Babeș-Bolyai University
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PhD Thesis:

The Multilevel Approach of the Emergence in Multi-Team Systems

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7. General Discussion and Conclusion

Keywords: multi-team systems, emergent phenomena, multilevel analysis, social networks, collaborative systems, multiple team membership

Introduction

For the last forty years, due to the global pressures, organizations have reinvented themselves and have shifted from traditional work designs like individual assignments to team-based structures and collective performance. In this way, the organizations are likely to respond promptly to the environmental dynamics mostly because teams display a high variety of resources (Rico, Alcover de la Hera, & Tabernero, 2011). Over 80 percent of organizations worldwide adopt team-based structures (Cohen & Bailey, 1997) to perform a variety of tasks. Moreover, the context of globalization and its competitive pressures have engendered the emergence of flexible and versatile working systems such as virtual teams, matrix organizations, and multi-team systems (Curșeu, 2006). These contemporary organizational forms are complex adaptive systems designed to deal with ill-defined societal problems (i.e. The International Conference on Air Pollution and Control from Paris, 2015), complex emergency situations (i.e. 9/11 World Trade Center; Hurricane Katrina, 2005) or laborious interdisciplinary projects (i.e. service providers, custom software development). From a top-down approach, organizations are entities formed by teams and teams are formed by individuals, who act based on their own features and particularities. A collection of individuals becomes a team when they *socially interact, possess common goals, are brought together to perform various organizational tasks, exhibit interdependency toward goals, attributes, processes and outcomes, have different roles and responsibilities and all together are part of an organizational system* (Kozlowski & Ilgen, 2006, p. 79). To apply the same logic to multi-team systems (MTS), they are set of teams *interacting directly and interdependently in response to environmental contingencies toward the accomplishment of collective goals* (Mathieu, Marks, & Zaccaro, 2001). For instance, in an emergency situation,

an MTS is formed to reach a collective distal goal like saving the victims of a plane crash, while pursuing various proximal and interdependent ones (i.e. the air traffic control team needs to find the location of the crash, the firefighter team needs to extract the victims from the wreck, the medical care unit needs to provide medical assistance).

As the definition illustrates, MTSs are nested systems composed of different levels (i.e individuals, teams) that constantly assimilate new inputs from the internal (i.e. team composition changes, new comers) and external environment (i.e. the economic, unexpected situations). The conglomerate of influences within and outside of the system shape intra and inter-team processes, generate the emergent phenomena and motivate the system to reach proximal and distal outcome. As such, emergence 1) is a *multi-level process*, manifesting at different levels of analysis, 2) displays a *dynamic nature*, resulting from the co-evolution of lower-level properties and 3) it is longitudinally-oriented, unfolding over *time* (Kozlowski, Chao, Grand, Braun, & Kuljanin, 2013). In line with this argument, multilevel and emergent perspectives are the most suitable frameworks that permit the bottom-up and top-down examination of nested configurations. The current dissertation follows these principles across the studies and employs designs that address the multilevel nature of emergence and emergent constructs. Whether quantitative or qualitative, the compilation of the studies explores the interplays between individual-level properties, collective processes and motivational states, and multi-team systems attributes.

The present thesis is composed of five studies linked by the common theoretical backgrounds but carried out through distinct methodologies peculiar to multilevel designs. **The first study (chapter 2)** is an integrative review that examines the emergence and emergent constructs. Emergence is the process through which interacting agents generate higher order properties in complex adaptive systems (McGrath, Arrow, & Berdahl, 2000; Goldstein, 1999). Recent developments in systemic thought argue that complex biological

and social systems cannot be fully understood by simply studying their constituent parts, and more attention should be devoted to better understand the nature of emergent system level phenomena (Gallagher & Appenzeller, 1999; Svyantek & Brown, 2000). The concept of emergent states in groups originated in the work of Marks and his collaborators (2001) and was first used to distinguish state-like attributes of teams from processes (patterned actions that transform team inputs into outputs). Although various emergent states (i.e. cohesion, trust, group cognition) received substantial attention in the literature, so far the literature lacks a comprehensive overview of the team state-like attributes that qualify as emergent states. In the pursuit of understanding how the emergent phenomena occur and to what extent they can be identified in the organizational systems, a set of minimal criteria (i.e. origins, nature, and measurement) was provided in line with previous systemic approaches (McGrath, 1997; Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Klein, 2000) and interdisciplinary models (Goldstein, 1999; Syvantek & Brown, 2000). More specifically, emergent phenomena were defined as the global outcomes (criterion: macro-level) that have not been observed in the system before (criterion: novelty), are generated by the co-evolution of lower level properties (criterion: dynamism) and at the same time are interrelated with similar phenomena (criterion: interrelatedness), but preserving certain identity over time, they can be observed and evaluated (criteria: observation and assessment) (Goldstein, 1999; Curșeu, 2006). Taking into account these five characteristics, we put forward a taxonomy and we analyzed in-depth each category of emergent phenomena based on the following criteria: their origins, nature and methodologies of evaluation. Therefore, we distinguished between socio-affective states (i.e. cohesion, trust, psychological safety, and conflict), structures (i.e. cognitive and social structures) and competencies (i.e. cognitive and emotional intelligence). Finally, the review provided a detailed analysis of the influences that emergent phenomena manifest on the effectiveness of the system. The integrative conclusion of this review is in

line with the core idea of systemic approaches, namely it explains the recurring dynamic interplay between the collective states, structures and competencies. During multiple interactions, the groups and multi-team system develop motivational states, cognitive structures, and competencies that are expected to facilitate their successful functioning. However, the literature analysis suggested that socio-affective states seemed to be the proximal outcomes of these interactions, affecting directly the harmony within the system and eventually its performance. In addition, the present review provided an extensive knowledge applied in the methodologies of the subsequent studies of the dissertation.

The next chapter **(chapter 3)** addresses the emergent phenomena from a multilevel perspective in order to explore the dynamics of formal and emergent MTS structures (i.e. bystanders) that interact in order to manage a search and rescue (SAR) operation following a plane crash that occurred in January 2014 in Romania. Complex emergencies (i.e. plane crashes, terrorist attacks or natural disasters) involve high stakes, are ill-structured and are described by unpredictability and time-pressure (Lodree Jr & Taskin, 2008). For optimal results, the crisis response needs to be fast in order to efficiently address the inherent task complexity, and be flexible enough to handle the unpredictability of the fast changing context (Luciano, DeChurch, & Mathieu, 2015; Mathieu, Marks, & Zaccaro, 2001). Research regarding the critical factors for MTS performance is still in its infancy and so far explored factors like planning, coordination and leadership (Mathieu et al., 2001; Marks, DeChurch, Mathieu, Panzer, & Alonso, 2005; Lanaj, Hollenbeck, Ilgen, Barnes, & Harmon, 2013; Bienefeld & Grote, 2013), and emergent cognitive structures such as situational awareness and cross-understandings (Kozlowski & Ilgen, 2006; DeChurch & Zaccaro, 2010). However, most of this research is theoretical (Mathieu et al., 2001; Kozlowski & Ilgen, 2006) or was conducted in laboratory settings, with ad-hoc teams dealing with rather artificial tasks, often based on computer simulations (Bienefeld & Grote, 2013; Lanaj et al., 2013; Marks et al.,

2005). But an important contextual element when dealing with emergencies and ignored by formalized simulations is the spontaneous involvement of bystanders, actors that are not officially part of the MTS but volunteer to engage in the rescue operation (see Lipton and Glanz, 2002, for the role of bystanders in the 9/11 rescue operation). As such, the present case study aims to explore the way formal and emergent MTS structures (i.e. bystanders) interact in order to deal with the environmental contingencies. The contribution of this research is twofold. First, we take a multilevel and longitudinal perspective in order to analyze how processes and emergent states unfold across levels (i.e. individual, team and system) and time and ultimately impact the performance of the MTS. Second, by studying a complex real-life MTS engaged in high stakes task, we also capture the impact of ad-hoc teams, formed by bystanders on the MTS processes and its effectiveness.

We used triangulation both in data collection and data analysis. That is, we used multiple methods of collecting data (i.e. researcher conducted interviews, formal reports and archival records of interviews from mass-media), from several different sources (i.e. the victims of the plane crash, the MTS component teams, the Romanian Government and other authorities) and two researchers independently coded the data. The transcripts of the audio and video materials and the official documents constituted the set of raw data. Given the exploratory nature of the study, we used a hybrid approach of thematic analysis, and combined the theory-driven approach (Crabtree & Miller, 1999) with a data-driven one (Boyatzis, 1998). We started by defining a set of codes in line with the theoretical framework that guided the design of the interview (Marks et al., 2001; Marks et al., 2005; Bienefeld & Grote, 2013; DeChurch & Zaccaro, 2010) and with the multilevel approach.

The results described the functioning of an MTS characterized by a high degree of differentiation (teams with different competencies, work processes and normative systems) and high dynamism (fast changing system composition, involvement of bystanders as

emergent structures). According to our analyses, bystander involvement adds supplementary resources needed for task accomplishment (e.g., local knowledge needed for generating accurate situation awareness at the MTS level) yet they also generate substantial constraints on the transformation processes (planning and coordination). We summarize the mechanisms that could explain the influence of emergent MTS structures on the MTS effectiveness in a set of theoretical propositions. The first two propositions state a positive influence of emergent MTS structures on MTS effectiveness through the highly contextualized resources brought in by the bystanders. The last two propositions state a negative effect of emergent structures on MTS effectiveness, explained by the constraints imposed the bystanders on transformation processes at the MTS level.

Our findings have important implications for improving the MTS responses to emergency situations. The component teams and the MTS had difficulties in developing situation awareness and cross-understanding, mostly due to poor information integration and lack of experience in working together. Therefore, having the component teams engage in regular trainings and simulations would be real development opportunities since they would allow them to develop an enriched understanding about each other's mental models, to learn a common set of procedures, and to learn how to coordinate during the various transition-action episodes of the operation. Our findings also revealed the importance of training emergency MTS leaders on how to provide support for the system as a whole, during the transition phases: facilitate information integration, mission analysis and goal setting, as well as during action phases: monitoring the progress of component teams and ensuring coordination.

Chapter 4 builds on the social network theory and argues that MTSs can be conceptualized as networks of teams with different patterns of relations emerging out of their interactions during task completion (Poole & Contractor, 2011). Conceptualizing MTSs as networks represents a powerful framework that allows exploring the way configural

properties of the system influence the emergence of higher level phenomena that describe the collective: emergent processes (i.e. communication) and states (i.e. situation awareness). Thus, social network analysis (SNA) can provide valuable insights regarding the compilational models of emergence (Kozlowski & Klein, 2000; Murase, Doty, Wax, DeChurch, & Contractor, 2012), which argue that higher level phenomena (i.e. MTS situation awareness, for instance) emerge through the interaction of different non-substitutable lower level elements (i.e. different configurations of team and individual level situation awareness, Salmon, Stanton, Walker, & Green 2006). This is often the case of complex systems such as SAR MTSs. Due to the frequent fluid membership, competence diversity and the increased reliance on technology for interacting and solving the task at hand, the MTS component teams (CTs) are less likely to experience processes and states in a similar manner (i.e. following a compositional model), but rather the opposite is more likely: different configurations of lower level inputs interact and generate higher level properties (i.e. thus following a compilational model of emergence) (Murase et al., 2012, DeChurch & Zaccaro, 2010).

In trying to elucidate the mechanisms that foster MTS performance, this study takes a longitudinal perspective to explore the way in which fluid MTS membership is associated with changes in the communication network across various performance episodes and reflects on their implications for MTS processes (i.e. communication, coordination), emergent states (i.e. situation awareness), and, ultimately, MTS performance. In addition, the present research adopts a social network approach built upon both qualitative and quantitative data. This allows a departure from the traditional compositional models of emergence towards a more fine-grained analysis of the compilational emergent states that are more likely in the case of complex systems such as MTSs (Shuffler et al., 2015, Kozlowski & Klein, 2000).

In order to address our research questions and identify the patterns of relations between the relevant constructs across the four performance episodes, we employed a mixed method approach by combining a quantitative (social network metrics like density, centralization and node centrality) and qualitative analysis (thematic analysis). With respect to the former, we performed a network analysis on message content from two types of raw data: semi-structured interviews designed in line with the theoretical framework, on the one hand, and archival data (i.e. official reports issued by various entities taking part in the SAR operation and press material (i.e. press video recordings during the mission, filmed press-conferences with key players and the victims and press interviews etc.), on the other hand.

In line with Luciano et al's (2015) theory of meso-functioning, the findings illustrate that fluid membership in a competency diverse emergency MTS acts as a disruptive force, via the pressures it imposes on the communication network parameters. Particularly, the findings indicate the emergence of a decentralized communication network as a response to the complex and ambiguous task environment, in line with previous group level research (Brown & Miller, 2000). However, our study also highlights the dark side of this structural feature since a decentralized communication pattern facilitates the fast dissemination of ambiguous or invalid information. This, in turn, negatively impacts the whole operation by deterring the system from its purpose. In addition, this study has also shown that the extent to which decentralization is conducive towards MTS performance depends on the density of the communication lines established among the CTs as well. The weak interconnectedness among specialized CTs contributed to faulty communication and information opacity. In turn, this negatively influenced the emergence of MTS situation awareness and further leads to important process losses such as inefficient between-team coordination and failure to exploit the resources brought into play by the CTs.

The study brought evidence in support of the destabilizing effect of the fluid membership on the MTS, by altering communication patterns. Therefore, one important implication of our findings could refer to the importance of specifying a minimal set of norms that would regulate the way an MTS deals with fluidity. Also, as decentralized communication seems to facilitate the dissemination of ambiguous or invalid information, another practical implication might concern mitigating this risk. We suggest that an MTS leadership team could manage this drawback by acting as an information integrator. One of its functional roles could be that of monitoring the information flow across the system and filtering invalid data.

Chapter 5 extends the multilevel compilation of studies with a particular case of multi-team systems such as collaborative configurations. Herein, the task at hand is also complex and ambiguous, but, unlike the rescue operations, collaborative decision tasks constrain the various stakeholders (i.e. teams) representing distinct interests to meet at a round table and address a societal problem (i.e. refugee crisis, economic issues) (Schruijer, 2006; Vansina & Taillieu, 1997). Power differences are inherent to intergroup negotiations in such collaborative systems. We build on the approach-inhibition theory of power (Keltner, Gruenfeld & Anderson, 2003) and argue that power disparity has both cognitive and affective consequences for intergroup interactions in collaborative multiparty systems. According to power approach-inhibition model (Keltner et al., 2003), powerful actors tend to behave in a disinhibited way, to experience positive emotions and engage in automatic information processing, while powerless actors tend to experience negative emotions, engage in systematic information processing and behavioral inhibition. We extend these insights from individuals to the team level of analysis and argue that through contagion and polarization, these individual tendencies are amplified in teams. Therefore, the present study aims to explore the dual role of power disparity in collaborative settings. On the one hand, power

asymmetry increases the cognitive activity of the parties (i.e. task conflict and cognitive dissent), but on the other hand it generates a negative affective climate within the system (i.e. relationship conflict and psychological safety).

Two hundred and thirty nine students (198 females), with an average age of 23.65 years, distributed in 54 teams (across 9 simulations), participated at the present study. The participants enrolled in a Romanian University attended the Social Psychology and Organizational Dynamics and Complexity courses, where we used a simulation to explore the dynamics of the multi-team systems. The simulation uses a generic structure presented in Schruijer (2006), and participants have the chance of experience within group as well as between group interactions. The between group interactions are organized as dyadic or triadic meetings (two max three groups meet and discuss) as well as plenary meetings in which each group has a delegate representing their interest in the plenary meeting. At the onset of the simulation, all groups have a transition phase, when they engage in intra-group discussions and do not interact with the other groups. Participants were given a questionnaire at two points of time. The first one was administered after the in-group transition phase in order to assess the expectations of the stakeholders, and the second one was administered after the plenary session in order to examine to what extent a configurative input like power asymmetry (power differences between groups) influence the quality of the interactions (i.e. emergent states such as task and relationship conflict, minority dissent, psychological safety) between the groups from a collaborative system. All the data were aggregated at the group level and power disparity was computed as a coefficient of variance (Harrison & Klein, 2007). A 2 (power, non-power) x 2 (time 1, time 2) mixed factorial design ANOVA with repeated measures was used. Data analyses were performed separately for each variable (task conflict, cognitive dissent, relationship conflict, and psychological safety) in order to explore

the interaction effects between power disparity (low and high) at the system level and the emergent states developed during the time 1 and time 2.

As predicted by our hypotheses, the results demonstrate that power disparity is a social force that challenges the multi-team system to increase its cognitive activity and to be fully engaged in the 'working mood'. Although the system experiences the beneficial role of task conflict and minority dissent, power disparity entails relational turmoil and reduces psychological safety between the parties involved. From a holistic perspective, our results bring important contributions to the group dynamics literature. Power disparity has been considered detrimental to the evolution of the system, mostly because it triggers conflict between groups (Gray & Schruijer, 2010). In this study, we demonstrate that power disparity can convert into a facilitator able to generate effective mechanisms for collaborative decisions. In line with Bion's view (1952), we assume that power asymmetry motivate the system to operate in the 'work-group mentality', a condition in which groups integrate the variety and manage their frictions effectively.

Chapter 6 addresses the interplay between employees and their multiple working teams. This work design is more and more adopted by modern organizations, that are challenged by global competitive pressures and as such, they aim to provide a wide variety of innovative services and products, by allocating the available resources effectively. Multiple team membership (MTM) is conceptualized as a situation in which working time is fragmented over multiple teams. Switching between team contexts implies that employees hold a variety of roles. Therefore, the present study builds on a multiple role perspective on MTM and draw on theories of role strain and role accumulation (Marks, 1977) to examine the impact of MTM on employee well-being. The role strain or "scarcity" perspective argues that engaging in multiple roles is detrimental to employees' well-being because shifting between roles is likely to result in role strain due to conflicting expectations or an overload of

demands (Goode, 1960). The role accumulation or "expansion" perspective argues that a multiplicity of roles holds the potential to enhance employees' well-being because they gain access to resources through multiple role enactment (Sieber, 1974). In order to contribute to the scant conceptual and empirical work in this area, this research integrates the two perspectives and systematically models the implications of multiple team membership for a set of job-related challenges and opportunities. More specifically, it uses as a framework the Job Demands-Resources model (Bakker & Demerouti, 2007) to explore the extent to which multiple team membership is a job demand (in terms of taskload, team process load and conflict with team members, resulting in job strain as a negative indicator of well-being) or a job resource (in terms of team social support and job autonomy, resulting in work engagement as a positive indicator of well-being) for employees.

The data were collected from employees working in a Romanian IT company that used multiple team membership as a work design (MTM is especially common in highly competitive settings such as IT; O'Leary, Mortensen, & Woolley, 2011). Our final sample consisted of 151 respondents. Participants were asked to fill out an individual questionnaire that contained items on demographic characteristics (gender, age, job positions) and asked respondents to report the number of teams they were members of and the percentage of time they allocated to each of these teams. In addition, the questionnaire contained items on job demands (task load, team process load, and conflict), job resources (team social support and autonomy) as well as job strain and work engagement. In order to explore the effects of working at the interface with multiple teams, we tested a path model that associated multiple team membership with a set of job demands and job resources, which in turn predicted employee well-being. Data analyses were performed using Structural Equation Modeling in AMOS version 19, a statistical technique that allowed us to test multiple (indirect) interrelations simultaneously (Byrne, 2010).

Our findings indicated that MTM was perceived as a job demand. Specifically, as members had to distribute their time more equally over a number of teams, they experienced their work as more demanding in terms of teamwork but not taskwork. It seems that when employees had a hard time distributing their personal resources (e.g., time and energy) to multiple teams, they experienced more demands associated with team processes (such as communication and coordination) as well as more interpersonal demands because of conflict with team members. Subsequently, employees who spent a considerable amount of time on multiple teams suffered from increased job strain. We did not find a positive association between the fragmentation of time across teams and task load (increase in the pace and volume of work). It is possible that various teams held a productive relationship with each other in such a way that time fragmentation did not simply add to the employee's workload but helped in executing tasks (Matthews, Whittaker, Moran, Helsley, & Judge, 2012).

The implication of our findings for practitioners is that teams and their members should receive support that facilitates working in multiple teams and somehow reduces the demanding nature of multiple team membership. First of all, teams need to be supported in their team(work) processes, and to this end organizations can assign team coaches to each team and provide teams with technology that facilitates processes such as communication and coordination. Our findings also point to conflict management as a key activity in teams that requires special attention when members spend only a limited amount of time on the team.

To conclude, the present compilation of studies makes several theoretical and methodological contributions regarding the interplay between the dynamics of different MTS levels (i.e. individuals, teams, interactions between the component teams and system-level attributes). Based on the innovative methodologies and group dynamics theoretical models, the cross-level effects could be observed and analyzed throughout four quantitative and qualitative studies. In addition, several suggestions are advanced for the design of future

practical interventions. The present studies mainly reveal the factors that contribute to the dynamics of different levels incorporated in MTS structures. As such, the practitioners, guided by these theoretical and empirical analyses, could adjust their interventions in the attempt to design effective adaptive systems. For instance, chapters 3 and 4 make a few suggestions related to the critical factors that contribute to the success of the MTSs in complex emergency situations: (1) the necessity of regular trainings and simulations in order to develop mental models about each other and to learn common procedures and ways in which effective coordination processes can be developed; (2) the integrator role assigned to MTS leaders; (3) the relevance of the technological equipment. The practical contributions of the next two chapters, 5 and 6, are centered mostly on the consultancy programs in which the facilitator should stimulate the groups to work with diversity and to integrate the variety in their processes (Gray & Schruijer, 2010). Power disparity and multiple team membership are both working conditions with positive and negative consequences as well. Therefore, the consultants should intervene and exploit the benefits and reduce the hindrances related to these attributes. For instance, conflict management and team-coaching interventions are expected to reduce job strain and the negative affectivity within and between the teams. Also, the organizational support is recommended to be highly developed in order to increase the individual well-being. The organizations could implement coaching and training interventions for employees and their teams as well as providing instrumental support (i.e. adequate communication technology) in order to facilitate the collaboration between the different entities (i.e. individuals, teams) within the system.

The idea of the current dissertation has derived from the practical reality, in which a wide range of organizational forms (i.e. teams of teams; human - robot teams) has emerged and their need for effective interventions has increased as well (Salas, Cooke, & Rosen, 2008). More and more organizations ask for consultancy programs that are expected to

improve their teamwork processes. The present studies therefore answer these calls and address the gap between research and practice by contributing with evidence-based suggestions intended to enhance the performance of various configurations of multi-team systems (i.e. emergency, collaborative, custom development).

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