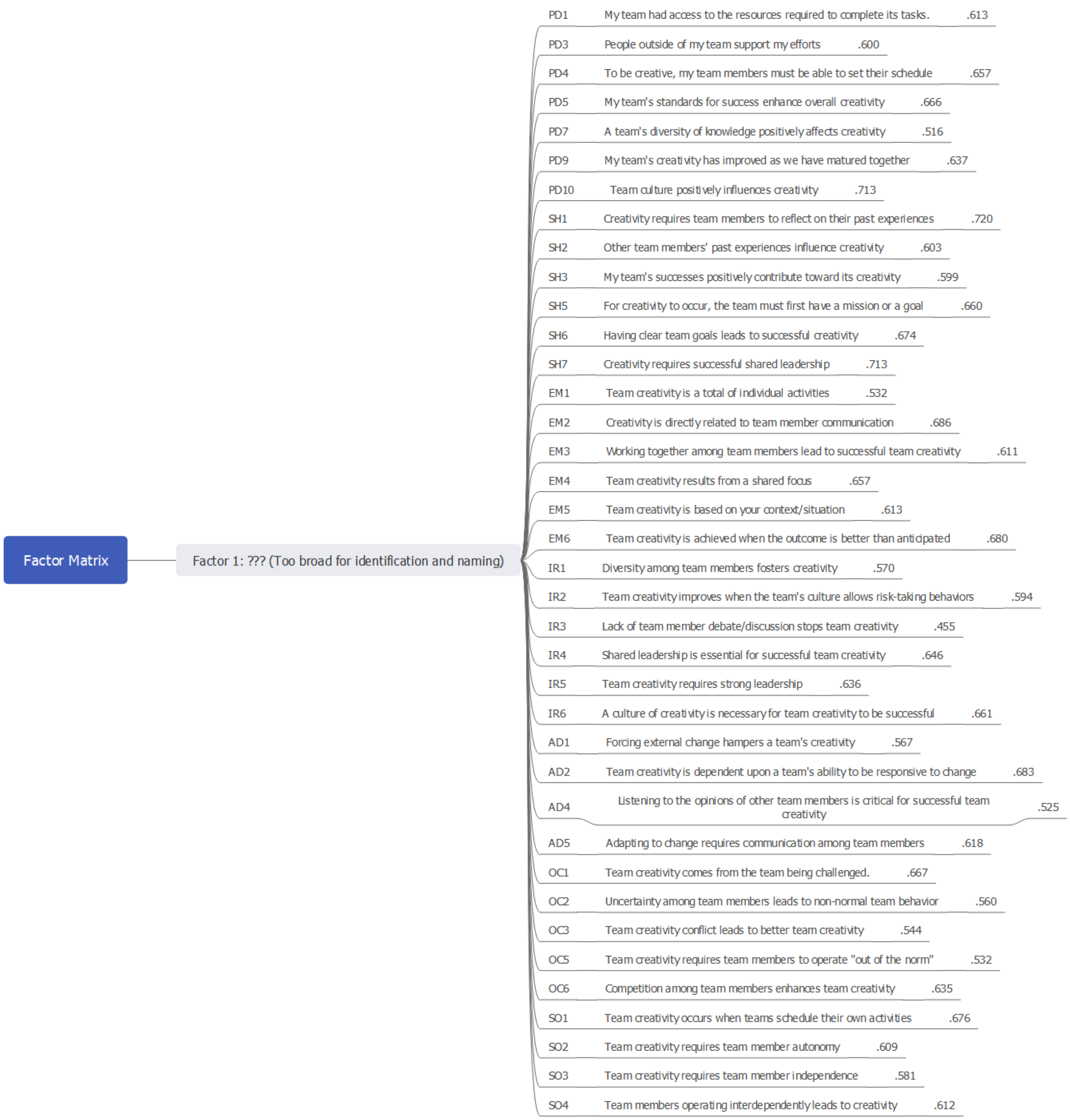
*Factor loadings suppressed at .40.

Regarding crossloaded items, Table 27 contained 14 crossloading items where the items load at .40 or higher on two or more factors. If there are several crossloadings, Costello and Osborne (2005) stated that these items "may be poorly written or the *a priori* factor structure could be flawed" (p. 5). Hence, Costello and Osborne recommended removing these crossloadings if adequate loadings (i.e., .40 or higher) are found on each factor, which would eliminate over a dozen survey items.

Figure 15 illustrates the final results that revealed one total factor with three or more items per factor, excluding the crossloaded items, with factor loadings ranging from .455 to .713. Factor 2 was excluded because it had only one item, making it invalid because it has fewer than three correlated items (Henson, 2010). Therefore, the factor structure was recomputed until an optimal factor structure was developed.

Figure 15

Factor Matrix Without Rotations



Step 5 Results: Factor Rotation

Orthogonal rotation is appropriate when it is assumed that the factors extracted are independent from one another (Huck, 2012). Bandalos & Finney (2010) indicated that oblique rotations generally result in more accurate representations when there is an absence of theory to guide the data. Therefore, both rotation methods were utilized to compare the results because the solution is more interpretable and technically justifiable. "The goal of rotation is to simplify and clarify the data structure" (Costello & Osborne, 2005, p. 3). Table 28 is a varimax (orthogonal) rotated factor matrix that initially shows seven factors. However, Factors 4 and 7 each have only one corresponding item, and Factor 6 has two items, thus eliminating them as viable factors. Factor 5's three adequately loaded (i.e., greater than .40) items are crossloaded items and were also removed, much like crossloaded items in the previous nonrotated factor matrix table.

Table 28

Varimax (Orthogonal) Rotated Factor Matrix

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
PD1			.589					
PD2		.622						
PD3			.603					
PD4			.448					
PD5			.654					
PD6		.651						
PD7			.644					
PD8		.703						
PD9			.674					
PD10			.713					
PD11			.760					
PD12			.743					
PD13		.757						
PD14		.752						
PD15		.762						

(table continues)

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
SH1	.468		.413					
SH2	.468							
SH3	.508		.483					
SH4		.661						
SH5	.690							
SH6	.713							
SH7	.685							
NL1		.667			.514			
NL2		.656			.524			
NL3		.678			.541			
EM1		.434						
EM2	.618							
EM3	.645							
EM4	.679							
EM5	.419	.432						
EM6	.626							
IR1			.401					
IR2								
IR3								
IR4	.580							
IR5	.657							
IR6	.634							
IR7		.694						
AD1		.559						
AD2	.635							
AD3		.777						
AD4	.533							
AD5	.652							
OC1	.451			.436				
OC2		.438						
OC3		.491						
OC4		.653			.408			

(table continues)

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
OC5		.458						
OC6	.434					.430		
SO1						.532		
SO2		.435						
SO3							.635	
SO4								

*Factor loadings suppressed at .40.

Figure 16

Varimax (Orthogonal) Rotated Factor Matrix: EFA Survey Items with Factor Loadings

Figure 16 illustrates Table 28's final results that revealed three total factors with three or more items per factor, with factor loadings ranging from .401 to .777. Figure 16 shows the final tally of three valid factors with all of the crossloaded items removed. Only the variables with a minimum of .40 factor loadings were included, resulting in a more interpretable and theoretically justifiable factor matrix than the unrotated factor matrix.

Oblique rotation is utilized when there is an underlying assumption that factors may correlate (Henson, 2006). Oblique rotations are beneficial, even optimal, when analyzing measures of human behavior and or psychology (Hinkin, 1998). It is believed that the items are correlated, so the best rotation technique, by definition, would be the oblique rotation. For example, systems have a history is expected to be slightly correlated with the factor path-dependent, as both view the history of the system or event. However, theoretically, these two factors are distinctively different. Oblique rotation is recommended due to these potential correlations between the theoretical factors presented in the initial model tested using EFA techniques. Thus, Table 29 is a Promax (non-orthogonal) oblique rotated pattern matrix table that initially showed seven factors. However, Factor 7 had only two adequately loaded items, so I removed them from the final count.

Table 29

Promax (Non-Orthogonal) Oblique Rotated Pattern Matrix

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
PD1			.480					
PD2		.618						
PD3			.602					
PD4								
PD5			.656					

(table continues)

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
PD6		.670						
PD7			.721					
PD8		.707						
PD9			.703					
PD10			.770					
PD11			.765					
PD12			.824					
PD13		.795						
PD14		.856						
PD15		.796						
SH1				.444				
SH2								
SH3								
SH4		.634						
SH5	.826							
SH6	.793							
SH7	.702							
NL1					.627			
NL2		.404			.638			
NL3		.447			.646			
EM1				.406				
EM2	.555							
EM3	.698							
EM4	.761							
EM5								
EM6	.660							
IR1								
IR2				.423				
IR3								
IR5	.729							
IR6	.606							
IR7		.595						

(table continues)

Survey Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
AD1								
AD3		.664						
OC1				.525				
OC2								
OC3					.456			
OC4					.488			
OC5								
OC6						.487		
SO1						.651		
SO2							.448	
SO3							.750	
SO4						.402		

*Factor loadings suppressed at .40.

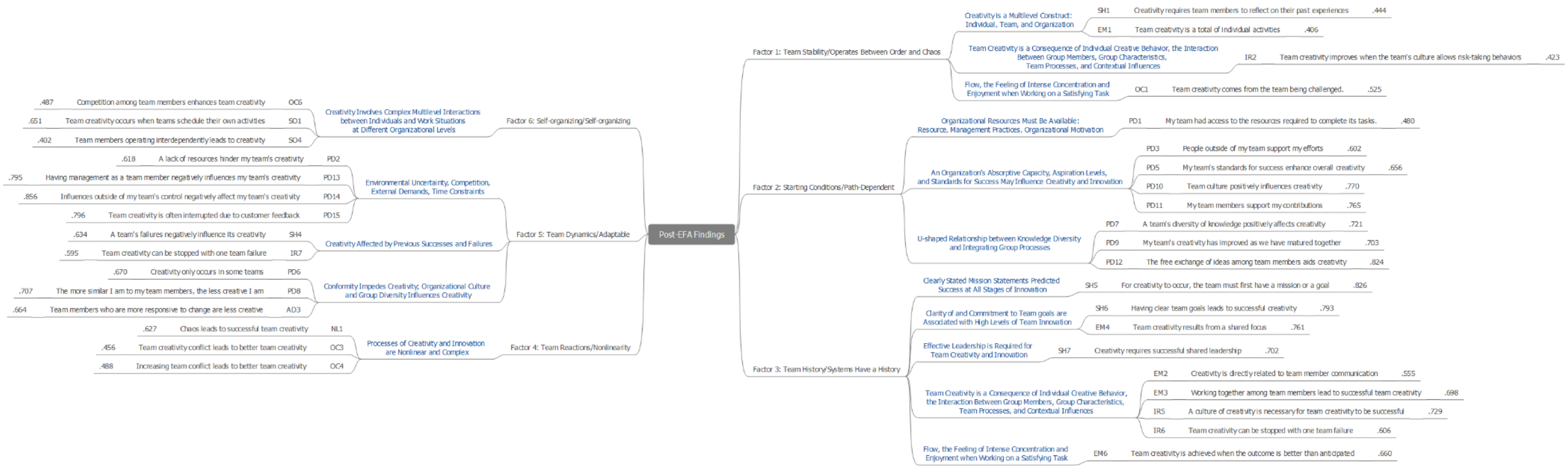
Figure 17 illustrates Table 29's final results that revealed six total factors with three or more items per factor, with factor loadings ranging from .406 to .826. As I suspected in Chapter 3, oblique rotation resulted in more acceptable data representations that were both more interpretable and theoretically justifiable, discussed in further detail in the next section.

Step 6 Results: Factor Naming

Bandalos and Finney (2018b) stressed the importance of the factor naming process and advised that the factor name should communicate the "identity of the factor, rather than the observed variables themselves" (p 108). When many observed variables correlate with it, a factor becomes much easier to understand (Tabachnick et al., 2019). Nevertheless, the naming of the factors was a rather subjective and problematic exercise because the variables may be loaded onto more than one factor (aka split loadings); these variables may correlate with each other to produce a factor despite having little underlying meaning for the factor (Tabachnick et al., 2019).

Figure 17

Promax (Non-Orthogonal) Oblique Rotated Factor Matrix: EFA Survey Items with Factor Loadings



Indeed, split loadings occurred after EFA and CFA were conducted in which the same variables were loading onto more than one factor. These split loadings were removed entirely from the factor analysis suggested by Hinkin (1997) to lessen the confusion. Thereby, eliminating the split loading, factor naming became an easier and more fruitful exercise.

As mentioned in Chapter 2, each of the eight CAS characteristics was given an alternative lay title to make them understandable for survey participants. Therefore, each of the factors' names was given an alternative lay title, followed by its CAS characteristic title.

As such, the oblique rotation revealed 12 survey items across four various factors or CAS characteristics in Factor 1: three items from "Systems have a history (SH)," four items from "Emergence (EM)," three items from "Irreducible (IR)," and three items from "Adaptive (AD)." Items with salient loadings with structure coefficients of .40 and higher were used; salient loadings on SH corresponded to team missions/goals and successful shared leadership for driving team creativity and innovation. Loaded items on EM described team communication and group cohesion around a shared focus. Salient loadings on IR portrayed strong leadership and a culture of creativity as needed for team creativity, which haphazardly can be squelched with one team failure. The salient loaded items on AD corresponded to team conflict, uncertainty, and atypical behaviors for encouraging team members to become more creative and innovative. The new items for each factor were reanalyzed, and an appropriate name was assigned to each factor. This process, for each of the factors, is provided next. The following subsections describe the factor naming process and its results.

- *Factor 1: Team Stability/Operates Between Order and Chaos*. Factor 1 is "Team Stability/Operates Between Order and Chaos" with three salient loadings that correlated with team learning conditions and emergent behaviors in which "innovative pathways of governance emerge” (Ellis & Herbert, 2011, p. 34) where team members “appreciate and monitor the implications of feedback, nonlinear and mutual causation” (p. 34). Figure 18 demonstrates specific item loadings correlated with team learning, broken down into four categories: Past reinforcement history; creativity is a multilevel construct; pro-innovation culture and empowering environment; and competition between creative and routine behavioral options. The name for this factor was simplified to ‘Team Stability.’Factor 1 is “Team Stability/Operates Between Order and Chaos” with three salient loadings that correlated with team learning conditions and emergent behaviors in which “innovative pathways of governance emerge” (Ellis & Herbert, 2011, p. 34) where team members “appreciate and monitor the implications of feedback, nonlinear and mutual causation” (p. 34). Figure 18 demonstrates specific item loadings correlated with team learning, broken down into four categories: Past reinforcement history; creativity is a multilevel construct; pro-innovation culture and empowering environment; and competition between creative and routine behavioral options.

Figure 18

Factor 1: Team Stability/Operates Between Order and Chaos Factor Loadings

- *Factor 2: Starting Conditions/Path-dependent*. Factor 2 is “Starting Conditions/Path-dependent,” with all eight loadings corresponding to the path-dependency items as a CAS characteristic. Figure 19 demonstrated specific item loadings correlated with path-dependency, broken down into three categories: organizational resources, absorptive capacity, and knowledge diversity. More precisely, item PD1 was associated with “organizational resources must be available: resources, management practices, and organizational motivation." Items PD3, PD5, PD10, and PD11 corresponded with "an organization's absorptive capacity, aspiration levels, and standards for success may influence creativity and innovation." The name for this factor was simplified to 'Starting Conditions.'

Figure 19

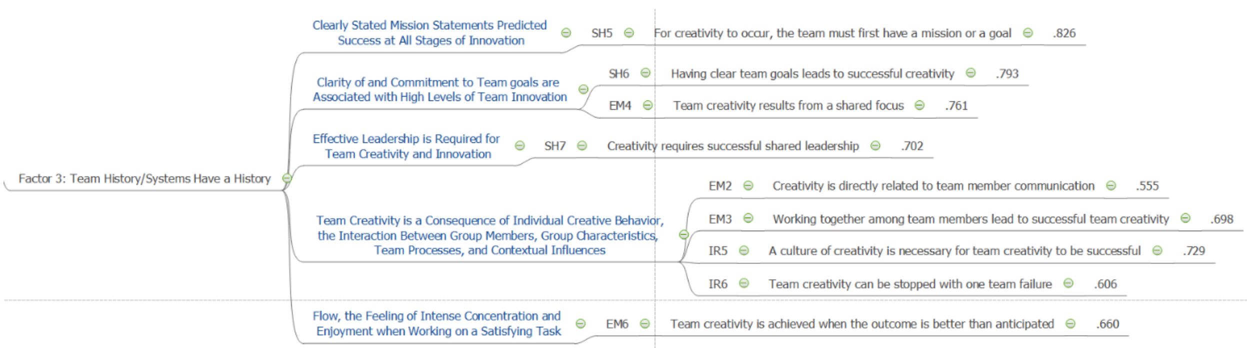
Factor 2: Starting Conditions/Path-Dependent Factor Loadings

- *Factor 3: Team History/Systems Have a History.* Factor 3, "Team History/Systems Have a History," was composed of team members' individual experiences and time-relevant information developed over time as they learn and transition together. Figure 20 shows how Factor 3 corresponded to Team History/Team CAS behaviors and processes such as past reinforcement history, creativity affected by previous successes and failures, clearly stated mission statements predicting success at all stages of innovation, clarity of and commitment to team goals that are associated with high levels of team innovation, and effective leadership that is required for team creativity and innovation. More specifically, items SH5 corresponded with the CAS Team History observation that clearly stated mission statements predicted success at all stages of innovation. Items SH6 and EM4 corresponded with "clarity of and commitment to team goals are associated with high levels of team innovation." Item SH7 was associated with "effective leadership is required for team creativity and innovation." Items EM2, EM3, IR5, and

IR6 corresponded with "team creativity is a consequence of individual creative behavior, the interaction between group members, group characteristics, team processes, and contextual influences." Consequently, the name for this factor was simplified to 'Team History.'

Figure 20

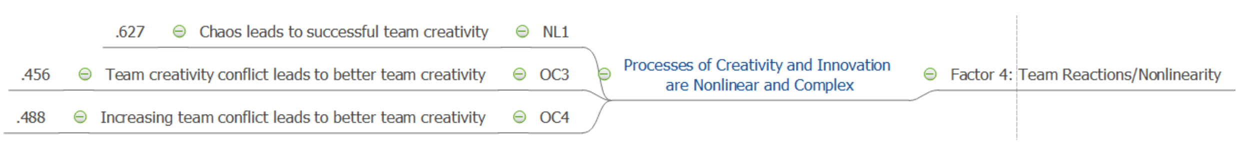
Factor 3: Team History/Systems Have a History Factor Loadings



- *Factor 4: Team Reactions/Nonlinearity.* Factor 4, "Team Reactions/Nonlinearity," was comprised of three salient loadings that correspond with the nonlinear and complex creativity and innovation processes (see Figure 21). Items NL1, OC3, and OC4 corresponded with the CAS team processes of creativity and innovation that are nonlinear and complex. Items such as chaos and conflict would increase nonlinear team creativity and innovation processes (Turner & Baker, 2019b). The name for this factor was simplified to 'Team Reactions.'

Figure 21

Factor 4: Team Reactions/Nonlinearity Factor Loadings



- *Factor 5: Team Dynamics/Adaptable.* Factor 5, "Team Dynamics/Adaptable," relates to a team's ability to address disturbances/perturbations or environmental threats. This factor was composed of" eight of the nine salient loadings corresponding to disruptive and disconcerting events that negatively affected team creativity (see Figure 22). More specifically, PD2, PD13, PD14, and PD15 items corresponded with environmental uncertainty, competition, external demands, and time restraints. Items SH4 and IR7 correlated with the observation that creativity is affected by previous success and failures. Lastly, PD6, PD8, and AD3 matched the CAS team characteristics that conformity impedes creativity; organizational culture; and group diversity influences creativity. As a result, the remaining ninth loading found that creativity only occurs in some teams. The name for this factor was simplified to 'Team Dynamics.'

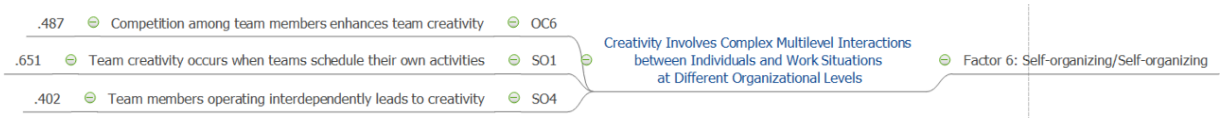
Figure 22

Factor 5: Team Dynamics/Adaptable Factor Loadings

- *Factor 6: Self-organizing/Self-organizing.* Factor 6, "Self-organizing" related to a team's interdependent and independent abilities, consisting of interdependence/Interdependence" three loadings that correlate at various organizational levels with complex multilevel relationships between people and work situations (see Figure 23). More precisely, items OC6, SO1, and SO4 were related to the CAS team characteristic in which "creativity involves multilevel interactions between individuals and work situations at different organizational levels." Thus, the name for this factor was simplified to 'Self-organizing.'

Figure 23

Factor 6: Interdependence/Interdependency Factor Loadings



In summary, EFA revealed multiple various rearrangements of salient loadings that resulted in six final factors from the oblique Promax rotation. In the next section, I use CFA to test the 6-factor structures and compare this 6-factor model with alternative models to determine which model best represents the data. The following section evaluates different factor structures by conducting a CFA, defining the dimensions of a build, and deciding which loading patterns fit the data.

Summary of EFA Procedure

The purpose of EFA was to determine the number of indicators or observed variables that influence latent factors or constructs and analyze which variables "go together" to summarize latent constructs (Henson, 2010). For the current study's purpose, EFA was conducted to determine which CAS characteristics correlated with team creativity and innovation processes. As a result, the EFA results show two primary factor models: the 3-factor and 6-factor models. The 3-factor model results from an orthogonal rotation with three primary factors: Team History/Systems have a history, Team Stability/Operates between order and chaos, and Starting Conditions/Path-dependent. The 6-factor model results from an oblique rotation with six factors: Team Stability/Operates between order and chaos, Starting Conditions/Path-dependent, Team History/Systems have a history, Team Reactions/Nonlinearity, Team Dynamics/Adaptable, and Self-organizing/Self-organizing.

Confirmatory Factor Analysis (CFA)

Step 1: Hypothesis and Model

The initial hypothesis and model observed eight factors based on the CAS characteristics, composed of 63 indicators. However, post-EFA and CFA results revealed six valid factors with 56 indicators.

Step 2: Data Collection

The current study collected a sample size of 300 participants for the CFA. The demographics for this second sample were provided earlier in Table 19. This table provided demographics for both samples for comparative purposes.

Step 3: Missing Data

As predicted in Chapter 3, the current study did not have any missing observations per the sampling design. The Qualtrics survey panel design provided a guarantee that there would be no missing data.

Step 4: Model Fit

Two CFAs were conducted to further examine the factor structures of the data. A CFA is based on previous research or current theory by defining the latent and observable variables, in which the observed variables are often the individual survey items (Huck, 2012). The latent factors identified in the EFA were applied to the CFA examination. One CFA was conducted based on the varimax rotation structure, and a second CFA was conducted based on the Promax rotation structure. These two examinations provided a comparison between alternative models.

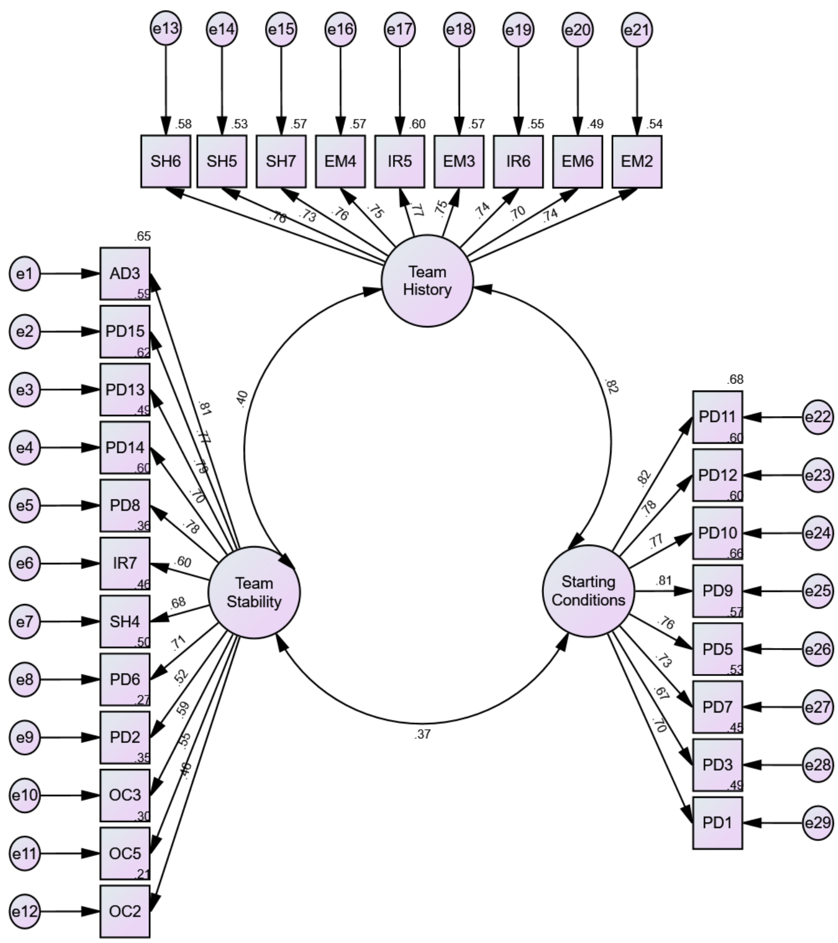
A non-significant chi-square statistic (e.g., $\geq .05$) identifies an acceptable fit (Kline, 2016). Other fit indices to be assessed include the Comparative Fit Index (CFI), Tucker-Lewis

Index (TLI), and the root mean square error of approximation (RMSEA) (Hancock et al., 2018). Values greater than .90 for the CFI and TLI indicate a good fit, and values lower than .08 for the RMSEA correspond to a reasonable fit (Hooper et al., 2008; Hu & Bentler, 1999).

The initial results included the three-factor and six-factor models. However, I later added the five-factor model because I eliminated the "Team Reaction" factor because its average variance expected (AVE) value was below the acceptable minimum of .50. However, the construct validity values of the five-factor model were not significantly different from the six-factor model.

Figure 24

Structural Model for the Three-Factor Model from EFA Varimax Rotation



- *Three-factor model: Varimax rotation findings*. Figure 24 presents the structural model for the three-factor model generated by the varimax rotation. This three-factor model included the factors of team stability, team history, and starting conditions. This model was tested as an alternative model derived from the varimax rotation during the current study's EFA analysis.

The results of the CFA for the three-factor model demonstrated a reasonable model fit ($\chi^2(374) = 1106.81$, $p < .001$, confirmatory fit index (*CFI)* = .86, Tucker-Lewis index (TLI) = .85, root mean square error of approximation (*RMSEA)* = .08). Table 30 presents the fit statistics for the CFA for the varimax rotation.

Table 30

CFA Fit Statistics for Three-Factor Model from Varimax Rotation

χ^2	*df*	*p*	*CFI*	*TLI*	*RMSEA*	*SRMR*
1106.81	374	<.001	.86	.85	.08	.09

- *Five-factor model: Promax rotation findings*. Figure 25 presents the structural model for the five-factor model generated by the Promax rotation. The results of the CFA for the five-factor model demonstrated a reasonable model fit ($\chi^2(485) = 1191.58$, $p < .001$, confirmatory fit index (*CFI)* = .88, Tucker-Lewis index (*TLI*) = .87, root mean square error of approximation (*RMSEA)* = .07), standardized root mean square residual (*SRMR*) = .07). Table 31 presents the fit statistics for the CFA for the promax rotation.

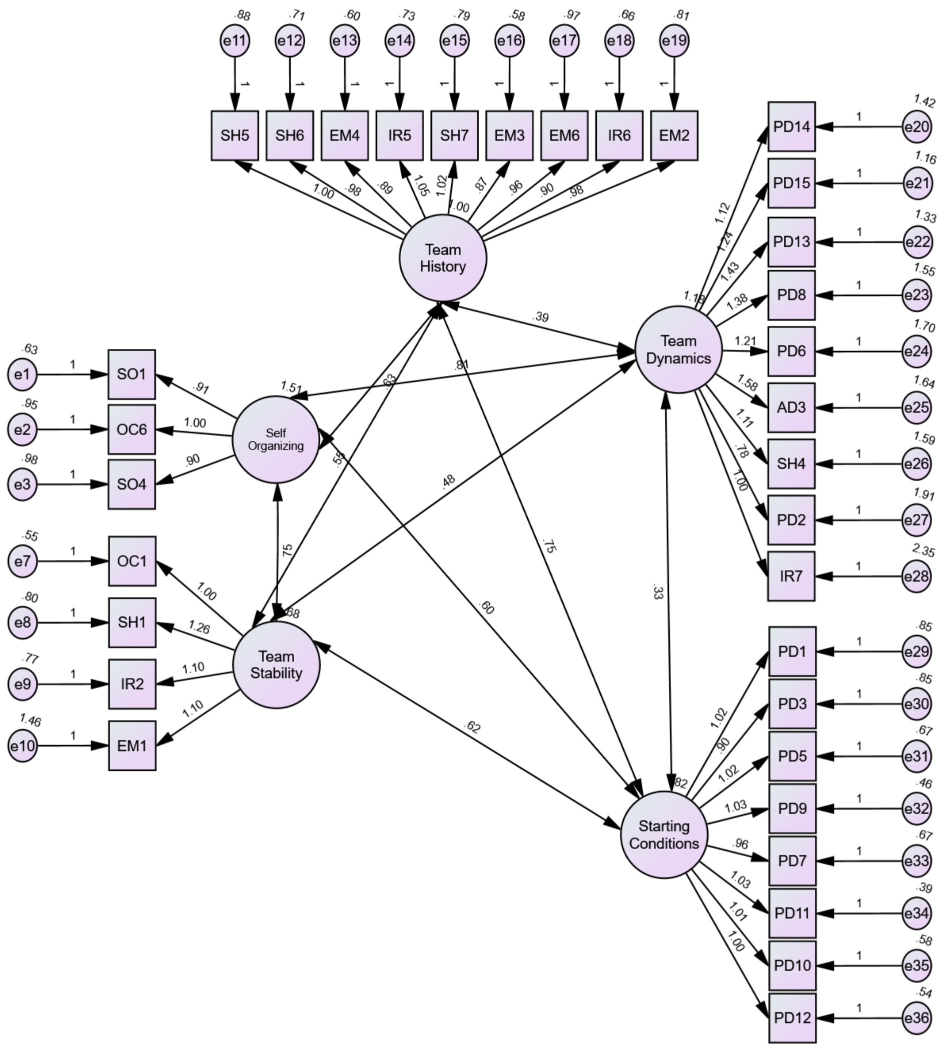
Table 31

CFA Fit Statistics for Five-Factor Model from Varimax Rotation

χ^2	*df*	*p*	*CFI*	*TLI*	*RMSEA*	*SRMR*
1191.58	485	<.001	.88	.86	.08	.08

Figure 25

Structural Model for the Five-Factor Model from EFA Promax Rotation

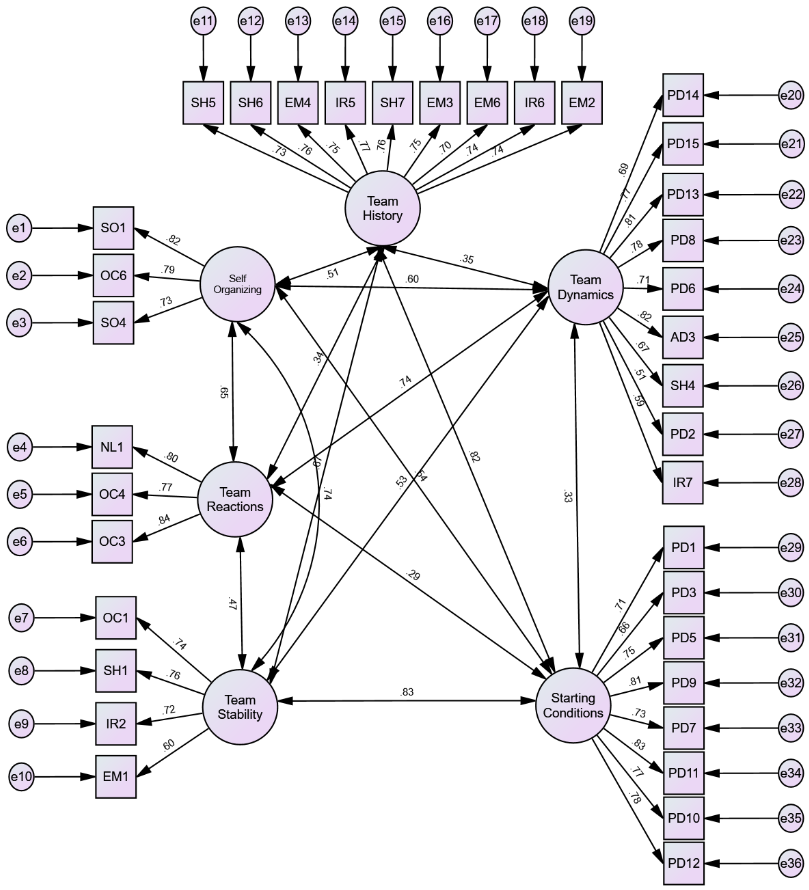


- *Six-factor promax rotation findings.* Figure 26 presents the structural model for the

six-factor model generated by the Promax rotation. This model includes the six factors of team stability, team reactions, self-organizing, team history, team dynamics, and starting conditions. These are the six-factors that were derived from the Promax rotation analysis during the EFA analyses. This six-factor model was used as one of the alternative models used to determine the best model.

Figure 26

Structural Model for a Six-Factor Model from EFA Promax Rotation



The results of the CFA for the six-factor model demonstrated a reasonable model fit ($\chi^2(579) = 1423.35$, $p < .001$, confirmatory fit index (*CFI)* = .88, Tucker-Lewis index (TLI) = .87, root mean square error of approximation (*RMSEA)* = .07). Table 32 presents the fit statistics comparison for the CFA for the promax rotation and the varimax rotation.

Table 32

CFA Fit Statistics for Six-Factor Model from Promax Rotation Compared to Varimax Rotation

	χ^2	*df*	*p*	*CFI*	*TLI*	*RMSEA*	*SRMR*
Promax	1423.35	579	<.001	.88	.87	.07	.07
Varimax	1106.81	374	<.001	.86	.85	.08	.09

Note: required values are >.90 and <.08.

Step 5: Factor Loadings and Correlations

- *Varimax rotated findings*. The factor loadings were examined for the three-factor model from the varimax rotation (Table 33). All of the factor loadings were greater than .40, further validating the findings of the EFA. This provides additional evidence for the three-factor structure of team stability, starting conditions, and team history

Table 33

Factor Loadings for Three-Factor CFA (Varimax Rotation)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
AD3	Team stability	0.806
PD15	Team stability	0.768
PD13	Team stability	0.789
PD14	Team stability	0.698
PD8	Team stability	0.776
IR7	Team stability	0.6
SH4	Team stability	0.68
PD6	Team stability	0.711
PD2	Team stability	0.519
OC3	Team stability	0.594
OC5	Team stability	0.552
OC2	Team stability	0.461
PD11	Starting conditions	0.824
PD12	Starting conditions	0.777
PD10	Starting conditions	0.774
PD9	Starting conditions	0.81
PD5	Starting conditions	0.756
PD7	Starting conditions	0.727
PD3	Starting conditions	0.669
PD1	Starting conditions	0.703
SH6	Team history	0.76

(table continues)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
SH5	Team history	0.731
SH7	Team history	0.756
EM4	Team history	0.754
IR5	Team history	0.774
EM3	Team history	0.753
IR6	Team history	0.741
EM6	Team history	0.697
EM2	Team history	0.736

- *Promax Rotated Findings*. The factor loadings were examined for the five-factor model from the Promax rotation. All of the factor loadings were greater than .40, further validating the findings of the EFA. This finding provides additional evidence for the five-factor structure of team stability, team history, team dynamics, starting conditions, and self-organizing. Table 34 presents the findings of the factor loadings for the five-factor model.

Table 34

Factor Loadings for Five-Factor CFA (Promax Rotation)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
SH1	Team stability	0.756
OC1	Team stability	0.742
IR2	Team stability	0.716
EM1	Team stability	0.600
IR5	Team history	0.775
SH6	Team history	0.759
SH7	Team history	0.757
EM4	Team history	0.754
EM3	Team history	0.753
IR6	Team history	0.741

(table continues)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
EM2	Team history	0.735
SH5	Team history	0.731
EM6	Team history	0.697
AD3	Team dynamics	0.802
PD13	Team dynamics	0.803
PD8	Team dynamics	0.769
PD15	Team dynamics	0.781
PD6	Team dynamics	0.711
PD14	Team dynamics	0.781
SH4	Team dynamics	0.692
IR7	Team dynamics	0.578
PD2	Team dynamics	0.522
PD11	Starting conditions	0.831
PD9	Starting conditions	0.809
PD12	Starting conditions	0.777
PD10	Starting conditions	0.768
PD5	Starting conditions	0.751
PD7	Starting conditions	0.729
PD1	Starting conditions	0.708
PD3	Starting conditions	0.665
SO1	Self-organizing	0.815
OC6	Self-organizing	0.783
SO4	Self-organizing	0.746

Table 35

Factor Loadings for Six-Factor CFA (Promax Rotation)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
SH1	Team stability	0.756
OC1	Team stability	0.742

(table continues)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
IR2	Team stability	0.716
EM1	Team stability	0.601
OC3	Team reactions	0.837
NL1	Team reactions	0.799
OC4	Team reactions	0.767
IR5	Team history	0.775
SH6	Team history	0.759
SH7	Team history	0.757
EM4	Team history	0.754
EM3	Team history	0.753
IR6	Team history	0.741
EM2	Team history	0.735
SH5	Team history	0.730
EM6	Team history	0.698
AD3	Team dynamics	0.816
PD13	Team dynamics	0.809
PD8	Team dynamics	0.779
PD15	Team dynamics	0.775
PD6	Team dynamics	0.713
PD14	Team dynamics	0.695
SH4	Team dynamics	0.671
IR7	Team dynamics	0.590
PD2	Team dynamics	0.507
PD11	Starting conditions	0.831
PD9	Starting conditions	0.808
PD12	Starting conditions	0.778
PD10	Starting conditions	0.769
PD5	Starting conditions	0.751
PD7	Starting conditions	0.729
PD1	Starting conditions	0.708
PD3	Starting conditions	0.665
SO1	Self-organizing	0.820

(table continues)

Survey Item	Latent Factor	Standardized Estimate (Factor Loading)
OC6	Self-organizing	0.788
SO4	Self-organizing	0.735
AD3	Team dynamics	0.816
PD13	Team dynamics	0.809
PD8	Team dynamics	0.779
PD15	Team dynamics	0.775
PD6	Team dynamics	0.713
PD14	Team dynamics	0.695
SH4	Team dynamics	0.671
IR7	Team dynamics	0.590
PD2	Team dynamics	0.507

Table 36 reveals the comparisons and differences between the three different factor models and their model fits.

Table 36

CFA Results for Team Creativity and Innovation Processes as CAS

Model	χ^2	*df*	*p*	*CFI*	*TLI*	*RMSEA*	*SRMR*
3 factor	1106.81	374	<.001	.86	.85	.08	.09
6 factor	1423.35	579	<.001	.89	.87	.07	.07
5 factor	1191.58	485	<.001	.88	.86	.08	.08

Summary of CFA Procedures

CFA is a hypothesis-driven technique used to examine causal relationships among variables (Wipulanusat et al., 2017). CFA was conducted on the three-factor, six-factor, and later the five-factor models. Based on the theory of team creativity and innovation processes as CAS, the three-factor model confirmed the three-factor's model fit: a) Team Stability/Operates between Order and Chaos, b) Starting Conditions/Path-dependent, and c) Team History/Systems

Have a History. Moreover, CFA also confirmed the six-factor's model fit: a) Team Stability/Operates Between Order and Chaos, b) Team History/Systems Have a History, c) Team Dynamics/Adaptable, d) Starting Conditions/Path-dependent, e) Team Reactions/Nonlinearity, and f) Self-organizing.

Upon confirming construct validity later on in the current study, a CFA was conducted on a five-factor model after removing the factor, Team Reactions/Nonlinearity. The reason being that that factor's AVE was less than .50, despite its CR being above .70. Although Fornell and Larcker (1981) claimed that convergent validity still existed because its CR being above .70, I re-ran a CFA on the five remaining factors to see if the five-factor's model fit would improve. The results showed that the five-factor model's model fit was slightly less than that of the six-factor model, strengthening the CAS factor's convergent validity, Team Reactions/Nonlinearity.

Thus, the six-factor model was deemed the fittest model after testing the alternative models: the three-factor and the five-factor model.

Phase 5 Results: Internal Consistency Assessment: Cronbach's Alpha

Cronbach's alpha test of internal consistency was used to assess the scales' reliability in the three-factor model and the six-factor model. The strength of the alpha values was interpreted through guidelines suggested by George and Mallery (2016), in which α = .900-.999 Excellent, α = .800-.899 Good, α = .700-.799 Acceptable, α = .600-.699 Questionable, α = .500-.599 Poor , α < .5 Unacceptable. All the scales in both the three-factor model and the six-factor model met the acceptable threshold for internal consistency. Table 37 presents the Cronbach alpha for the scales.

Table 37

Cronbach Alpha Test of Reliability for Scales

Latent factor	Three-Factor Model		Five-Factor Model		Six-Factor Model	
	# of Items	α	# of Items	α	# of Items	α
Team stability	12	.91	4	.79	4	.79
Starting conditions	8	.91	8	.91	8	.91
Team history	9	.92	9	.92	9	.92
Team reactions			9	.90	3	.84
Team dynamics			3	.82	9	.90
Self-organizing					3	.82
Total number of items	29				36	

Phase 6 Results: Construct Validity

Average Variance Expected (AVE) and Composite Reliability (CR) for Three-Factor Model

The average variance extracted (AVE) and composite reliability (CR) tests were used to examine the convergent validity of each construct of the three-factor model. The AVE represents the sum of the squared standardized factor loadings, or item reliability, divided by the number of items. Construct validity also requires a test for convergent and discriminate validity. Test for convergent validity to the extent that is expected to be related are, in fact, related. Test for discriminate validity to the extent that constructs that should have no relationship, in fact, do not have any relationship. The AVE for team stability, starting conditions, and team history were .452, .572, and .555, respectively. The composite reliability for the three factors were all above .90 (team stability = .906, starting conditions = .914, and team history = .918). Team stability fell below the threshold of .500 for AVE; however, the composite reliability was above the .70 threshold. These findings provide evidence on the constructs' convergent validity on the three-factor model (Table 38).

Table 38

Average Variance Extracted and Composite Reliability for Three-Factor Model (Varimax Rotation)

Latent factor	Average Variance Extracted (AVE)	Composite Reliability (CR)
Team stability	.452	.906
Starting conditions	.572	.914
Team history	.555	.918

Average Variance Expected (AVE) and Composite Reliability (CR) for Five-Factor Model

The average variance extracted (AVE) and composite reliability (CR) tests were used to examine each construct's convergent validity in the five-factor model. The AVE represents the sum of the squared standardized factor loadings, or item reliability, divided by the number of items. The AVE for team stability, team history, team dynamics, starting conditions, and self-organizing was .499, .624, .521, .572, and .611. The composite reliability for the three factors were all above .90 (team stability = .800, team history = .918, team dynamics = .906, starting conditions = .914, and self-organizing = .825). All factors were above the threshold of .500 for AVE and .700 threshold for CR. These findings provide evidence on the convergent validity of the constructs on the five-factor model.

Table 39

Average Variance Extracted and Composite Reliability for Three-Factor Model (Varimax Rotation)

Latent factor	Average Variance Extracted (AVE)	Composite Reliability (CR)
Team stability	.499	.800
Team history	.624	.918
Team dynamics	.521	.906
Starting conditions	.572	.914
Self-organizing	.611	.825

Average Variance Expected (AVE) and Composite Reliability (CR) for Six-Factor Model

The average variance extracted (AVE) and composite reliability (CR) tests were used to examine each construct's convergent validity for the six-factor model. The AVE represents the sum of the squared standardized factor loadings, or item reliability, divided by the number of items. The AVE for team stability, team reactions, team history, team dynamics, starting conditions, and self-organizing was .501, .323, .626, .511, .574, and .615, respectively. The composite reliability for the six factors were: team stability = .799, team reactions = .845, team history = .919, team dynamics = .902, starting conditions = .915, and self-organizing = .827. Team reactions fell below the threshold of .500 for AVE; however, the composite reliability was above the .700 threshold. As stated previously, Fornell and Larcker (1981) claimed that convergent validity still existed because its CR being above .70. The AVE for team stability was above the threshold (.500) for the six-factor model compared to it being below the three-factor model threshold. These findings provide evidence on the convergent validity of the six-factor model's constructs (Table 40).

Table 40

Average Variance Extracted and Composite Reliability for Six-Factor Model (Promax Rotation)

Latent factor	Average Variance Extracted (AVE)	Composite Reliability (CR)
Team stability	.501	.799
Team reactions	.323	.845
Team history	.626	.919
Team dynamics	.511	.902
Starting conditions	.574	.915
Self-organizing	.615	.827

Convergent Validity

Another test for verifying convergent validity is to test whether AVE's square roots are greater than the squared intra-construct correlations (SIC) (Wipulanusat et al., 2017). Table 41 shows a matrix that demonstrates the correlation of each construct with the other constructs. The values above the diagonal (i.e., above the 1.00 correlation coefficients), it can be easily seen that the AVE values are above 0.5; moreover, they are above the correlation coefficients for each construct. Although team reactions AVE is below .50, its CR is above .70, making for acceptable convergent validity (Fornell & Larcker, 1981).

Table 41

Convergent Validity: Square Root of AVE is Greater than the SIC Values

Latent factor	Team Stability	Team Rctns	Team History	Team Dyn	Starting Conds	Self-Org	AVE	CR
Team stability	1.00	.22	.45	.28	.69	.55	.501	.799
Team reactions	.47	1.00	.11	.55	.08	.42	.323	.845
Team history	.67	.33	1.00	.12	.67	.26	.626	.919
Team dynamics	.53	.74	.35	1.00	.11	.37	.511	.902
Starting conditions	.83	.29	.82	.33	1.00	.29	.574	.915
Self-organizing	.74	.65	.51	.61	.54	1.00	.615	.827

Note: Values below the diagonal are estimates of intra-construct correlations, and values above the diagonal are squared intra-construct correlations (SIC).

Discriminant Validity

Average variance is extracted analysis to establish discriminant validity. In an AVE analysis, we test whether the square root of AVE to each construct is much more than the correlation square between a pair construct. AVE measures the explained variance of the construct (Mohamed & Ahmed, 2020). When comparing AVE with the correlation coefficient, we want to see whether the construct items explain more variance than the other constructs' items (Mohamed & Ahmed, 2020; Wipulanusat et al., 2017). Table 42 shows that the vast majority of the construct items explain more variance than the other constructs' items.

Table 42

Discriminant Validity: Square Root of AVE is Greater than the Construct's Correlation Square

Latent factor	Team stability	Team reactions	Team history	Team dynamics	Starting Conditions	Self-Organizing
Team stability	**.71**					
Team reactions	.47	**.57**				
Team history	.67	.33	**.79**			
Team dynamics	.53	.74	.35	**.71**		
Starting conditions	.83	.29	.82	.33	**.76**	
Self-organizing	.74	.65	.51	.61	.54	**.78**

Note: Values on the diagonal represent the square root of the AVE.

Summary

Survey data were collected from 711 respondents via Quatrics survey panels over one month. Of those responses, all 711 responses were deemed complete and acceptable for analysis. The demographic data were analyzed and coded in SPSS and SAS. Multiple analysis was conducted on the data, including exploratory factor analysis and confirmatory factor analysis to validate the new instrument. For construct validity, average variance extracted (AVE) and composite reliability (CR) were conducted. Further discussion of these data and conclusions about the study and implications for further research are discussed in Chapter 5.

CHAPTER 5

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of the current study was to validate a survey instrument that measured team creativity and innovation processes as complex adaptive systems (CAS). With over 91% of 1000 Fortune companies using team-based structures ("Teamwork in Business," 2018), today's organizations place greater emphasis and resources on team creativity and innovation processes (Ancona & Caldwell, 2014). Despite the extra focus and capital, many of these organizations' future is dire as the average tenure of Standard & Poors (S&P) is predicted to go from 20 years down to less than 12 years by 2027 (Hillenbrand et al., 2019). With current research still puzzled and widely divided on the construct agreements of team creativity and team innovation (Hughes et al., 2018), it is of little surprise that work teams continue to struggle in managing their creative and innovative processes (Edmondson, 2012).

The current study answered researchers' call to "adopt a different logic of inquiry" regarding team creativity and innovation processes that will "raise the level of theoretical sophistication, and … lead to better practical applications" (Ramos-Villagrasa et al., 2018, p. 136). The current study used complexity theory to explain how team creativity and innovation processes are similar to CAS characteristics. Hence, the current study validated a survey instrument that identified six factors with several salient loadings correlated with team creativity and innovation processes as CAS characteristics. This chapter addresses the conclusions that I have discovered from my review and study and suggestions for future research and practice.

Summary of the Findings

The current study aimed to validate a survey instrument that measures team creativity and innovation processes as CAS. The current study utilized several statistical techniques to analyze the factor structure of team creativity and innovation processes as CAS by estimating model fit, inter-item relationships, evidence for discriminant validity, and reliability. The current study investigated the construct validity of team creativity and innovation processes as CAS through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). An exploratory factor analysis (EFA) with principal axis factoring was conducted on the initial 56-item instrument. The first study (N = 411) produced six latent factors that included 40 variables with factor loadings .40 and over. Sixteen items with factor loadings less than .40 were eliminated, resulting in a 40-item instrument.

Exploratory factor analysis (EFA) was used to evaluate the number of latent factor structures within the survey instrument and the number of correlating items underlying each factor's set (Wipulanusat et al., 2017). The current study only focused on factor loadings equal to or higher than .40 because these are considered moderate to high communalities (Hinkin et al., 1997; Wipulanusat et al., 2017). Based on the oblique rotational method, the EFA results showed six latent factors with three or more items per factor with salient loadings ranging from .406 to .826. Those six latent factors were named as follows:

1. Team Stability/Operates Between Order and Chaos
2. Starting Conditions/Path-Dependent
3. Team History/Systems Have a History
4. Team Reactions/Nonlinearity
5. Team Dynamics/Adaptive
6. Self-organizing/Self-organizing

Confirmatory factor analysis (CFA) was conducted and confirmed that both the three-factor and six-factor post-EFA models' goodness-of-fit values were reasonable (Table 43; Figure 27).

Table 43

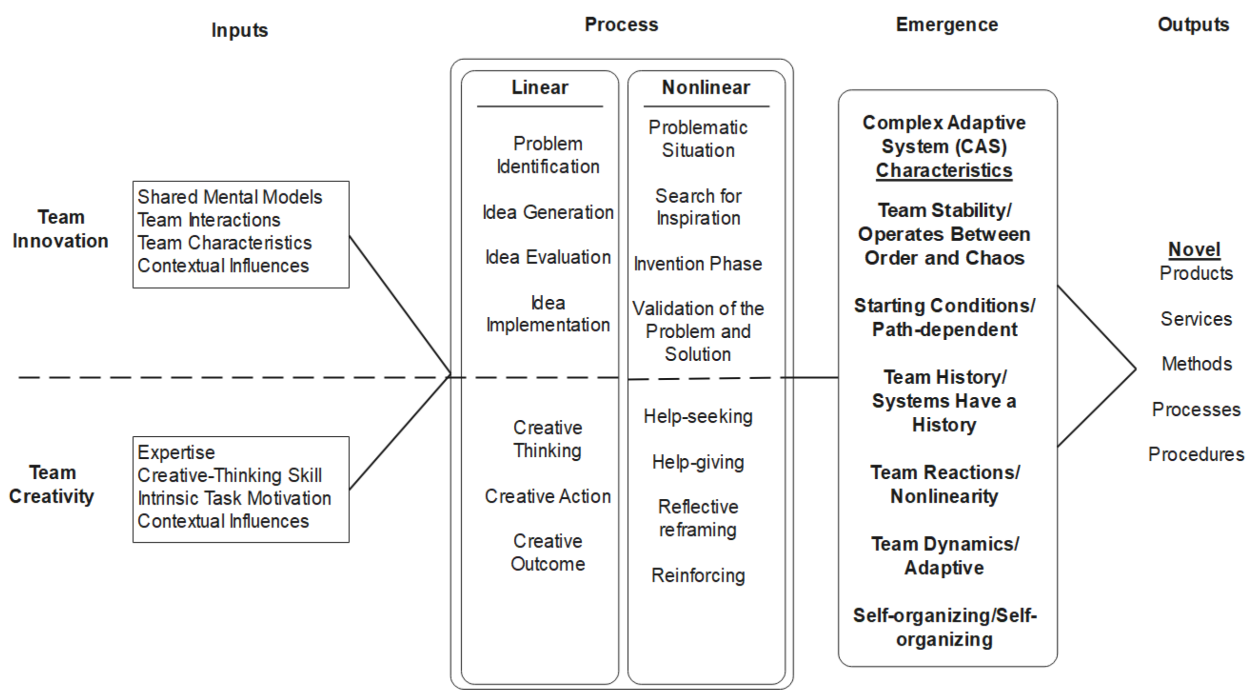
CFA Fit Statistics for Six-Factor Model from Promax Rotation Compared to Varimax Rotation

	χ^2	*df*	*p*	*CFI*	*TLI*	*RMSEA*
Promax	1423.35	579	<.001	.88	.87	.07
Varimax	1106.81	374	<.001	.86	.85	.08

Note: required values are >.90 and <.08.

Figure 27

Modified Model of Team Creativity and Innovation Processes as CAS



Interpretation of the Findings

As previously mentioned in Chapter 1, the current study's significance is that it adopted a different logic of inquiry regarding team creativity and innovation processes. The current study veered from current literature by identifying team creativity innovation processes as a CAS based on complexity theory, compared to deconstructing team creativity and team innovation as separate but equal constructs. This new perspective allowed the creation of a new instrument that measures team creativity and innovation processes as CAS, thus raising the level of theoretical sophistication and leading to better practical applications. The current study validated the new instrument by determining that team creativity and innovation processes can be identified as CAS; specifically, six unique CAS factors have emerged. These findings are significant because they confirm that team creativity and innovation processes can be researched as a CAS. The implication is that the current study answered Hughes et al.'s (2018) call for developing a new scale for "assessing workplace creativity and innovation that offer clear facet-level measurement and scales that distinguish between person, processes, and product" (p. 563).

Neither "Emergence" nor "Irreducible" CAS characteristic items from the initial theory emerged as a significant and valid factor from the EFA and CFA analyses. Also, for the six-factor model, the AVE for "Team Reactions/Nonlinearity" fell below the .50 threshold, despite its composite reliability being above .70, which leaves the remaining five validated CAS characteristics and constructs:

1. Team Stability/Operates Between Order and Chaos
2. Starting Conditions/Path-dependent
3. Team History/Systems Have a History
4. Team Reactions/Nonlinearity
5. Team Dynamics/Adaptive
6. Self-organizing/Self-organizing

The current study demonstrated that the IT sector participants had no issues with viewing team creativity and innovation as a unified construct, thus alleviating these two constructs' conflation and confusion. The data that produced the validated instrument showed evidence that the participants could readily identify team creativity and innovation processes as a CAS.

Combining creativity and innovation as a team construct would enhance, rather than impede, efforts to accurately measure the construct.

Hughes et al. (2018) recommended that future instruments "assess the key stages of creativity and innovation in detail to provide fully construct representative measurement" and to "assess how individuals or teams generate and implement novel ideas" (p. 564). As such, the current study's instrument offers six key stages for team creativity and innovation; moreover, specific actions that team members can take to spur their teams' creative and innovative processes. For example, the "Team Stability/Operates Between Order and Chaos" CAS characteristic recommended that team members reflect on their past experiences and that they need to be sufficiently challenged to improve team creativity and innovation processes. Another example, under the "Starting Conditions" stage, team members must be ensured adequate resources to complete their tasks, or that team members must be allowed the free exchange of ideas without fear of judgment or punishment from either their peers and management. Each of the six validated CAS characteristics/stages offers specific actions to drive team creativity and innovation processes per Hughes et al.'s recommendations.

Limitations of the Study

The process of naming factors or factor naming proved to be a challenging exercise, hindered by a major limitation of only having two individuals involved in the process. This is considered a limitation because the factor naming process is riddled with subjectivity, and thus, a best practice mandates that multiple individuals are involved in the naming process. Tabachnick et al. (2019) recommend having at least 5-10 individuals involved in the naming process, which afterward, divided into two separate groups that convene to constructively argue and discuss the factors’ final names. Tabachnick et al. readily admit that this process takes longer and requires effective group cooperation but results in a higher validated process.

The second limitation of the current study is that its conclusions are limited because of the narrow relationship between the initial eight CAS latent factors and 56 indicators. Post EFA results, the survey instrument measured six factors and 40 indicators, revealing only correlational relationships versus causal findings. However, finding causality was outside the current study’s scope as its primary aim was to validate the correlational relationships of the survey instrument that measures team creativity and innovation processes as CAS.

Recommendations

The current study aimed to validate a survey instrument that measures team creativity and innovation processes as CAS. After conducting both EFA and CFA analyses, the current study validated that six factors, including 36 indicators, measure team creativity and innovation processes as CAS. The current study recommended using the six-factor oblique Promax model over the alternative five-factor model and the three-factor, Varimax rotated model. The oblique model is considered more accurate and representative of the population (Hinkin, 1998), providing further support for the six-factor oblique model.

Addressing the first limitation of having only two individuals involved in the naming process, the current study proposes following Tabachnick et al.’s (2019) recommendation of having at least 5-10 individuals involved in the naming process, which afterward, divided into two separate groups that convene to constructively argue and discuss the factors’ final names. In addressing the second limitation in which the relationship between the eight initial latent CAS factors and 56 indicators is rather narrow, the proposed validated instrument presented in the current study needs to be tested further with different samples and contextual situations (e.g., health care, software, manufacturing. Researchers and scholar-practitioners could use the validated instrument to begin testing the instrument and to further refine the instrument and, over time, the theory that creativity and innovation are a CAS. Moreover, further research is needed to test this instrument using independent samples. Furthermore, there is a lack of research from the senior management teams' creative and innovative processes (Anderson et al., 2014). For this reason, I plan on distributing the validated instrument to over 300 senior banking leaders in the banking and financial sector as the next phase in this study. This sample includes senior bankers employed by over 50 different U.S. banks with between $10 billion to $3 trillion in assets under their management. For this future study, I will test the validated instrument and further refine it for the banking sector and senior management teams.

The other recommendation has to do with the significance of the current study, as outlined in Chapter 1, to leverage its results towards better practical applications. The newly validated instrument offers practical scales for assessing workplace creativity and innovation processes based on a unifying theoretical framework. Organizations could use the instrument to diagnose strengths and weaknesses in their work teams' creativity and innovation processes. For example, I had my organization develop and create a mission statement for its banking school after the instrument emphasized how mission statements drive and foster team creativity and innovation processes. Here, the mission statement helps to develop a shared mental model among team members. This development process took over six months, involving multiple stakeholders and key influencers over several iterations. The numerous discussions and debates between the stakeholders were eye-opening as they revealed that there were widely differing opinions on the purpose and value of the banking school for the organization, the faculty, clients (i.e., member banks), and the students. Chaos and conflict were present throughout many meetings, helping to spark creativity and cohesion among team members. These factors, developing shared mental models, working through conflictual situations, developing transactive memory systems, and developing cooperation from all team members through a shared mission statement, benefited the team creativity and innovation process as they contributed to the stakeholders' shared-ness and sensemaking activities. As a result, we established a mission statement that resonated with all stakeholders and leaders, which is now strongly promoted throughout the company, faculty, clients and students.

Further creativity and innovation research is needed in the area of multilevel research. The creativity and innovative processes as a CAS should be studied using multilevel techniques that include the individual, team, and executive/organization levels of analysis. The creativity and innovative processes are cyclical and multilevel, requiring multiple perspectives from all levels of analysis (Anderson et al., 2014; Turner & Baker, 2020). The recommendation would be to expand the current study's instrument survey to derive a multilevel instrument that includes the individual, team, and executive/organization levels of analysis.

Lastly, it would be remiss of me if I failed to address system dynamics, especially in the context of the Cynefin framework. System dynamics have been dominant in management thinking for the past 50 years, treating organizations as machines and predictable strategic paradigms (McCrone & Snape, 2020). Vennix (1995) explained that "system dynamics was originally founded as a method for modeling and simulating the behavior of industrial systems" (p. 335). Treating organizations as machines results in system dynamic statements and phrases such as "'levers for change,' 'drivers for growth,' 'alignment,' 'optimization,' etc." (McCrone & Snape, 2020, Strategy in the Ordered Domains section). System dynamics also refers to technologies for modeling complex systems and a way of thinking about complex systems

(Spector, 2021). McCrone and Snape (2020) found that system dynamics believe that most of the future system's landscape is known or knowable through analysis. Thus, mental models are essential in system dynamics because they explain how a system works, how it evolves, and how it behaves over time. (Sterman, 1994). System dynamics have evolved beyond systems thinking, and thus, more research must be done under the theoretical framework of system dynamics that could also explain the holistic relationships between complexity and C/I factors.

Conclusion

Work teams and their creative and innovative processes are critical to organizations' success and longevity (Hillenbrand et al., 2019; Im et al., 2013; Rosing et al., 2018). Nevertheless, the definition and measurement of creativity and innovation have been a real challenge for researchers, which has been a disservice to organizations and their work teams (Hughes et al., 2018), as team members continually struggle with their creative and innovative processes (Edmondson, 2012; Khedhaouria & Ribiere, 2013). As Hughes et al. (2018) succinctly put it, "we're doing ourselves a disservice, wasting time, money, and other resources, because, without high-quality measurement, all other empirical endeavors are conducted in vain. Our review of extant measures provides a clear message: we need new tools to assess workplace creativity and innovation" (p. 564). The current study answered their call by validating a new instrument that measures team creativity and innovation processes as CAS. Moreover, the validation process consisted of both exploratory factor analysis and confirmatory factor analysis, using two separate samples ($n = 411$ and $n = 300$), which Hughes et al. (2018) noted was an exceptional method amongst other creativity and innovation scales studied in their decade-spanning research.

Hughes et al. (2018) also discovered that over 80% of creativity and innovation studies were written in the past decade, signifying the growing urgency and importance of creativity and innovation processes within organizations. The current study contributes to this research by providing a validated instrument with highly accurate scales that measure team creativity and innovation processes as CAS. This unifying and unique framework raises the level of theoretical sophistication and leads to better practical applications.

APPENDIX A

IRB DOCUMENTS

IRB Certificate of Completion

CITI PROGRAM

Completion Date 16-Nov-2018
Expiration Date 15-Nov-2021
Record ID 29484491

This is to certify that:

Jae Schroeder

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Social & Behavioral Research - Basic/Refresher (Curriculum Group)
Social & Behavioral Research - Basic/Refresher (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

University of North Texas (Denton, TX)

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wa9a0972a-372d-44b9-bcbc-835a39d68f13-29484491

IRB Application Approval

Schroeder, Jae

From:	UNT_IRB@cayuse.com
Sent:	Thursday, September 24, 2020 12:23 PM
To:	Schroeder, Jae; Turner, John
Subject:	[EXT] IRB-20-471 - Initial: Exempt Approval for Online Study

UNT DIVISION OF RESEARCH & INNOVATION
Research Integrity & Compliance

September 24, 2020

PI: John Turner
Study Title: Team Creativity and Innovation as CAS

RE: Human Subjects Application # IRB-20-471

Dear Dr. John Turner:

In accordance with 45 CFR Part 46 Section 46.104, your study titled "Team Creativity and Innovation as CAS" has been determined to qualify for an exemption from further review by the UNT Institutional Review Board (IRB).

Attached to your IRB application in the Study Detail section under the Attachments tab are the consent documents with IRB approval. Since you are conducting an online study, **please copy the approved language and paste onto the first page of your online survey.**

No changes may be made to your study's procedures or forms without prior written approval from the UNT IRB. Please contact The Office of Research Integrity and Compliance at 940-565-4643 if you wish to make any such changes. Any changes to your procedures or forms after 3 years will require completion of a new IRB application.

COVID-19 is having an impact on normal operations and procedures at UNT. Please review the following guidance to ensure you may proceed with in-person human subjects research. You must comply with all information located on this page during the conduct of your study to ensure safety of the participants and the research team.

We wish you success with your study.

Note: Please do not reply to this email. Please direct all questions to untirb@unt.edu

Sincerely,

APPENDIX B

CREATIVITY/INNOVATION PROCESS FROM A

COMPLEXITY THEORY PERSPECTIVE

(Turner & Baker, 2020, pp. 27–29)

CAS Characteristics	Compilation of all Theories
Path dependent	(1) Organizational resources must be made available for employees to be creative: Resource, Management Practices, Organizational Motivation. (3) Creativity is domain-specific and may change over time as a domain evolves. An organization's absorptive capacity, aspiration levels, and standards for success may influence the selection or rejection of creative action and innovations. (4) Organizational control differs based on culture, nationality, national culture. (5) U-shaped relationship between knowledge diversity and integrating group processes. Low diversity, group tends toward conformity. Very high diversity, groups less likely to have shared mental models, low communication. Members learn integrating skills and discover safety through effective management of diversity. Creativity requires an undemanding environment, while implementation requires precisely the opposite. External demands, threat, and uncertainty motivate groups to innovate at work. Improving group psychosocial safety will increase the level of creativity in work groups. (6) Ever changing cycle of the requirements for exploration and exploitation. (8) Field.
Systems have a history	(1) The system is complex, but it is not unknowable. (2) Past reinforcement history. (3) Creativity can be facilitated by people's expectations drawn from previous successes or vicarious learning, but those who have suffered ill consequences, or imagine rejection or punishment, from creative action will be reluctant to undertake such endeavors. (4) Organizational control may impinge upon creativity by teams embedded in the organization. (5) Clearly stated mission predicted success at all stages of the innovation process (conception, planning, execution, and termination). Clarity of and commitment to team goals is associated with high levels of team innovation. (6) Initiating structure and consideration. Initiating structure is defined as leader behaviors that structure tasks, define goals, and control goal attainment. Consideration is person related and represents leader behaviors that support and motivate followers in accomplishing their work. (7) Generating a shared vision among employees, consistent with their values and beliefs. Clear organizational goals and vision. Alignment of individuals around these goals. Empowering environment. (8) Domain.
Nonlinearity	(3) The process (creativity) continues as an ongoing cyclical set of relationships. (5) Innovation is a nonlinear process, encompassing both creativity and innovation implementation. Innovation is not a linear process… it may be conceived of as cyclical with periods of innovation initiation, implementation, adaptation, and stabilization. (6) The processes of creativity and innovation are nonlinear processes. Innovation processes are complex and nonlinear.
Emergence	(1) By combining one's expertise, creative-thinking skills, and intrinsic motivation, creativity is likely to occur. (2) Individual: creativity is the result of antecedent conditions, cognitive style and ability, personality, relevant knowledge, motivation, social influences, and contextual influences. Team level: creativity is a consequence of individual creative behavior, the interaction between group members, group characteristics, team processes, and contextual influences. Organizational level: innovation is a function of both individual and group creativity. (3) Creative action is the result of the joint influence of sensemaking processes, motivation, and knowledge and skills. If one of these processes is missing, it can hinder the creative action. (4) Cultural diversity promotes divergence in teams, and divergence leads to creativity. (5) Four factors that facilitate innovation: vision, participative safety, task orientation, and support for innovation. Context must be demanding. (6) Innovation (separate from creativity) involves social processes. (7) Four types of factors important to innovation at work: organizational factors, relationships at work with one's supervisor, job characteristics, group or social factors, and individual characteristics. Perceived freedom or discretion. Group reinforces risk-taking. Group cohesiveness. Leadership relationships. feedback and recognition. (8) The field (those affected by the creator) and the domain (norms, rules, culture) make up the context and the person (the creator) is influenced by and influences the contextual conditions (field and domain). Flow: that feeling of intense concentration and enjoyment that people experience when they work on a satisfying task.
Irreducible	(1) Orientation toward innovation (from upper-management). (2) Group norms that create high conformity expectations result in low individual creative performance. Individual creativity is increased by organizational cultures supporting risk taking behaviors. Group diversity leads to higher group creativity. (3) Evolutionary processes reflecting multiple domains can simultaneously influence individual behavior. Conditions facilitating creativity may be undone by a

CAS Characteristics	Compilation of all Theories
	single negative influence. (4) Cultural diversity positively associated with creativity. (5) Perceived support for innovation. (6) Leader/Supervisor support. (7) Pro-innovation culture, empowering environment.
Adaptive	(1) Challenging ideas in a constructive way. (2) Represents a dramatic aspect of organizational change, providing a key to understanding change phenomena and organizational effectiveness. (3) Absorptive capacity, organization's ability to recognize the value of new information, assimilate it, and utilize it. (5) Psychologically safe environment that allows stimulating debate and discussion. Must have strong group integration processes and a high level of intra-group safety. Individuals, groups, or organizations seek to achieve desired changes, or avoid the penalties of inaction. (6) Temporally flexible leadership, ambidextrous leadership. Situational. (8) Interactions between individual and sociocultural contexts.
Operates between order and chaos	(1) Challenging work. (2) High uncertainty has caused organizations/teams to reframe old issues and explore new ideas. (3) Competition between creative and routine behavioral options may be especially important to organizational creativity. Organization's propensity for either risky or conservative behaviors. (5) Environmental uncertainty, competition, external demands, time constraints. Innovation implementation involves changing the status quo, which implies resistance, conflict, and a requirement for sustained effort. Requisite variety, disagreement and variety, are necessary for systems to adapt to their environment and perform well. (6) Managing conflicting demands at multiple organizational levels. Balance between exploration and exploitation, active management and self-regulatory processes. Leadership operates between the orthogonal value dimensions of control-flexibility and internal-external focus.
Self-organizing	(1) Allows for a considerable degree of freedom or autonomy. (2) Creativity is a complex interaction between the individual and his or her work situation at different levels of organization. (3) Behavior episodes: Accumulated experiences lead individuals to develop interpretive schema, preferences, expectations, and knowledge related to specific domains of behavior. (4) Creativity must be supported by the social and group dynamics. (5) Flexibility of thought and organization (self-organizing), fostered by diversity, influence team innovation. (6) Self-regulatory processes. Paradoxical use of very different leadership styles or roles are necessary for innovation success (self-managed by leader and context). (8) Person.

Notes: CAS = Complex Adaptive Systems; 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 4 = Model of Paternalistic Organizational Control and Innovation and Group Creativity; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity.

APPENDIX C

RELATIONSHIP BETWEEN THE CAS CHARACTERISTIC,

TEAM C/I, AND SURVEY ITEM

(Turner & Baker, 2020, pp. 27–29)

CAS Characteristic	Team C/I Theory & Agents	Survey Item
Path-Dependent	(1) Organizational resources must be made available for employees to be creative: Resource, Management Practices, Organizational Motivation.	(1) My team had access to the resources required to complete its tasks. (1) A lack of resources hinders my team's creativity.
	(3) Creativity is domain-specific and may change over time as a domain evolves. An organization's absorptive capacity, aspiration levels, and standards for success may influence the selection or rejection of creative action and innovations.	(3) My team's standards for success enhance overall creativity.
	(4) Organizational control differs based on culture, nationality, national culture.	
	(5) U-shaped relationship between knowledge diversity and integrating group processes. Low diversity, group tends toward conformity. Very high diversity, groups less likely to have shared mental models, low communication. Members learn integrating skills and discover safety through effective management of diversity. Creativity requires an undemanding environment, while implementation requires precisely the opposite. External demands, threats, and uncertainty motivate groups to innovate at work. Improving group psychosocial safety will increase the level of creativity in workgroups.	(5) Creativity only occurs in some teams. (5) Factors external of the team negatively influence creativity. (5) Team culture positively influences creativity. (5) Having higher-level organizational team members, hierarchically, negatively influences team creativity. (5) Free exchange of ideas among team members aids creativity. (5) To be creative, my team members must be able to set their own schedule. (5) The more similar I am to my team members the less creative I am. (5) My team's creativity has improved as we have matured together. (5) My team members support my contributions. (5) People outside of my team support my efforts. (5) A team's diversity of knowledge positively affects creativity. (5) External influences negatively affect team creativity.
	(6) Ever-changing cycle of the requirements for exploration and exploitation.	(6) Team creativity is often interrupted due to customer feedback
	(1) The system is complex, but it is not unknowable.	

CAS Characteristic	Team C/I Theory & Agents	Survey Item
Systems have a history	(2) Past reinforcement history.	(2) Creativity requires team members to reflect on past experiences.
		(2, 3) Creativity is influenced by other team members' past experiences.
	(3) Creativity can be facilitated by people's expectations drawn from previous successes or vicarious learning, but those who have suffered ill consequences, or imagine rejection or punishment, from creative action will be reluctant to undertake such endeavors.	(3) Team creativity requires a safe environment. (3) My team's successes positively contribute toward its creativity. (3) A team's failures negatively influence its creativity.
	(4) Organizational control may impinge upon creativity by teams embedded in the organization.	
	(5) Clearly stated mission predicted success at all stages of the innovation process (conception, planning, execution, and termination). Clarity of and commitment to team goals is associated with high levels of team innovation.	(5) For team creativity to occur, it must first have a mission or a goal. (5) Having clear team goals leads to successful creativity.
	(6) Initiating structure and consideration. Initiating structure is defined as leader behaviors that structure tasks, define goals, and control goal attainment. Consideration is person-related and represents leader behaviors that support and motivate followers to accomplish their work.	(6) Creativity requires successful team leadership.
	(7) Generating a shared vision among employees, consistent with their values and beliefs. Clear organizational goals and vision. Alignment of individuals around these goals. Empowering environment.	(7) My current organizational position can help my team's creativity.
	(8) Domain.	
Nonlinearity	(3) The process (creativity) continues as an ongoing cyclical set of relationships.	
		(3, 5) Team creativity is an iterative (cyclical) process. Team creativity occurs naturally.
	(5) Innovation is a nonlinear process, encompassing both creativity and innovation implementation. Innovation is not a linear process… it may be conceived of as cyclical with	

CAS Characteristic	Team C/I Theory & Agents	Survey Item
	periods of innovation initiation, implementation, adaptation, and stabilization.	
	(6) The processes of creativity and innovation are nonlinear processes. Innovation processes are complex and nonlinear.	(6) Chaos leads to successful team creativity. Team creativity is easy to replicate. (6) Lacking direction results in successful team creativity. (6) The more uncertainty there is about the process, the greater the chance for successful team creativity.
Emergence	(1) By combining one's expertise, creative-thinking skills, and intrinsic motivation, creativity is likely to occur.	(1) Team creativity is a composite of individual activity.
	(2) Individual: creativity is the result of antecedent conditions, cognitive style and ability, personality, relevant knowledge, motivation, social influences, and contextual influences. Team level: creativity is a consequence of individual creative behavior, the interaction between group members, group characteristics, team processes, and contextual influences. Organizational level: innovation is a function of both individual and group creativity.	(2) Creativity is directly related to team member interactions. (2) Interactions among team members lead to successful team creativity.
	(3) Creative action is the result of the joint influence of sensemaking processes, motivation, and knowledge and skills. If one of these processes is missing, it can hinder the creative action.	(3) As team member interactions decrease, creativity decreases. Creativity is a team activity. Team creativity is achieved when the outcome is better than anticipated.
	(4) Cultural diversity promotes divergence in teams, and divergence leads to creativity.	
	(5) Four factors that facilitate innovation: vision, participative safety, task orientation, and support for innovation. Context must be demanding.	
	(6) Innovation (separate from creativity) involves social processes.	
	(7) Five types of factors important to innovation at work: organizational factors, relationships at work with one's supervisor, job characteristics, group or social factors, and	

CAS Characteristic	Team C/I Theory & Agents	Survey Item
	individual characteristics. Perceived freedom or discretion. Group reinforces risk-taking. Group cohesiveness. Leadership relationships. Feedback and recognition.	
	(8) The field (those affected by the creator) and the domain (norms, rules, culture) make up the context and the person (the creator) is influenced by and influences the contextual conditions (field and domain). Flow: that feeling of intense concentration and enjoyment that people experience when they work on a satisfying task.	(8) Team creativity is contextual/situational. (8) Team creativity results from 'Flow,' a team's collective concentration and enjoyment.
Irreducible	(1) Orientation toward innovation (from upper management).	
	(2) Group norms that create high conformity expectations result in low individual creative performance. Individual creativity is increased by organizational cultures supporting risk-taking behaviors. Group diversity leads to higher group creativity.	(2) Team creativity improves when the team's culture allows risk-taking behaviors. (2) Lack of team member debate/discussion stops team creativity. (2) Diversity among team members fosters creativity.
	(3) Evolutionary processes reflecting multiple domains can simultaneously influence individual behavior. Conditions facilitating creativity may be undone by a single negative influence.	(3) Team creativity can be stopped with one team failure. Team leadership is essential for successful team creativity.
	(4) Cultural diversity positively associated with creativity.	
	(5) Perceived support for innovation.	
	(6) Leader/Supervisor support.	(6) Team creativity requires strong leadership
	(7) Pro-innovation culture, empowering environment.	(7) A culture of creativity is necessary for team creativity to be successful.
Adaptive	(1) Challenging ideas in a constructive way.	The more adaptable team members are, the less creative they become. Team creativity is hampered by teams adapting to external change. Team creativity is dependent upon a teams' ability to be adaptive.
	(2) Represents a dramatic aspect of organizational change, providing a key to understanding change phenomena and organizational effectiveness.	
	(3) Absorptive capacity, organization's ability to recognize the value of new information, assimilate it, and utilize it.	

CAS Characteristic	Team C/I Theory & Agents	Survey Item
	(5) Psychologically safe environment that allows stimulating debate and discussion. Must have strong group integration processes and a high level of intragroup safety. Individuals, groups, or organizations seek to achieve desired changes or avoid the penalties of inaction.	(5) Listening to other team members' opinions is critical for successful team creativity.
	(6) Temporally flexible leadership, ambidextrous leadership. Situational.	
	(8) Interactions between individual and sociocultural contexts.	(8) Adapting to change requires interactions among team members.
Operates between order and chaos	(1) Challenging work.	(1) Team creativity comes from the team being challenged.
	(2) High uncertainty has caused organizations/teams to reframe old issues and explore new ideas.	(2) Uncertainty among team members leads to non-normal team behavior.
	(3) Competition between creative and routine behavioral options may be especially important to organizational creativity. Organization's propensity for either risky or conservative behaviors.	(3) Competition among team members enhances team creativity.
	(5) Environmental uncertainty, competition, external demands, time constraints. Innovation implementation involves changing the status quo, which implies resistance, conflict, and a requirement for sustained effort. Requisite variety, disagreement, and variety are necessary for systems to adapt to their environment and perform well.	(5) Team creativity results from following a routine. (5) Team creativity requires team members to operate 'out of the norm.' (5) Increasing team conflict leads to better team creativity.
	(6) Managing conflicting demands at multiple organizational levels. Balance between exploration and exploitation, active management, and self-regulatory processes. Leadership operates between the orthogonal value dimensions of control-flexibility and internal-external focus.	
Self-organizing	(1) Allows for a considerable degree of freedom or autonomy.	(1) Team creativity requires team member autonomy (1) Team creativity occurs when teams schedule their own activities.

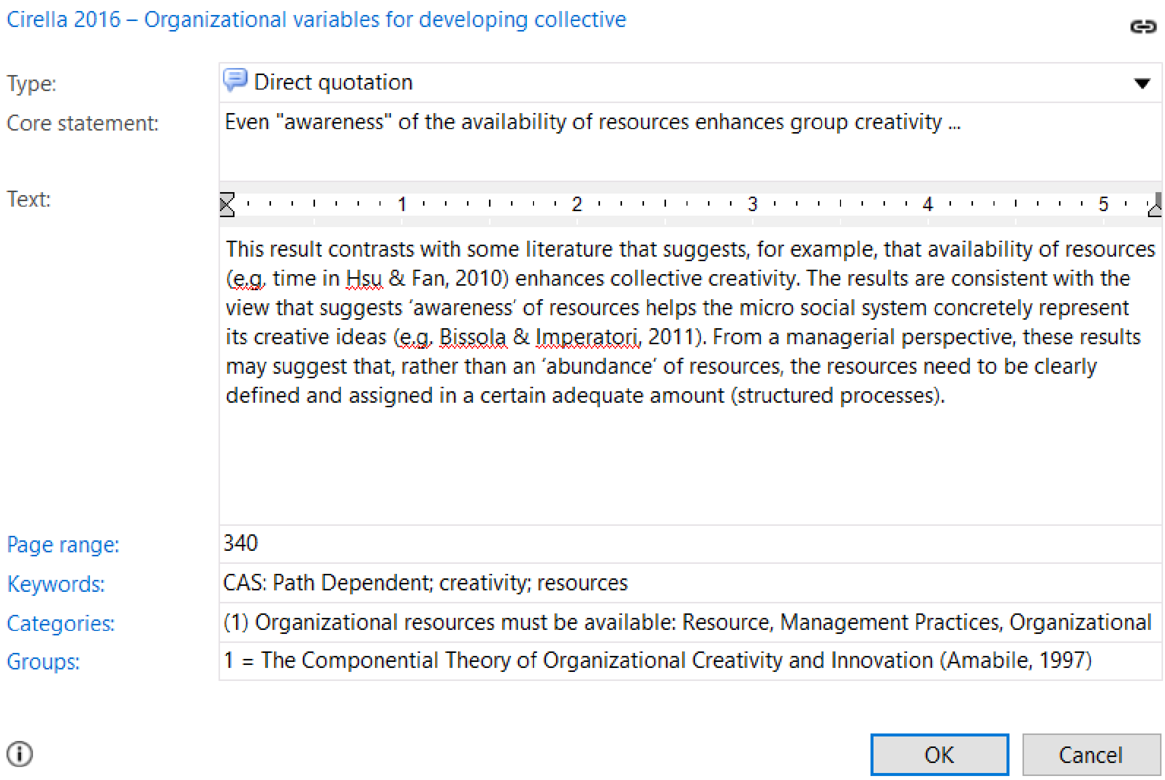
CAS Characteristic	Team C/I Theory & Agents	Survey Item
	(2) Creativity is a complex interaction between the individual and his or her work situation at different levels of organization.	(2) Team members operating interdependently leads to creativity.
	(3) Behavior episodes: Accumulated experiences lead individuals to develop interpretive schema, preferences, expectations, and knowledge related to specific domains of behavior.	(3) Team creativity requires team members to develop mental pictures.
	(4) Creativity must be supported by the social and group dynamics.	
	(5) Flexibility of thought and organization (self-organizing), fostered by diversity, influence team innovation.	(5) Teams must be flexible and able to change during the creative process.
	(6) Self-regulatory processes. Paradoxical use of very different leadership styles or roles is necessary for innovation success (self-managed by leader and context).	(6) A team's ability to self-regulate leads to successful team creativity.
	(8) Person.	

Notes: CAS = Complex Adaptive Systems; 1 = The Componential Theory of Organizational Creativity and Innovation; 2 = Interactionist Perspective of Organizational Creativity; 3 = Theory of Individual Creative Action; 4 = Model of Paternalistic Organizational Control and Innovation and Group Creativity; 5 = Theory of Team Climate for Innovation; 6 = Ambidexterity Theory; 7 = Theoretical Framework of Individual Innovation; 8 = Contextual Model of Creativity.

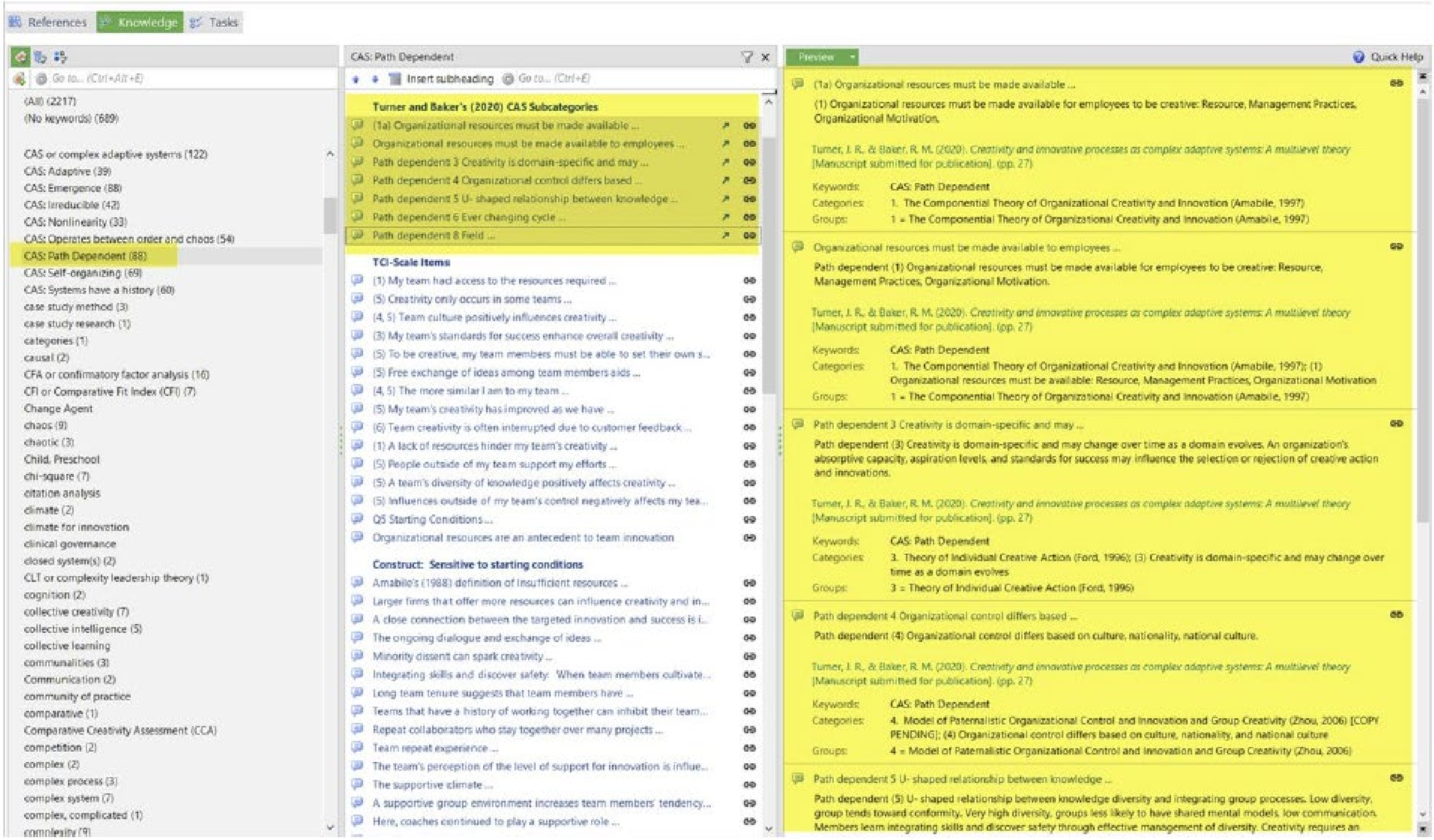
APPENDIX D

FIGURES FOR CODING USING CITAVI 6.6.0

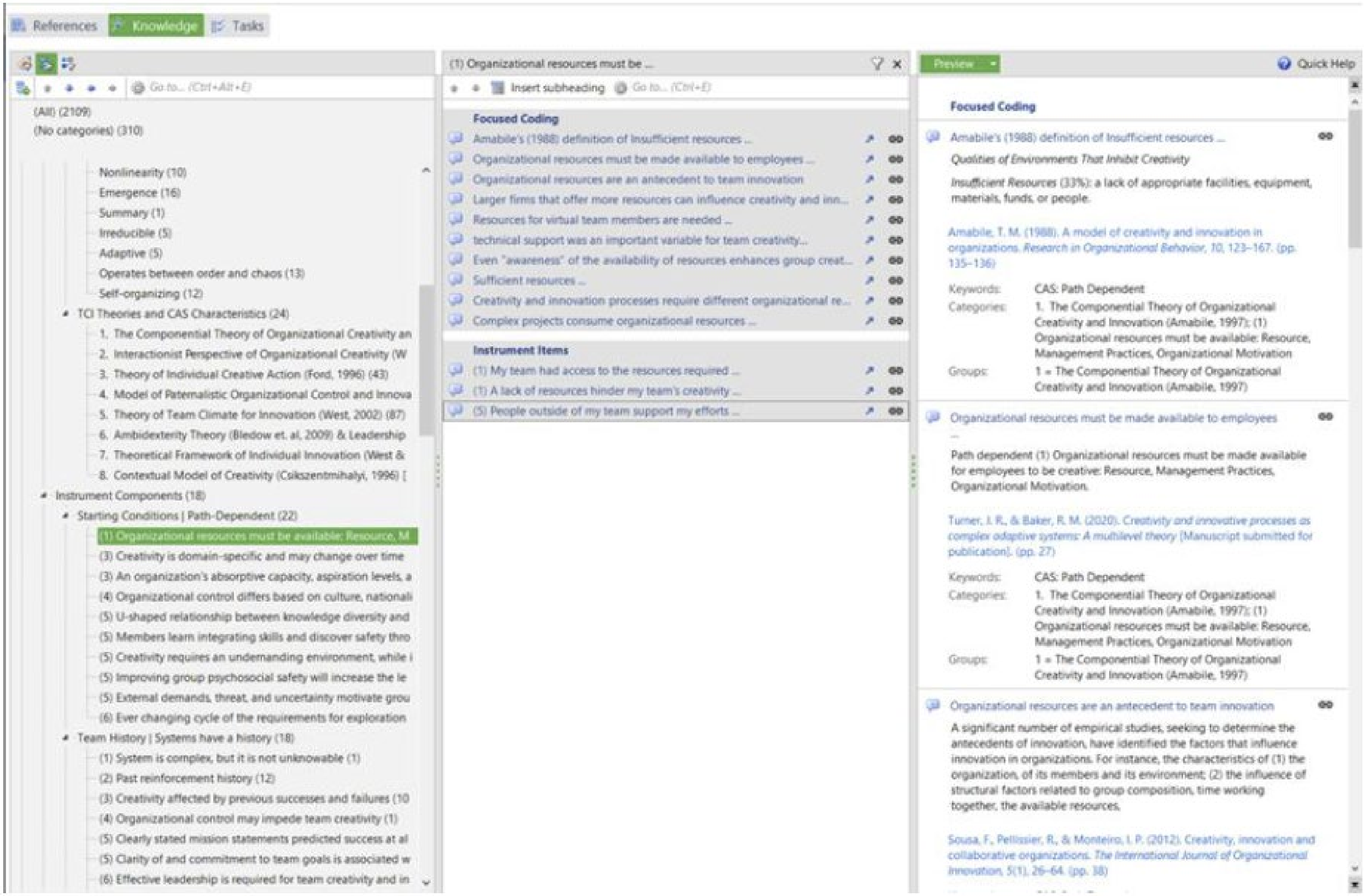
Classification Process in CITAVI 6.6.0



Focus Coding Using CITAVI 6.6.0



Focus Coding Using CITAVI'S 6.6.0 Search Engine



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