

"Teams Made of Teams"—A Review of Research on Multi-Team Systems

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Abstract: *The reason teams are so popular today is that as organizations reorganize to compete more effectively, they see them as a way to better leverage the talents of their employees. Teams can make products, deliver services, negotiate, coordinate projects, make recommendations, and make decisions. Next, let's briefly describe the four most common types of teams in organizations: problem-solving teams, self-managed teams, cross-functional teams, and virtual teams. Then, introduce the multi-team system, which uses a "team of teams" model. Such systems are becoming more common as the complexity of work increases. Multi-team collaboration is one of the effective ways to handle complex environments and accomplish dynamic tasks. It has been widely used in the field of cooperative R&D and emergency management, and has become an important topic of common interest in the practice and academic communities. This paper synthesizes previous research on multi-team systems and presents some suggestions and future research directions for MTS.*

Keywords: *multi-team systems; organizational behavior; system performance*

1. Introduction

Several decades ago, when Gore, Volvo, general foods and other companies introduced teams into their production process, it caused a sensation because few companies did so at that time. Today's situation is quite the opposite. Enterprises that do not adopt teams can become news hot spots. Work teams can be seen everywhere.

The reason why teams are so popular today is that when organizations restructure in order to compete more efficiently, they regard teams as a better way to use employees' talents. The management found that in a changing environment, the team is more flexible and responsive than the traditional department structure or other forms of long-term departments. Teams can quickly assemble, configure, Refocus, and disband. However, the team has another role that cannot be ignored - motivation. The team can promote employees to participate in front-line work decisions. Therefore, another explanation for the prevalence of teams is that they are an effective means for the management to enhance the democratic atmosphere in the organization and improve the enthusiasm of employees.

2. Types of Teams

Teams can make products, deliver services, negotiate, coordinate projects, make recommendations and make decisions. The following are the four most common types of teams: problem-solving teams, self-managed teams, cross-functional teams and virtual teams.

2.1. Problem-solving teams

In the past, the team was generally composed of 5-12 employees from the same department. They spent several hours a week in meetings to discuss how to improve product quality, productivity and work environment. In such problem solving teams, members exchange views or make suggestions on how to improve work procedures and methods; however, these groups have little power to unilaterally implement any of their recommendations.

2.2. Self-managing teams

Self-managed work teams are usually composed of 10-15 people. They are engaged in closely related or complementary work and assume many responsibilities previously undertaken by their supervisors. Generally speaking, their responsibilities include: planning and arranging work schedule, assigning work tasks to members, making front-line work decisions, taking measures against problems, and dealing with suppliers and customers. A fully self-management team can even choose its own team members and let them evaluate each other's performance. As a result, the importance of the supervisor has declined, and sometimes the position can even be cancelled.

2.3. Cross-functional teams

In order to develop its instant coffee brand via, Starbucks has created a special team, which is responsible for every link from production, global public relations, global communications to marketing in the United States. The product created by the team is cost-effective in production and distribution, and adopts a closely integrated and multifaceted marketing strategy. This example illustrates the use of cross functional teams. This kind of team is composed of employees from different work areas at the same level of the organization, who work together to complete a task.

Cross functional teams enable employees in different fields within the organization (even in different organizations) to exchange information, inspire them to adopt new methods to solve problems, and work together to complete complex projects. Of course, managing a cross functional team is not like managing a picnic. It often takes a lot of time in the early stages, because team members need to learn to cope with complexity and diversity. It takes time for members, especially those with different backgrounds, experiences and views, to build trust and truly work together.

2.4. Virtual teams

All the previous team types work face-to-face. Virtual teams are working teams that use computer technology to connect members scattered in different places to achieve a common goal. In a virtual team, members cooperate "online". For example, through broadband network, videoconference system, e-mail and other communication methods, whether they are only separated by a wall or thousands of mountains and rivers. Now, the technology has been so advanced and virtual teams are so popular that it may not be appropriate to call them "virtual". Today, almost all teams do some remote work.

So far, the types of teams we have described are usually small independent teams, but their activities are related to the overall objectives of the organization. When the task becomes more and more complex, the team size will become larger. With the increase of team size, higher coordination requirements will follow, resulting in a critical point. Once this point is exceeded, the joining of new members will cause more harm than good. In order to solve this problem, organizations began to adopt a multiteam system, gathering two or more independent teams to jointly achieve a higher-level goal. In other words, a multiteam system is a "team of teams".

3. Cutting-edge research in MTS

3.1. Definition of MTS

Marks et al. argue that MAT consists of multiple teams, each of which works together with at least one other team in a highly interdependent context ^[1]. Although these constituent teams have independent near-term goals, they all share the same distal goals, which inherently require interdependent team coordination to achieve. The success of an MTS is defined as the achievement of distal goals. Another core element is that MTS is not constrained by traditional organizational boundaries, but can be composed of teams from different, collaborating organizations.

Research on multi-teams has also been conducted at multiple levels, for example, Dechurch et al. explored the issue of shared leadership of multi-teams at the holistic level ^[2]; Kennedy et al. explored communication and coordination mechanisms among teams at the subteam level; and Wombacher et al. explored multiple identities and cross-boundary behaviors of members at the individual level. However, the current studies are mostly developed based on a particular story line, leading to a lack of understanding of the holistic qualities of the operation of multi-team cooperation models, which inhibits the development of theories related to multi-team cooperation. Under a systems perspective,

Marks et al. have further defined multi-team cooperation as a multi-team system, breaking through the focus of previous studies on the phenomenon of multi-team cooperation and emphasizing that the holistic nature of multi-team, inter-team and intra-team cross-level associations and interactions should be fully considered^[1].

3.2. Analysis on the evolution path of multiteam theory research

3.2.1. Foundation Stage

The period from 2001 to 2006 was the foundation phase. This phase of research was dominated by MTS collaboration and leadership research, with computer simulations of fighter jet flight simulation experiments as the main research method. Marks et al. explored the effects of cross-team processes and intra-team processes on MTS performance in MTS, noting that cross-team processes positively affect MTS performance more than intra-team processes^[1]. Dechurch et al. divided the functional leadership behavior of MTS leadership teams into two dimensions, strategy formulation and collaboration facilitation, and applied a computer simulation of a fighter jet flight simulation experiment to confirm the positive impact of both dimensions of functional leadership behavior on multi-team performance, in addition to the mediating role of cross-team collaboration^[3]. The literature distinguishes multi-team systems from single teams in terms of interaction processes and leadership mechanisms, explains the importance and complexity of inter-team interaction processes in multi-team systems, and lays the theoretical foundation for subsequent empirical studies.

3.2.2. Deepening stage

The period from 2007 to 2013 is the deepening phase. Two important features of this phase are: first, the research on MTS collaboration and the connotation and mechanism of MTS leadership continues to be deepened; second, the current MTS research results are summarized in a phased manner. Empirically, Dechurch et al. for the first time inferred that leadership teams have the functions of strategy formulation and collaboration facilitation at three levels of multi-team systems: unit teams, multi-team systems, and cross-multi-team systems through historical econometric analysis, and confirmed the facilitative effects of strategy formulation and collaboration facilitation on multi-team processes, performance states, and performance^[3]. In addition, Davison et al. used the Air Force Leadership Development Simulation Experiment paradigm to distinguish six collaborative behaviors in MTS and found that horizontal collaboration between unit teams had a negative impact on MTS performance and vertical collaboration between unit team boundary managers and MTS leaders had a positive impact on MTS performance only when the solution situation required that team to accomplish critical tasks^[4]. The study illustrates that there are significant differences in the effects of collaborative behaviors between functionally distinct teams (e.g., executive team, logistics team, boundary management team, and leadership team) in multi-team systems on multi-team performance, with the facilitation of collaboration between unit teams that directly handle tasks being stronger than the facilitation of collaboration between leadership teams. Currently, multi-team systems are an important organizational approach for government emergency relief systems, large corporations, and financial institutions when they face difficult challenges, and measures to enhance collaboration among leadership teams would also be one way to improve multi-team performance.

3.2.3. Diversification stage

The period from 2014 to the present is the stage of diversified development of MTS. Compared with the previous two phases, the theoretical research of MTS in this phase has been greatly enriched in terms of groups, contents, methods, and research objects. Structural characteristics of multi-team systems, collaboration mechanisms, and applications in health care became the focus of attention during this period, and case studies and computer simulation experiments were the main research methods. Loblaw et al. provided the first description of clinicians' inter- and intra-group interaction processes from a cancer care perspective and suggested that by identifying goals, roles, and managing the interdependence of inter- and intra-team tasks can facilitate clinicians' attention to patients and care collaboration processes to advance quality of care^[5]. This study was conducted with cancer patients, and the results all show the importance of inter-team communication and cooperation in multi-team systems compared to individual-to-individual communication and cooperation required within a single team, and the need to improve inter-team collaboration mechanisms in multi-team systems for the treatment of major diseases. De Vries et al. verified that vertical collaboration behavior enhances the positive effects of intra-team functional diversity on horizontal collaboration and reduces the negative effects of intra-team functional diversity by conducting a computer simulation experiment with 236 MTS in

groups of 14 people^[6].

3.3. Categories of MTS

According to organizational boundaries, multiteam systems are divided into internal MTS and cross boundary MTS. The intra organization multiteam system consists of teams within the same organization, and the cross organization multiteam system consists of teams across different organizations ^[7]. Intra organizational multiteam system has more similar value, motivation and cognitive system than cross organizational multiteam system; The cross organization multiteam system faces higher complexity than the intra organization multiteam system.

According to the establishment method, the multiteam system is divided into appointed MTS and emergent MTS. The assigned multiteam system is established based on the appointment to complete specific tasks, and the emergent multiteam system is temporarily established without prior planning^{[8][9]}. The designated multiteam system usually has a specific and formal structure design at the leadership setting, workflow and goal levels, while the emerging multiteam system has a flexible structure of self-organization and self-management.

3.4. Differences between MTS and other organizational forms

Network organization is an organizational form very similar to multiteam system. It is defined as an organic organizational system composed of network connections of active nodes. The active nodes of network organization can be organizations, teams or individuals, and each node can be homogeneous or heterogeneous.

Network organization and multiteam system have the following common points: first, the common origin, that is, to cope with the dynamic and complex environment and tasks; Second, the overlapping research scenarios, that is, the connection form of Inter Organizational team cooperation, can be defined as network organization or multiteam system. However, there are still many differences between the two. In order to avoid confusion, this paper compares the multiteam system and network organization from seven aspects: discipline background, theoretical dimension, constituent units, node similarities and differences, node relationships, application fields and research topics. Specifically, the discipline background of network organization is economics. Economists believe that network organization is a transcendence of the dichotomy of market and enterprise in the new institutional economics; The discipline background of multiteam system is organizational behavior. Network organization is a medium macro theoretical perspective, while multiteam system is a medium micro theoretical perspective. The basic unit of network organization is mainly enterprise (i.e. organization), and the basic unit of multiteam system is team. The functions among the enterprises constituting the network organization can be homogeneous or heterogeneous; However, the teams in the multiteam system have different functions. The relationship between enterprises in network organization is loose or close; However, teams in a multiteam system are highly interdependent. The application field of network organization is industry and commerce; The application field of multiteam system is relatively wide. It can be applied not only in the industrial and commercial field, but also in the scientific research field, emergency management field, military field and other fields involving team cooperation. Due to the above differences, scholars' research topics are also different. By searching the relevant literature, we can see that the research topics related to network organization mainly include industrial clusters, enterprise competitive advantage, network governance, etc; The research topics of multiteam system are more micro, such as leadership, collaboration, shared mental model, etc.

In addition, the multiteam system is easily confused with multi-functional teams and matrix organizations. Although multi-functional teams and matrix organizations have emerged to cope with today's complex and dynamic environment, and also have the characteristics of flexibility and adaptability, they are still qualitatively different from multiteam systems. In order to avoid confusion, this paper compares multiteam system with multi-functional team and matrix organization from three aspects: composition, objectives and inter team relations. Specifically, the biggest difference between the multiteam system and the multi-functional team is that the multiteam system has hierarchical multi-objective, while the multi-functional team has only one objective; Compared with the matrix organization, the biggest feature of the multiteam system is that the teams are highly dependent on each other to achieve the shared goals, while there is no shared goal among the project teams that constitute the matrix organization.

3.5. Research topics for multi-team systems

The main reason for the emergence of the organizational form of multiteam system is to complete the objectives quickly and well. It has been widely used in the field of cooperative R & D and emergency management. The focus of cooperative is to pursue "good", and the focus of emergency management is to pursue "fast". Based on such practical differences, scholars' research topics also have their own emphasis. Therefore, this paper combs the characteristics and common problems in different situations and the different research perspectives of scholars.

3.5.1. MTS under cooperation

In the context of cooperative, the emergence of multiteam system is a collaboration based on social division of labor, and an effective way to decompose complex and huge tasks. In cooperative, how to achieve effective collaboration and efficient communication among teams are important practical issues. In addition, leadership issues, team cohesion issues, and the balance between creativity and time efficiency are also worthy of attention. Scholars study how to achieve effective collaboration among teams from the aspects of collaboration types and strategies, structural consistency, commitment level and the impact of intra team cooperation quality on inter team collaboration^[10]; Study how to achieve effective communication between teams from the aspects of team proximity, time pressure and partnership^{[7][11]}; From the perspective of the different roles played by sub team leaders and system leaders in different stages of the project, this paper provides some useful suggestions for the multiteam system leadership^[12]; From the perspective of individual self-management ability, this paper analyzes how the multiteam system can improve cohesion^[13]; How to balance the relationship between system creativity and time efficiency is solved from the communication density of formal communication network and informal communication network and its impact on coordination^[14].

3.5.2. MTS under emergency management scenario

Under the emergency situation, each sub team participating in the emergency is facing a high degree of time pressure, and at the same time it has to complete life-threatening tasks. Under such dual pressures, it is difficult to achieve cooperation among teams^[3]. Multiteam system in emergency situation is a management organization form that integrates sub teams to make them cooperate effectively. In emergency situations, how to act when individuals face inconsistent goals, how to effectively cooperate among teams, and how to improve the adaptability of multiteam systems in emergency situations are important practical issues. In addition, how to deal with efficiency issues, leadership issues and cross team activities are also very noteworthy. Scholars have analyzed individual behavior in the face of goal conflict from the perspective of trust, commitment and identity^[15]; Studied how to cooperate among teams from the aspects of goal consistency and shared leadership^{[8][9]}; The leadership function of multiteam system is analyzed from the perspective of functional leadership theory^[3]; The influencing factors on members' cross team behavior were analyzed from the aspects of psychological safety, leadership tolerance and status^[8].

MTS in cooperative situations usually has top-down members, tasks, goals and structural specifications, while MTS in emergency situations usually has bottom-up cooperative teams and the establishment of emergency goals and structures. These types may differ significantly in governance structures, coordination processes, and emergencies. For example, an emergency MTS team may be forced to work together because of an upcoming or recent crisis, or may choose to cooperate to achieve common desired goals^[1]. Relevant foreign literature has not paid attention to how to form MTS, especially in the case of emergency MTS, how to form binding cooperation agreements and contracts.

3.5.3. Other aspects of individual level input

Other aspects of individual level input, such as individual demographic characteristics, personality and values, may also have a positive or negative impact on the operation of the multiteam system. In addition, there are also top-down and bottom-up interaction among the inputs at the system level, team level and individual level. Top down impact. For example, when the goals of the system layer change, if the team functions or the skills of individuals in the team do not match the changed goals, the replacement of the team or individuals will occur. Bottom up impact. For example, when the boundary manager changes, the status of the team may change with the authority level of the boundary manager.

4. Multiteam system performance

Since the theory of multiteam system was put forward in 2001, more and more researchers began to

study the performance of multiteam system, and the research on MTS performance is booming. However, Lanaj et al. pointed out that the multiteam system is neither a traditional team nor a standard large organization^[16]. Therefore, the theoretical and empirical results in the traditional team and organization literature may not be extended to the multiteam system environment. In order to more fully clarify the knowledge base of the multiteam system, it is necessary to expand the theoretical construction and empirical research. Hoegl and weinkauf found that MTS' leadership hindered the performance in the first stage, but benefited in the later stage^[10]. Marks et al. found that leadership training can improve functional leadership, which is positively related to MTS performance, and leadership intervention at the team level can not promote MTS performance^[17]. Only leadership intervention at the multiteam level can achieve the desired purpose. Millikin et al. found in the research on multiteam system of American multinational semiconductor companies that the self-management of their members will promote the performance of their multiteam system, and the cohesion plays a regulating role on the two^[18].

In the field of multiteam research, different scholars have given different restrictions on the performance of multiteam system based on different research objects. Marks defined the performance of the emergency rescue multiteam system as rescuing the dying and healing the wounded^[1]; Magnus & DeChurch limited the performance of the fire rescue multiteam system to fire fighting and rescue^[19]; Wagner & Hollenbeck limited the performance of the multiteam system to destroying the enemy and preventing their own aircraft from being shot down and their bases from being destroyed in the experimental research conducted by the selected US Air Force captains^[20].

Based on the above, although different scholars have made different restrictions on multiteam system performance based on different research objects, there is still no clear definition of multiteam system performance. The multiteam performance introduced in this paper generally refers to the results achieved at the multiteam level.

5. Conclusions

Scholars have conducted in-depth research on the multiteam system from different perspectives with different research methods. Through combing the existing research, it is found that: in terms of research methods, they mainly focus on experimental research, quasi experimental research and case study; At the level of research topic, it mainly focuses on the system effectiveness in the context of multiteam system, and pays less attention to the interaction within the team and between teams; In terms of the content of the research topic, more attention is paid to the input and behavior process of the multiteam system, and less attention is paid to the impact mechanism of the emergence state. Therefore, due to the limitations of current research methods and research topics, as well as the complexity of the multiteam system itself, this paper believes that the future research can be carried out from the following aspects.

5.1. Research methods

First, multiteam system simulation research. multiteam system has the basic characteristics of system and is suitable for the analysis method of system theory. Based on this, software platforms such as repast, swarm and net logo are used to simulate the operation of multiteam system, which can explain and analyze very complex situations.

For example, analyze multiple systems at the same time or over time. Simulation analysis is an ideal method for preliminary analysis of multiteam system operation. However, due to the unnatural nature of simulation, subsequent research on the real world is still needed.

Second, the social network research of multiteam system. Using the analysis method of social network to pay attention to the nodes, connections and network structure in multiteam system is helpful to understand the meso phenomenon of multiteam system. Social network analysis can not only insight into the bottom-up influence of individuals, teams and systems, but also provide top-down information. At present, the research on the network structure of multiteam system only involves the leadership network structure and communication network structure, and there are many gaps in the research on other network structures. In the future, we can carry out in-depth research on such aspects as trust structure and power structure.

5.2. Research topic

First, in team research research in the context of multiteam system. The form of multiteam cooperation is becoming more and more common. The current research is lack of what will affect the team participating in multiteam cooperation and how to deal with it. Therefore, paying attention to the situation within the team in the context of multiteam system has certain practical and theoretical significance.

Second, the study of interaction mechanism within and between teams. There are two forces of integration and confrontation within and between teams. What factors benefit or damage both within and between teams, what factors benefit the team but damage the system, and what factors benefit the system but damage the team have not been fully explained in the current research. Therefore, it has profound practical and theoretical value to pay attention to the interaction mechanism between teams and within teams.

Thirdly, the research on the affective and cognitive mechanism between teams. The current research on the operating mechanism of emotion and cognition is relatively scarce. In terms of cognition, there are still research gaps in research topics such as shared situation awareness and shared information bias; In terms of emotion, the research topics such as pressure and motivation also need to be further explored by scholars.

It has been nearly 20 years since the development of multiteam system theory, and the related research has made some progress and achievements, but it has not yet formed a perfect and complete theoretical system. With the flexible use of research methods, the continuous expansion of research perspectives and the continuous enrichment of research content, the sustainable development of multiteam system research will continue to be promoted in the future.

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