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ORIGINAL RESEARCH

A Study of the Developmental Mechanisms of Inter-Team Conflict Processes Within Multi-Team Systems - An Exploratory Analysis Based on a Collaborative R&D Context

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Purpose: The analysis of the pivotal determinants that impact the progression of inter-team conflict processes in multi-team systems, as well as their underlying mechanisms, serves to explicate the developmental framework of said conflict processes.

Methodology: This study adopts a vantage point centered on the evolution of inter-team conflict in multi-team systems, with a specific focus on the sequential progression including "conflict latency → conflict perception → conflict management → conflict outcome → conflict feedback.

Results: By transmuting qualitative data into quantitative data through the discernment of inter-conceptual relationships' directionality and quantity, this study distills the key chain of relationships between categories. Employing the explanatory structure model, the developmental mechanism of inter-team conflict processes in multi-team systems is unveiled. Notable sources of conflict include team goal identification, team role multiplicity, inter-team relationships, and team competence. Factors that exert a significant influence on conflict management comprise inter-team conflict types, inter-team relationships, team competence, inter-team heterogeneity, team affiliation, and system goals. Reviewing the genuine motivations underlying conflict management behavior, as well as adopting a lengthier temporal perspective, emerges as a crucial consideration when analyzing the implications of conflict management on both the system and the team for evaluative purposes. Inter-team communication emerges as a pivotal influence on the efficacy of conflict management, which, in turn, is influenced by boundary managers, inter-team heterogeneity, and the inter-team interactive memory system.

Conclusion: Through an in-depth analysis of the hierarchical interrelationships among factors that influence conflicts within teams, we have established a model for the conflict development process. This model is instrumental in comprehensively understanding the dynamics of conflict evolution within teams. It serves as a reference point for formulating more precise and effective conflict management strategies. Moreover, this model not only offers practical guidance for resolving conflicts within a multi-team framework but also enhances inter-team collaboration. Therefore, it contributes significantly to achieving the objectives of the multi-team system.

Keywords: multi-team systems, conflict processes, developmental mechanisms, explanatory structural models

Introduction

In the contemporary complex and unpredictable operational environment, there is a critical need to improve organizational agility and efficiency. In response to this, the implementation of collaborative efforts across multiple teams has become increasingly common as a strategy to address these changing conditions and demands. Mathieu conceptualizes this approach as a Multi-team System (MTS) from a systemic perspective[1]. This view underlines the inherent systemic characteristics of an MTS. Considering the diversity in knowledge, skills, and roles among the various sub-teams within a multi-team system, inter-team conflicts are a frequent occurrence. These conflicts are especially prominent in cross-organizational multi-team systems, where differences in organizational cultures and values are more acute.

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Present studies on inter-team conflict within multi-team systems tend to either focus narrowly on analyzing segmented influences or limit themselves to merely describing the stages of inter-team conflict. Such approaches often overlook the comprehensive understanding of the dynamics involved. For instance, certain studies have focused on the impact of team commitment and profit distribution on inter-team conflicts.[2] Walter et al conducted research on the role of individual emotion regulation in transforming task conflicts and process conflicts into relationship conflicts.[3] They also made preliminary explorations into individual perceptions of task and process conflicts, including the probability of process conflicts evolving into team relationship conflicts. Paul et al noted the importance of sensitively perceiving and understanding conflicts within multi-team scenarios, though they did not extensively delve into this topic.[4] The academic community generally agrees on the crucial importance of managing multi-team conflicts in multi-team systems, but more exploratory research is needed on the complete developmental process of inter-team conflicts.

The study of the developmental path of the inter-team conflict process can facilitate a systematic and comprehensive understanding of inter-team conflict in multi-team systems, enabling a better understanding of its nested nature and complexity. In addition, it can provide theoretical guidelines for extensive quantitative empirical research. Inter-team conflict in multi-team systems comprises not only the two teams involved but also the entire system, thereby constituting a form of nested conflict.[5] Such nested conflicts entail system goals that necessitate collaborative efforts for achievement, rendering inter-team conflict management more complex than a mere matter of cooperation or non-cooperation.[6] Therefore, it is not feasible to replicate the findings of interpersonal conflict processes. Hence, this paper appraises the development of the "conflict latency → conflict perception → conflict management → conflict outcome → conflict feedback" process from the perspective of inter-team conflict in multi-team systems. The ensuing research to address the following questions: How does the inter-team conflict process evolve in a multi-team system? What are the pivotal factors influencing the developmental stages of inter-team conflict?

In response to the aforementioned research questions, an exploratory study of classical rooting theory is conducted in this paper. The study involves an in-depth analysis of a cooperative R&D reality situation involving multiple teams. Qualitative data is subsequently transformed into quantitative data by means of substantive and theoretical coding, taking into account the direction and quantity of inter-concept relationships. By employing the explanatory structural model methodology, a multi-level structural model is constructed. The model is then refined to explain the hierarchical arrangement of concepts, categories, and relationships, thereby identifying key factors that influence the progression of inter-team conflict processes in multi-team systems. Furthermore, the mechanisms of action underlying these factors are analyzed, thereby offering valuable insights for the practice of multi-team management.

The marginal contribution of this article lies in:1) This paper offers a systematic and comprehensive analysis of the evolution of conflicts among teams, addressing previously identified gaps in the understanding of conflict dynamics within team collaborations. It introduces a novel research angle, focusing on conflict to further study multi-team system cooperation, thereby contributing to the evolution of collaborative theories in multi-team environments. 2) Recognizing the complexity inherent in multi-team systems, this study acknowledges the limitations of applying traditional inter-personal conflict theories, which are primarily individual-centric, to these systems. It conducts a scientific breakdown of conflict progression between teams and proposes new models for understanding these dynamics. By examining the interrelationships and impact factors between different stages of team conflicts, the study makes significant strides in advancing conflict theory. 3) Employing grounded theory, the research identifies key factors influencing inter-team conflicts. These factors are conceptualized and theorized based on frameworks such as interactive memory systems, role theory, and boundary management theory. This approach not only deepens the understanding of these factors but also expands the application scope of the aforementioned theoretical frameworks. 4) Rooted in real-world scenarios, this study delves into the practical aspects of multi-team collaboration development. It presents a more systematic and detailed perspective on inter-team conflicts, grounded in practical contexts. This approach offers valuable insights for selecting optimal conflict management strategies in multi-team systems.

Review of the Literature

Inter-Team Conflict Within Multi-Team Systems

Research pertaining to inter-team conflict in the context of multi-team systems remains predominantly qualitative in nature, with only a limited number of empirical studies conducted thus far. Scholars have employed various search terms, such as "multi-team system conflict", and "inter-team conflict", to explore this subject matter. For instance, drawing upon social identity theory, some studies have assessed the impact of team members' dual identities on the management of inter-team conflict.[7] Additionally, studies grounded in resource allocation theory have explored how mechanisms of profit distribution influence inter-team conflict.[2] Moreover, analyses based on power distance theory have studied the effects of inter-team conflict on the power structure within teams.[8] Betts and Hinsz propose that inter-team conflict in multi-team systems can also be evaluated from the perspectives of intergroup relations, information exchange, role configuration, and shared representations.[9]

Intergroup Relations Perspective

Premised on the tenets of self-categorization theory, it has been posited that when teams characterized by distinct identities engage in interactions, a propensity for in-group favoritism and out-group hostility arises. In other words, team members tend to ascribe positive attributes to their own team while simultaneously denigrating the opposing team and its members, particularly when conflict remains latent.[9] It is crucial to acknowledge that this difference in intra- and inter-team reactions is not precipitated by any actual event, but rather by their inherent group identity. A commonly employed remedy for conflict resolution from intergroup relations is the "contact hypothesis", which involves enhancing opportunities for inter-team contact within a multi-team system to enhance mutual understanding. However, in certain instances, frequent contact may exacerbate conflict. Presently, garnering buy-in from all team members towards a shared objective is deemed a more efficacious approach, involving directing the team's attention, as well as that of its members, towards system-level goals and fostering buy-in and commitment to the common objective.[10]

Information Exchange Perspective

Drawing upon the theory of interactive memory systems, it has been posited that the presence of such systems contributes to effective and efficient information exchange among teams, whereas their absence renders inter-team conflicts more likely.[11] Interactive memory systems embody the possession of information across teams. They include the necessary expertise and a well-defined division of labor among teams, involving a clear understanding of the specific information and knowledge requisite for a given task, as well as the ability to assign specific tasks to particular teams and their members. Interactive memory systems include specialization, distribution mechanisms, and coordination mechanisms for information exchange between teams. To surmount conflicts arising from the absence of an interactive memory system, it has been suggested that emphasizing a shared identity among teams, cultivating identification with a collective pursuit of system-level goals, and fostering trust among teams are valuable measures.[12] Furthermore, it has also been observed that implementing pertinent training for boundary managers, enabling them to serve as pivotal conduits for inter-team information exchange, can enhance such exchange and foster inter-team collaboration.[13]

Role Configuration Perspective

Based on the tenets of role conflict theory, it has been posited that teams operating within a multi-team system assume distinct roles that contribute to the attainment of shared objectives. However, when inter-team role conflict or role redundancy arises, it can contribute to inter-team conflict. Role conflict occurs when tasks are delegated to teams other than the intended recipients, thereby jeopardizing the social identity of the intended team and its members. Therefore, this state of role conflict may give rise to dissatisfaction among team members and foster inter-team discord, thus resulting in conflict.[14] Role redundancy, on the other hand, occurs when multiple teams or team members are assigned similar or identical roles. This redundancy also poses a threat to the social identity of the team and its members, thereby intensifying competition between teams and potentially leading to conflict.[15] This perceived threat amplifies inter-team competition and may eventually precipitate conflict. To preempt and mitigate conflicts arising from role configuration, it

is necessary to establish role definitions at the outset of a multi-team system and periodically reaffirm or redefine these roles.

Shared Representation Perspective

Drawing from the principles of shared mental model theory, it has been observed that inter-team conflict may arise when shared mental models fail to materialize or when misalignment occurs. Shared mental models denote a collective understanding among teams regarding each other's anticipated conduct. In the context of a multi-team system, the expected behavior model comprises task procedures, subteam characteristics and their members, anticipated inter-team interactions and coordination patterns, as well as strategies, etc.[16] To alleviate conflicts from inadequate or erroneous shared mental models, several remedies can be employed. These include explicitly defining the responsibilities of each team and ensuring understanding among all relevant parties, as well as providing pertinent training to facilitate the formation of shared mental models.

Conflict Process Study

The current research primarily focuses on individual conflict in the conflict process. Conflict has consistently served as a crucial research component in the field of organizational management, with the inception of conflict process research dating back to 1967 when Pondy introduced the five stages of conflict development.[17] Subsequently, Korsgaard and other scholars delved into the stages of the conflict process.[18] These studies, centered on the conflict process, have been grounded in the framework of the five stages of conflict development. However, the existing research findings are not applicable when the subject of conflict shifts to a team. Therefore, this study seeks to define the stages of the conflict process in a team context, assess the interrelationships between these stages, refine novel propositions, and construct a fresh theoretical model of the conflict process, thereby yielding significant theoretical implications.

Data Collection and Analysis

Adhering to the research approach of "natural emergence", this study embarks on an exploratory study of classical rooting theory in the context of multi-team collaborative R&D. Through qualitative analysis, the qualitative data undergoes conversion into quantitative data, employing the direction and quantity of inter-concept relationships. Subsequently, employing the explanatory structural modeling method, a multi-level structural model is formulated to extract the pivotal pathways and influential factors governing the development of inter-team conflict processes in multi-team systems.

Data Collection

Root theory, as a theoretical framework, seeks to systematically collect and analyze data in order to gain profound insights into real-world predicaments and provide guidance for practical activities. Among the three branches of root theory, classical root theory stands out as the most "rooted", emphasizing the necessity of preserving the state of "natural emergence" during the formulation and construction of theories. It is particularly well-suited for the study of social processes. [19] It should be emphasized that we have obtained the informed consent of all participants in this study, including the publication of anonymous responses. The applicability of classical root theory to the study of social processes is highly pronounced. The data collection process comprises two distinct phases: the initial sampling phase and the theoretical sampling phase. The initial sampling phase primarily focuses on exploring pertinent research questions. To ensure a diverse range of responses and prevent homogeneity, the sample is selected based on their involvement in cross-organizational multi-team collaborations, without imposing any restrictions on their specific roles. The detailed information of the interviewees can be found in Appendix A. In this initial sampling phase, a total of ten respondents, including team leaders, team members, and organizational leaders, were interviewed. The primary interview questions were as follows: (1) describe two to four cross-organizational multi-team collaboration projects in which you have participated; (2) enumerate instances in which the collaboration process unfolded smoothly; (3) enumerate instances in which the collaboration process encountered difficulties.

The Theoretical Sampling Phase, with a focus on validation, was undertaken to achieve two primary objectives. Firstly, it aimed to ensure the sufficiency of data collection, specifically gathering a volume of data that would satisfy

theoretical saturation. This was crucial in transforming the initially established theoretical framework into a fully developed theoretical model. Secondly, it aimed to guarantee the validity of the collected data by ensuring that each argument was supported by at least two pieces of evidence. This approach served to enhance the credibility of the theoretical model. Following the clarification of the research question, "What is the process of inter-team conflict within multi-team systems?" at the conclusion of the initial sampling phase, the subsequent step is to identify boundary managers as interviewees for theoretical sampling. Boundary managers, or team leaders, act as crucial interfaces between their team and others, thus possessing a deep understanding and experience of inter-team conflicts. This makes them appropriate candidates for interviews. Organizational leaders, while they oversee key aspects of inter-team collaboration, typically have a limited understanding of the complex details of these interactions. Moreover, not all team members are involved with external teams during the inter-team collaboration process. Therefore, to optimize interview efficiency, the decision is to concentrate the interviews on boundary managers. During the Theoretical Sampling Stage, a total of 16 boundary managers were interviewed. These interviewees represented various institutions, including universities, research institutes, large state-owned enterprises, and large private enterprises. The detailed information of the interviewees can be found in Appendix B. The industries covered in the interviews encompassed Internet, aviation, construction materials, robotics, medical equipment, new energy, and chemical industry, among others. To optimize interview efficiency and obtain more insightful information, structured interviews were conducted during the Theoretical Sampling Stage, specifically employing the RGT interview technique. The RGT procedure followed a specific sequence: (1) The respondents were requested to provide a brief introduction to 2–3 cross-organizational multi-team collaboration projects that had left a lasting impression on them. (2) The respondents were then asked to recall 2–3 individuals from each project who had made a significant impact, whether from their own team or from other teams. (3) The respondents were invited to participate in a comparison game (wherein they were instructed to write the names of the individuals they had recalled on cards. Subsequently, three cards were randomly selected, and the respondents were asked to categorize them into two groups and provide explanations for their classification). (4) During the comparison game, the interviewer employed the Laddering method to elicit as much information as possible from the respondents (utilizing follow-up questions such as "why", "how", and "how"). This process was repeated with three newly selected cards until the interviewees no longer presented novel ideas or displayed evident disinterest in explaining their grouping rationale. Finally, the audio recordings from the interviews amounted to approximately 2500 minutes in total length. The compiled text version of the interviews yielded an effective word count of approximately 400,000 words. The text version of the interviews underwent a first transformation with the "Xunfei" conversion tool, followed by a thorough review and organization by the interviewer. Subsequently, the text version was returned to the interviewees, who were invited to verify the completeness and authenticity of the content, thereby ensuring the validity of the data.

Coding

The coding process of classical rooting theory comprises two major steps: substantive coding (which itself consists of two steps, namely open coding and selective coding), and theoretical coding. In this study, the utilization of NVIVO 11 qualitative analysis software facilitated the execution of open coding. Each interview transcript was read carefully, with an analysis conducted on a word-by-word and line-by-line basis. The data were then conceptualized using abstract terminology. Throughout the open coding process, a continuous comparison of concepts ensued, leading to the emergence of categories. Once the core categories materialized, the analysis transitioned to the selective coding phase, wherein only data closely associated with the core categories were chosen for coding. No novel concepts or categories were generated during this phase. Considering that the existing core categories sufficiently explicate the inter-team conflict process within the multi-team system, they were deemed saturated, thereby concluding the selective coding phase. Following the saturation of the core categories, the analysis proceeded to the theoretical coding stage, which involved a comprehensive exploration of the relationships between the concepts and categories derived from the substantive coding process. These relationships were then organized to form the prototype of a theoretical model. Concurrently, the researcher engaged in an extensive dialogue with the existing literature, thus leading to the development of a model explaining the development of inter-team conflict processes within a multi-team system. The core category, "development of inter-team conflict processes in multi-team systems", was substantiated by 992 codes across

nine levels. Furthermore, by aggregating the number of relationships using level 8 codes as elements, a total of 227 pairs of relationships were obtained. The large number of codes and the complex inter-code relationships impede the extraction of a clear pathway for the development of inter-team conflict processes. Therefore, this study eliminated relationships and related codes that lacked sufficient evidential support. Employing the explanatory structural model approach, a multi-level structural model was constructed, thereby distilling the key pathways and influencing factors governing the development of inter-team conflict processes within a multi-team system.

Explanatory Structural Model

Interpretative Structural Modeling (ISM) is a research methodology rooted in system science, employing a topological approach to assess the constituent elements of a complex system, as well as the direct and indirect relationships among them. Finally, this method explains the hierarchical arrangement of elements and the orientation of their relationships through the utilization of a directed daisy chain diagram.[20] The Explanatory Structural Model (ESM) is a pivotal tool for analyzing system engineering models. Originally developed by Professor Warfield in 1973, it has increasingly found application in socio-economic fields and has evolved significantly since. This paper delves into the logical connections and hierarchical organization inherent in the elements of inter-team conflict. By transforming these complex elements into clear structural models, the ESM proves to be an apt analytical methodology for this study. This approach effectively simplifies complex relationships into understandable models, making it highly suitable for analyzing the nuances of team dynamics and conflicts. The construction of the explanatory structural model involves three primary steps, outlined as follows.

Adjacency Matrix

The premise of the adjacency matrix is predicated upon the extraction of key elements for analysis, guided by both theoretical underpinnings and practical considerations. The number of key elements should not surpass 50, and if the quantity becomes excessive, reduction techniques such as factor analysis may be employed to ensure a lucid depiction of the interrelationships among structural elements.[21] The selection of key elements must be substantiated by either theoretical or practical grounds, whether it be through the qualitative approach of expert consultation or the quantitative methodology of principal component analysis. In the context of this study, drawing upon theories pertaining to inter-team conflict, the researchers integrated qualitative data obtained from interviews to distill the respondents' frequently mentioned viewpoints into initial nodes. Subsequently, core categories were extracted through coding techniques, thus yielding 18 key elements that exert an influence on inter-team conflict. The adjacency matrix, a Boolean matrix, is derived from the relationships between elements. When a direct binary relationship exists between an element and another element, it is denoted as 1; conversely, when no direct binary relationship is present, it is denoted as 0.

To construct the adjacency matrix, the researchers undertook the following steps: (1) They summarized the number of relationships using the eighth level code as the unit of analysis. The values in the matrix represented the frequency with which respondents mentioned each relationship. After collation, a total of 227 pairs of valid relationships were identified, resulting in a 156×156 matrix. (2) Relationships mentioned by fewer than three respondents were excluded, resulting in a final matrix size of 106 × 106, with 90 pairs of relationships remaining. (3) Codes that were not directly or indirectly related to inter-team conflict were excluded. However, three categories that generated less than three relationships with conflict-related categories were retained for further analysis. These categories included inter-team communication, inter-team cooperative behavior, and the inter-team interactive memory system. The rationale for retaining these categories was twofold. Firstly, inter-team cooperative behavior represents a form of behavior that opposes inter-team conflict, and understanding its dynamics can contribute to a deeper analysis of conflict. Secondly, while inter-team communication itself has a direct impact on conflict-related categories, it was mentioned fewer than three times. Nevertheless, interviews and a review of existing literature revealed that inter-team communication serves as a technical tool for conflict management, and effective communication plays a crucial role in conflict resolution. Thus, it can be argued that inter-team communication acts as a moderating variable in the relationship between conflict management and its outcomes. However, the matrix format does not allow for the demonstration of this moderating relationship. Therefore, the category of inter-team communication was retained in the study. Additionally, the inter-team interactive memory system was also retained due to its reciprocal relationship with inter-team communication. Finally, the researchers obtained 18 level 9

codes and 70 level 8 codes, as presented in Table 1. (4) A total of 24 pairs of relationships were identified using the ninth-level codes as the unit of analysis. These relationships were represented in column 1 of the adjacency matrix, while relationships not mentioned were represented in column 0 and the diagonal column 1. Thus, the researchers successfully obtained the adjacency matrix, as illustrated in Table 2.

Reachable Matrix

The relationship between elements through a certain length (or other elements) can be described by the reachability matrix, as stated in previous research.[22] Various methods exist for calculating reachable matrices. One such method is the concatenation approach, where the original matrix is added to the unit matrix to obtain the multiplication matrix. This process is repeated until the matrix no longer changes, resulting in the reachable matrix. While this method is straightforward, it can be time-consuming. Another method is the power multiplication technique, which involves adding the unit matrix to the original matrix and repeatedly performing power multiplication until the matrix remains unchanged. This method is suitable for specific matrices. Currently, the transfer closure method is widely employed, wherein the transfer matrix is computed until it reaches a steady state. For the purpose of this study, the transfer closure method is utilized to calculate the reachable matrix.[23]

The influence relationship between elements can be determined by examining the reachable matrix, which is obtained through the transfer closure method. This method involves solving the transfer matrix of the original matrix until it converges with the original matrix, resulting in the reachable matrix. Table 3 presents the reachable matrix after three iterations of code operations.

Table 1 Element Set

Number	Nine Levels of Codes	Eight Levels of Coding	Number	Nine Levels of Codes	Eight Levels of Coding
1	Border Manager	Border Manager Background	9	Inter-team process conflict	Inter-team technical solution conflicts
		Boundary manager role multiplicity			Inter-team schedule conflicts
		Boundary Manager Competence			Inter-team issue attribution conflicts
		Boundary Manager Power	10	Inter-team cognitive conflict	Inter-team concept conflict
		Boundary Manager Traits			Conflict of goals between teams
2	Heterogeneity among boundary managers	Age heterogeneity among boundary managers	11	Inter-team cooperation behavior	Inter-team support
		Heterogeneity of professional backgrounds among boundary managers			Inter-team cooperation
3	Team Capability	Team Assurance Capability			Inter-team coordination
		Team management skills	12	Inter-team conflict management behavior	Conflict Management Behavior - Third Party Intervention
		Team Technical Capability			Conflict Management Behavior-Accommodating
		Team-related cooperation experience			Conflict management behavior-avoidance
4	Multiplicity of team roles	Multiplicity of roles in the system			Conflict Management Behavior - Integration
		Duality of team scheduling			Conflict Management Behavior - Compromise
		Team task hierarchy			Conflict management behavior-led

(*Continued*)

Table 1 (Continued).

Number	Nine Levels of Codes	Eight Levels of Coding	Number	Nine Levels of Codes	Eight Levels of Coding
5	Inter-team relations	Inter-team relationship complexity	13	Team Learning	Internal team learning
		Tightness of relationships between teams			Team External Learning
		Interdependence between teams	14	Team goal identification	Boundary manager goal identification
		Previous relationships between teams			Team goal identification
		Inter-team constraints	15	Inter-team interactive memory system	Mutual understanding of the inter-team environment
6	Inter-team heterogeneity	Inter-team status heterogeneity			Mutual understanding of inter-team capabilities
		Heterogeneity of work patterns among teams			Mutual understanding of team needs
		Heterogeneity of professional backgrounds between teams	16	Team Level Results	Team Level - Win-win between teams
		Uneven resource input among teams			Team Level - Team Material Acquisition
		Inter-team organizational context heterogeneity			Team Level - Team Business Development
		Inter-team organizational affiliation heterogeneity			Team Level - Team Management Skills Enhancement
7	System Objectives	Dedication of the subject matter			Team Level - Team Technical Capability Enhancement
		System goal clarity			Team affiliated organization promotion
		System target difficulty factor	17	System level results	Smoothness of cooperation
		System target binding			System Innovation
8	Inter-team communication	Inter-team communication hierarchy			System goal achievement
		Inter-team communication procedures	18	Team Affiliation	Resource conditions of the organization to which the team belongs
		Inter-team communication content			Organizational structure of the team
		Frequency of inter-team communication			Team Affiliation Support
		Inter-team communication tools			The institutional culture of the organization to which the team belongs
		Smooth communication between teams			
		Inter-team information transfer			
		Inter-team information feedback			

Hierarchy Division

Specifically, the hierarchical division process comprises four distinct steps: connectivity, point reduction, edge reduction, and hierarchical division. The connectivity operation involves determining whether the system should be divided into disconnected regions. Typically, when constructing the adjacency matrix, only elements that exhibit a relationship with one another are retained, thereby eliminating the presence of disconnected regions. The point reduction operation, which treats the loop as

Table 2 Adjacency Matrix

$M_{18\times18}$	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
2	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
3	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0
4	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
5	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
6	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0
7	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0
9	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
12	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0
13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
18	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1

Table 3 Reachable Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0
2	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0
3	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	1	1	0
4	0	0	0	1	0	0	0	0	1	0	0	1	1	0	0	1	1	0
5	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0
6	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	1	1	0
7	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	1	0
8	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0
9	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	1	0
10	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	0
11	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
12	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0

(*Continued*)

Table 3 (Continued).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	0
15	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
18	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	1

a constituent element, is a viable approach due to the loop's status as a strongly connected component between elements. However, the decision to perform the point reduction operation hinges upon the significance of the loop as a research problem. In this study, the point reduction operation was not executed. The edge reduction operation involves the removal of the shortest path when multiple reachable paths exist, thus yielding the skeleton matrix. In this study, the edge reduction operation was carried out. To facilitate the hierarchical division, five key extraction principles were employed: the principle of result-first hierarchical extraction, the principle of cause-first extraction, the principle of cause-first-result-first rotation extraction, the principle of result-first-cause-first rotation extraction, and the principle of recursive reduction of activity element decomposition.[24] For this study, the cause-first-result-first rotation extraction principle was selected, enabling the placement of cause elements at the lowermost level of the hierarchical diagram and result elements at the uppermost level. This arrangement effectively portrays the cause-effect logic in a bottom-up manner.

In this study, the hierarchical division of the explanatory structure model is conducted in accordance with the principle of cause first - result first rotation. Let $R(e_i)$ be the reachable set of elements (the set of elements that are reachable by element e_i), $Q(e_i)$ be the prior set of elements (the set of elements that are reachable by element e_i), and $T(e_i)$ be the common set of elements ($T(e_i)=R(e_i)\cap Q(e_i)$). Utilizing the reachability matrix, the initial division yields the reachable set, prior set, and common set, as presented in Table 4. Employing the cause prioritization extraction principle, elements can be categorized when the common set aligns with the prior set. Therefore, the first division classifies elements 1, 2, 3, 4, 5, 6, 7, 14, and 18 into the lowermost level.

Subsequently, the rows and columns corresponding to elements 1, 2, 3, 4, 5, 6, 7, 14, and 18 are eliminated from the matrix, and a second division is conducted to derive the updated reachable set, prior set, and common set, as demonstrated in Table 5. This division adheres to the principle of prioritizing results, whereby an element can be categorized when its common set coincides with the reachable set. Therefore, the second division classifies elements 13 and 16 into the highest level.

The rows and columns corresponding to elements 13 and 16 are removed from the matrix, and a third division is executed to obtain the revised reachable set, prior set, and common set, as depicted in Table 6. This division follows the principle of prioritizing reasons, whereby an element can be categorized when its common set aligns with the prior set. As a result, the third division classifies elements 8, 9, 10, 11, and 15 into the subsequent lower level.

The matrix undergoes a fourth division, resulting in the removal of rows and columns corresponding to elements 8, 9, 10, 11, and 15. This division yields a new reachable set, prior set, and common set, as demonstrated in Table 7. The division follows the principle of prioritizing results, whereby an element can be categorized when its common set aligns with the reachable set. Therefore, element 17 is classified at the subsequent higher level.

Subsequently, the matrix undergoes a fifth division, leading to the elimination of rows and columns corresponding to element 17. This division generates a new reachable set, prior set, and common set, as illustrated in Table 8. The division adheres to the principle of prioritizing reasons, whereby an element can be classified when its common set aligns with the prior set. As a result of the fifth division, element 12 is allocated to the intermediate layer. At this stage, all elements have been divided, and the results of the hierarchical division using the two-way rotation method are presented in Table 9.

Table 4 Reachable Set, Prior Set and Common Set Obtained by the First Division

Element Number	$R(e_i)$	$Q(e_i)$	$T(e_i)$	$Q(e_i)=T(e_i)$
1	1, 8, 13, 15, 17	1	1	Q(1) = T(1)
2	2, 8, 13, 15, 17	2	2	Q(2) = T(2)
3	3, 11, 12, 13, 16, 17	3	3	Q(3) = T(3)
4	4, 9, 12, 13, 16, 17	4	4	Q(4) = T(4)
5	5, 11, 12, 13, 16, 17	5	5	Q(5) = T(5)
6	6, 12, 13, 16, 17	6	6	Q(6) = T(6)
7	7, 12, 13, 16, 17	7	7	Q(7) = T(7)
8	8, 13, 15, 17	1, 2, 8, 15	8, 15	≠
9	9, 12, 13, 16, 17	4, 9	9	≠
10	10, 12, 13, 16, 17	10, 14	10	≠
11	11, 13, 17	3, 5, 11	11	≠
12	12, 13, 16, 17	3, 4, 5, 6, 7, 9, 10, 12, 14, 18	12	≠
13	13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18	13	≠
14	10, 12, 13, 14, 16, 17	14	14	Q(14) = T(14)
15	8, 13, 15, 17	1, 2, 8, 15	8, 15	≠
16	16	3, 4, 5, 6, 7, 9, 10, 12, 14, 16, 18	16	≠
17	13, 17	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 17, 18	17	≠
18	12, 13, 16, 17, 18	18	18	Q(18) = T(18)

Notes: The "≠" is meant to indicate that T(ei) is not the intersection of R(ei) and Q(ei).

Table 5 Reachable Set, Prior Set and Common Set Obtained by the Second Division

Element Number	$R(e_i)$	$Q(e_i)$	$T(e_i)$	$R(e_i)=T(e_i)$
8	8, 13, 15, 17	8, 15	8, 15	≠
9	9, 12, 13, 16, 17	9	9	≠
10	10, 12, 13, 16, 17	10	10	≠
11	11, 13, 17	11	11	≠
12	12, 13, 16, 17	9, 10, 12	12	≠
13	13	8, 9, 10, 11, 12, 13, 15, 17	13	R(13) = T(13)
15	8, 13, 15, 17	8, 15	8, 15	≠
16	16	9, 10, 12, 16	16	R(16) = T(16)
17	13, 17	8, 9, 10, 11, 12, 15, 17	17	≠

Notes: The "≠" is meant to indicate that T(ei) is not the intersection of R(ei) and Q(ei).

Table 6 Reachable Set, Prior Set and Common Set Obtained by Third Division

Element Number	$R(e_i)$	$Q(e_i)$	$T(e_i)$	$Q(e_i)=T(e_i)$
8	8, 15, 17	8, 15	8, 15	Q(8) = T(8)
9	9, 12, 17	9	9	Q(9) = T(9)
10	10, 12, 17	10	10	Q(10) = T(10)
11	11, 17	11	11	Q(11) = T(11)
12	12, 17	9, 10, 12	12	≠
15	8, 15, 17	8, 15	8, 15	Q(15) = T(15)
17	17	8, 9, 10, 11, 12, 15, 17	17	≠

Table 7 Reachable Set, Prior Set and Common Set Obtained by the Fourth Division

Element Number	$R(e_i)$	$Q(e_i)$	$T(e_i)$	$R(e_i)=T(e_i)$
12	12, 17	12	12	≠
17	17	12, 17	17	R(17) = T(17)

Notes: The "≠" is meant to indicate that T(ei) is not the intersection of R(ei) and Q(ei).

Table 8 Reachable Set, Prior Set and Common Set Obtained by the Fifth Division

Element Number	$R(e_i)$	$Q(e_i)$	$T(e_i)$	$Q(e_i)=T(e_i)$
12	12	12	12	Q(12) = T(12)

Table 9 Hierarchy Results

Hierarchy Number	Elements in the Hierarchy	From Step
0	13, 16	Step 2
1	17	Step 4
2	12	Step 5
3	8, 9, 10, 11, 15	Step 3
4	1, 2, 3, 4, 5, 6, 7, 14, 18	Step 1

Regarding other operations involving the topological hierarchy diagram, this study abstains from calculating the number of systems, refrains from conducting point reduction calculations (ie, retaining loops), and instead performs edge reduction operations to obtain the skeleton matrix. This skeleton matrix is then utilized to derive the topological hierarchy diagram of the inter-team conflict process within the multi-team system for the explanatory structure model, as depicted in Figure 1 where the development stages of conflicts are illustrated from Level 4 to Level 0, corresponding to "conflict latency → conflict perception → conflict management → conflict outcome → conflict feedback". The diagram clearly illustrates the various stages of conflict development and the connections between them.

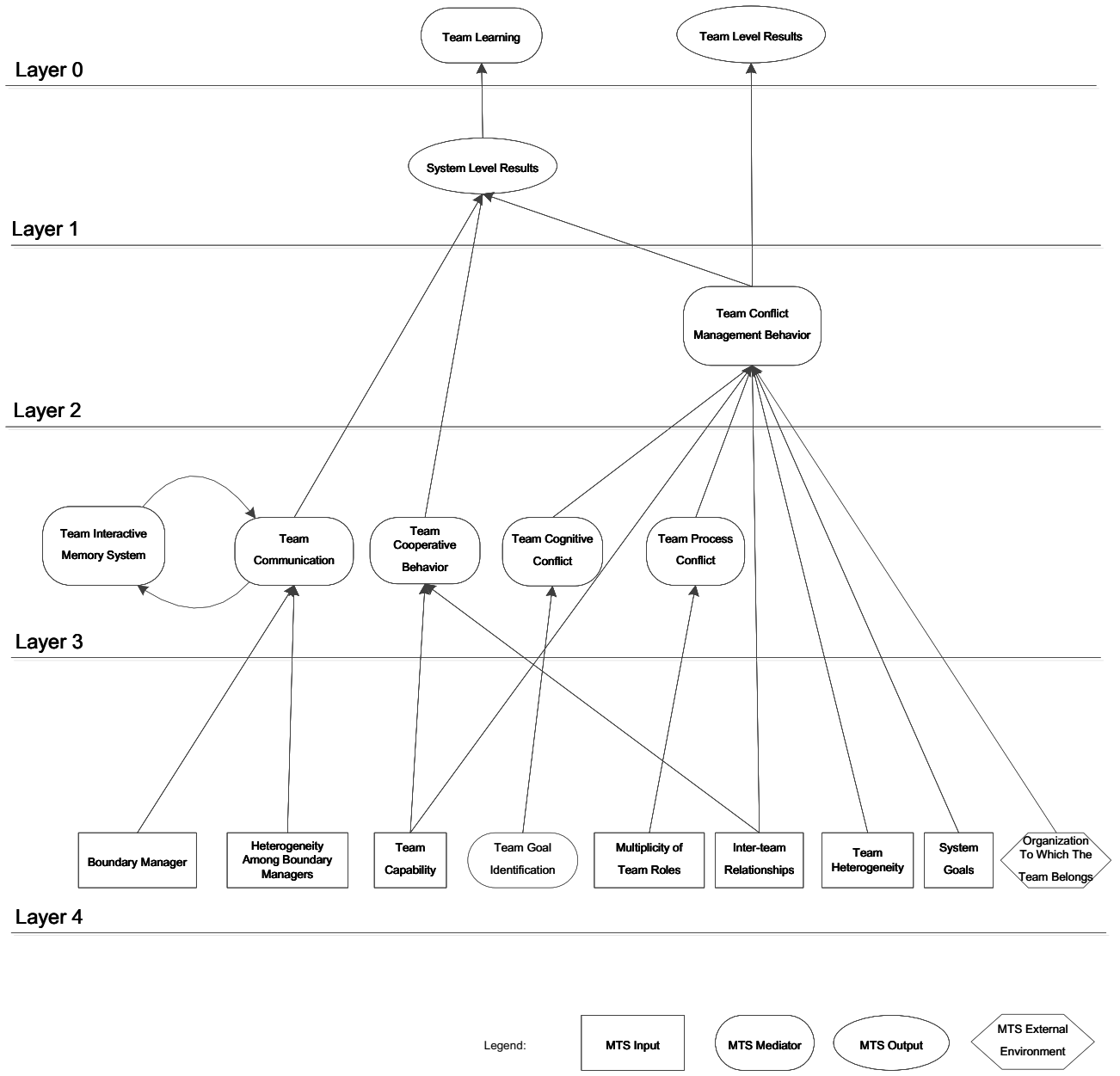

Figure 1 Hierarchy of conflict process development mechanisms between teams within a multi-team system.

Study Found

The inter-team conflict process in a multi-team system comprises three pathways: "conflict latency → conflict perception", "conflict perception → conflict management", and "conflict management → conflict outcome". Additionally, the process is influenced by inter-team communication. Therefore, this study explains the explanatory structure model of the inter-team conflict process in a multi-team system based on the aforementioned four aspects. Furthermore, the study conducts a comprehensive analysis of the development mechanism of the conflict process.

Conflict Latency → Conflict Perception

The generation of conflict in multi-team systems is not solely dependent on inter-team conflict sources; rather, it is a necessary but insufficient condition, ie, not all conflict sources have the potential to trigger conflict, but certain conflict sources are indeed involved in the conflict generation process. A qualitative analysis of inter-team conflict sources

reveals the existence of numerous multi-level and interactive sources in multi-team systems. By examining the direction and quantity of relationships among the categories derived from the qualitative analysis, this investigation identifies team goal identity, team role multiplicity, inter-team relationship, and team competence as the most substantiated conflict source categories. It is important to note that inter-team cooperation and inter-team conflict are, to some extent, opposing categories. When respondents discuss factors influencing inter-team cooperation, they implicitly acknowledge their impact on inter-team conflict as well. However, for the sake of clarity, the initial coding did not merge conflict and cooperation. Furthermore, the conflict process ceases when the conflict is no longer perceived, indicating that the conflict source no longer plays a role. Therefore, retaining the category of inter-team cooperative behavior is sufficient to present a comprehensive overview of the various potential pathways in the inter-team conflict process. Table 10 provides examples of relevant relationship structures and representative quotations.

Role multiplicity in teams comprises two scenarios: one in which the team participates in multiple multi-team projects, and the other in which the team assumes multiple roles in a multi-team project. Both scenarios give rise to role multiplicity and are susceptible to inter-team conflict. When a team engages in two or more multi-team projects concurrently, it assumes the role of a sub-team in multiple multi-team systems. Therefore, differences in parallelism and priority emerge among the various tasks of distinct multi-team systems. As task prioritization comes into play, process conflicts readily arise in lower-priority multi-team systems, such as scheduling conflicts and disputes over problem attribution. In addition, when a team assumes multiple roles in the same multi-team system, it also leads to process conflicts, such as ambiguity in problem attribution.

The goal hierarchy in a multi-team system constitutes a fundamental characteristic, wherein three levels of goals exist: system goals, team goals, and even individual goals. Cognitive conflicts between teams ensue when there is incomplete recognition of the system goals and the goals of other teams.

Table 10 Relationship Structure of "Conflict Latent → Conflict Perception" and Examples of Typical Quotations

Relationship Structure	The connotation of relationship structure	Examples of typical quotations
Team role multiplicity → Inter-team process conflict	The multiplicity of tasks, hierarchy and role ambiguity triggered by the multiplicity of roles in teams leads to process conflicts among teams.	Evidence 1: Their main priority is production; we have no option but to wait Evidence 2: We supply products to Enterprise A and provide technical services to Enterprise B, with support. The relationship is highly complex. When an issue arises, it is comprehensive and can not be solely blamed on A or B
Team goal identification→ Inter-team cognitive conflict	Conflicting goals and philosophies between teams are easily triggered when they do not agree on each other's goals and common system objectives.	Evidence 1: Conflicts regarding goals and philosophies between teams often arise when there is a lack of agreement on mutual goals and overarching system objectives. It is not that they are entirely uncooperative; obtaining their approval, especially from the top, can bring about change. Evidence 2: There is a lack of consensus between the parties about the project's direction. While one focuses on the cutting edge, the other emphasizes the present. Evidence 3: The other party aims to minimize costs, while our goal is ensuring high performance. This discrepancy arises due to a lack of communication regarding mutual expectations and boundaries.

(*Continued*)

Table 10 (Continued).

Relationship Structure	The connotation of relationship structure	Examples of typical quotations
Inter-team relations → Inter-team cooperation behavior	Teams are more likely to develop cooperative behaviors when there is interdependence and high-quality prior relationships.	Evidence 1: They are genuinely committed to this project and aim for its success. However we have options and can look elsewhere if needed. Evidence 2: Previously, there was a disagreement about who would get the opportunity for overseas training. This time, they are not as cooperative.
Team Capability→ Inter-team cooperation behavior	The stronger the team capacity, the more likely inter-team cooperative behavior will occur.	Evidence 1: They have an effective management system in place. and can execute tasks without hindrance. Evidence 2: Their output is top-notch, with excellent coordination. Their overall technical quality is high.
Inter-team cooperation behavior → System level results	Cooperative behavior is maintained between teams, and the process of conflict between teams stops and has a positive impact on system acquisition.	Evidence 1: Our collaboration in this domain has always been smooth. For instance, when we face challenges, they assist us in resolving them Exhibit 2: They partnered with us on this initiative, and when the final report was presented, there were no objections.

The influence of inter-team relationships on inter-team cooperation or conflict is primarily derived from two dimensions: inter-team interdependence and inter-team prior relationships. When teams are mutually dependent, they exhibit more cooperative behaviors in order to attain shared benefits. In cases where dependency is asymmetrical, the dependent party tends to display the utmost cooperative behavior, while the independent party may adopt a more casual approach. The perception of inter-team conflict is less likely to arise when teams have established high-quality prior relationships, thereby increasing the likelihood of continued cooperation.

The scope of team's capacity also plays a crucial role in shaping inter-team cooperation or conflict. This capacity comprises managerial proficiency, technical expertise, supportive security capabilities, and relevant cooperative experiences. The stronger the team's capacity, the better equipped they are to handle task complexity and meet the needs of other teams. Therefore, cooperative behaviors between teams become more probable, while the occurrence of inter-team conflict reduces.

Once the source of inter-team conflict comes into play and conflict is perceived, it triggers subsequent inter-team conflict management behaviors. Conversely, if conflict remains unnoticed and inter-team interactions remain pleasant and cooperative, the conflict process concludes. Inter-team cooperative behavior exerts a positive influence on the achievement of system goals and overall system performance.

Conflict Perception → Conflict Management

When inter-team conflict is perceived, the team responds with conflict management behaviors. Numerous factors influence the type of conflict management behavior adopted by a team. Through the construction and analysis of an explanatory structure model, this study identified six influential factors: inter-team conflict type, inter-team relationship, team competence, inter-team heterogeneity, the organization to which the team belongs, and system goals. The associated relationship structure and illustrative quotations are presented in Table 11.

The conflict management approach varies across different types of conflict teams. The presence of cognitive conflict between teams indicates a greater "distance" between them, making reconciliation more challenging and necessitating

Table 11 Relationship Structure of "Conflict Perception → Conflict Management" and Examples of Typical Quotations

Relationship Structure	The Connotation of Relationship Structure	Examples of Typical Quotations
Types of inter-team conflict → Inter-team conflict management	Teams respond to different types of conflict while adopting different conflict management approaches.	Exhibit 1: When faced with philosophical disagreements, external assistance becomes crucial. Expert validation sessions are typically conducted in such scenarios. Exhibit 2: Proceed to the lead unit to decide and develop a unified program.
Inter-team relations → Inter-team conflict management	The dependent party among teams is more likely to take a dominant approach to conflict management, and the dependent party is more likely to take a retreating approach to conflict management.	Evidence 1: The platform of the people is powerful; in relative terms, we lean towards compromise. Evidence 2: Although I have been pressured not to sign on, I can always find another place. However, he does not have that luxury.
Team Capability→ Inter-team conflict management	The more capable the team is based on the constraints of the overall goal, the more likely it is to take a step-back approach to conflict management.	Evidence 1: After debating the feasibility of the technology, we eventually decided. to give the other side a step forward. Evidence 2: In this project, we bear the primary responsibility. If they fall behind in progress, only we have to make amends for them. after all, we have the necessary expertise and resources.
Inter-team heterogeneity → Inter-team conflict management	Inter-team status heterogeneity and organizational affiliation heterogeneity have an impact on the way inter-team conflict is managed.	Evidence 1: We are the principal entity responsible for this project and generally operate in guidelines. Evidence 2: Given our common shareholders, direct confrontations or holding them accountable is not always feasible. Coordination is often the best course of action.
Organization to which the team belongs→ Inter-team conflict management	The organization to which the team belongs influences the team's conflict management through organizational culture and support or lack thereof.	Evidence 1: He is accustomed to leveraging his power in this system. He must take responsibility for what he says and wants. Evidence 2: If you do not want to do it, their leaders will replace you. There are always other colleagues ready to step in. so you must be on your A game.
System Objective→ Inter-team conflict management	System goals influence the way teams manage conflict through both subject matter specificity and binding.	Evidence 1: If you choose not to persevere, all previous efforts will seem in vain—quite like a flavorless chicken rib, which if discarded, results in regret. Evidence 2: He must deliver before the stipulated deadline; failure to do so could land him on a blacklist.

external intervention to resolve the conflict. Conversely, addressing inter-team process conflict requires action based on the level of conflict and the power dynamics at play.

Interdependence comprises partner selection, skills, abilities, prestige, and resources. The party that is dependent is more inclined to adopt a compromising and accommodating approach to conflict management, whereas the party with more resources tends to adopt a dominant and competitive approach.

Due to the nested nature of inter-team conflict, conflict management begins not only with the two parties involved but also considers the entire system. Thus, when the system goal is strongly binding, teams with greater capabilities are more

likely to act in a manner that accommodates each other to achieve the system goal. In addition, when a team serves as the focal point in the system and bears greater responsibility for achieving the system goal, the team's stronger capabilities increase the likelihood of adopting an accommodating approach towards the other party.

Inter-team heterogeneity primarily influences inter-team conflict management through variations in status and organizational context. Generally, teams with higher status tend to adhere to their principles and employ a dominant conflict management approach. When both teams are affiliated with the same interest group, they are more inclined to choose a collaborative and integrated approach to conflict management.

The influence of team organization on conflict management is primarily reflected through the provision of support and the permeation of organizational culture. When a team receives ample support from the organization, it gains access to abundant resources that enable the adoption of dominant behaviors when confronted with conflict. Conversely, in the absence of organizational support, the team is more likely to resort to an accommodating conflict management style. In addition, the organizational culture to which the team belongs extends its influence to multi-team collaboration and conflict management, ie, shaping the team's habitual behaviors.

Conflict management in teams is influenced by system goals, which are determined by both subject matter specificity and goal binding. Specifically, when the subject matter of a multi-team collaboration is highly exclusive, both teams involved face significant sunk and opportunity costs. Therefore, they are more likely to adopt a collaborative and integrated approach when addressing conflict. Similarly, when system goals are highly binding, teams are more prone to adopting compromise conflict management behaviors.

Conflict Management → Conflict Outcomes

In this study, conflict management in multi-team cooperation scenarios was categorized into three dimensions based on team motivation: "concern for us", "concern for each other", and "concern for the system". However, it is important to note that while motivations and interests may differ, the actions taken in a given conflict management situation can be the same. For instance, both the motives of "care about us - care about each other - care about the system" and "care about us - care about each other - do not care about the system" result in collaborative and integrated actions. Similarly, the motives of "do not care about us - care about each other - care about the system" and "do not care about us - care about each other - do not care about the system" lead to compromise and accommodation. On the other hand, the motives of "care about us - do not care about each other - care about the system" and "care about us - do not care about each other - do not care about the system" involve competing actions. However, due to the differing motivations, the results for the team and the system vary. Therefore, the analysis of conflict management should not solely focus on the actions taken and the underlying motivations, but also consider the long-term results. Table 12 provides examples of relevant relationship structures and typical quotations.

For the entire system, if the conflict management behavior of a team (which is not limited to a specific management action) is motivated by concerns for the system, a more favorable outcome can be attained. Conversely, even the same conflict management behavior may yield an entirely opposite result. For instance, when the team exhibits a moderate level of tolerance and accommodation towards another team in the interest of the system, a positive outcome is likely to ensue. Conversely, if the team adopts compromising actions out of concern for the other team's interest, the overall outcome at the system level will be adversely affected.

In the context of teams, the results of conflict management extend beyond mere multi-team collaboration and can often exhibit detours, retreats, or exploratory behaviors. For instance, if a team compromises on a project in order to establish a long-term opportunity with another team, the immediate outcome may not be optimal for collaboration. However, in the long run, it is expected to yield a positive outcome.

System-level results trigger learning behaviors in the team, and team learning, in turn, comprises both internal and external learning. When faced with temporary project failures, teams are often motivated to learn, analyze the causes of failure, and rectify any deficiencies. Conversely, when system-level results are favorable, teams tend to accumulate successful experiences and foster positive feedback.

Table 12 Relationship Structure of "Conflict Management → Conflict Outcome" and Examples of Typical Quotations

Relationship Structure	The Connotation of Relationship Structure	Examples of Typical Quotations
Inter-team conflict management → system level results	Inter-team conflict management behaviors differ based on motivation and have an impact on system outcomes.	Evidence 1: Provide them with ample space and tolerance. the primary goal is color recognition, followed by tracing. Alongside recognition technology. it can also accomplish positioning. Evidence 2: We may often contemplate about how to perfect and optimize the problem. They aim to minimize costs; the quicker, the better. Improvements can only be made gradually over time.
Inter-team conflict management → Team Level Results	Inter-team conflict management behavior affects teams based on a temporal perspective.	Exhibit 1: Everyone got together and coordinated frequently. Over time, they visited more often and even jointly applied for a research project. initiating further collaboration. Evidence 2: Assist them with evidence work. This aids their leaders in making decisions conveniently. Secondly, it eases communication with relevant equipment vendors. When equipment providers supply tools, having knowledge makes a difference, right? It can significantly affect them.
System level results → Team Learning	System results trigger learning behaviors in the team.	Evidence 1: Upon seeking international certification, it was evident we faced a technological setback. We then purchased foreign English original standards to learn. Evidence 2: The final result is excellent. The other party maintained stringent process control, and we plan to adhere to these standards moving forward.

Inter-Team Communication Influence Mechanism

Inter-team communication plays a pivotal role in influencing conflict management and its resultant outcomes. However, it is also influenced by various other factors, which this study has summarized as follows: boundary managers, heterogeneity among inter-boundary managers, and inter-team interactive memory systems. Table 13 provides examples of relevant relationship structures and typical quotations pertaining to these factors.

Numerous facets of inter-team communication have been identified as having a positive impact, including efficient transmission and feedback of information, moderate frequency of communication, well-defined communication procedures, and convenient means of communication, among others. On one hand, proficient inter-team communication facilitates effective exchange of needs and progress updates, thereby mitigating the occurrence of conflicts between teams. On the other hand, in instances where conflicts do arise, constructive communication serves as a bridge, bridging the divide and resolving or minimizing the destructive effects of such conflicts.

Boundary managers, as the intermediaries facilitating inter-team collaboration, assume a pivotal role in shaping inter-team communication. The personality and aptitude of these boundary managers constitute crucial factors influencing the efficacy of inter-team communication. When boundary managers possess elevated technical and communication skills, they are better equipped to coordinate effectively. Additionally, the personality of the boundary manager assumes significance, albeit without a difference of good or bad personality traits; rather, the suitability of the personality for the given situation is the determining factor. For instance, a boundary manager with a less stable and more open personality may not be conducive to regular inter-team communication.

The major share of communication between teams is conducted through the agency of boundary managers on both sides. Therefore, the effectiveness of inter-team communication hinges upon the ability of these boundary managers to communicate effectively with one another. The lower the heterogeneity between boundary managers, such as minimal differences in professional background, experience, and age, the greater the likelihood of shared mental models between

Table 13 Relationship Structure of Inter-Team Communication Influence Mechanisms and Examples of Typical Quotations

Relationship Structure	The connotation of Relationship Structure	Examples of Typical Quotations
Inter-team communication → System level results	Effective inter-team communication has a positive impact on system results.	Evidence 1: First, tell me what to use to achieve which effect. Which ready-made sample resources can be referred to? After communicating these items, this project went smoothly. Evidence 2: Especially when requirements change approaching the final acceptance, timely feedback is especially important.
Border Manager → Inter-team communication	The competencies and traits of boundary managers can affect the effectiveness of inter-team communication.	Evidence 1: There has been changes. I do not like to change often, so due to my personality, I had some communication problems with him. Evidence 1: The project coordinator's temperament is closely related. The original coordinator was an experienced expert with a temper. Some issues were hard to discuss directly with him. But after the change, everything could be discussed openly.
Heterogeneity among boundary managers → Inter-team communication	The lower the heterogeneity among boundary managers, the more effective the inter-team communication.	Evidence 1: He has worked in XX for many years, and our experience difference …… made our communication more challenging. Evidence 2: There is an associate researcher about my age. When I communicate with him, it feels like he does not know much, making the communication comfortable.
Inter-team communication ↔ Inter-team interactive memory system	Inter-team communication and inter-team interactive memory systems have a positive impact on each other.	Evidence 1: There is mutual influence. Over time, they might get to know your ways and methods. Evidence 2: Who has what ability to do what, this needs to be communicated upfront.

both sides. This, in turn, reduces the complexity of communication and enhances the efficacy of communication between the teams.

The effect between inter-team interactive memory systems and inter-team communication is mutually reinforcing. Effective and sufficient communication facilitates team members' understanding of one another, enabling them to clarify their respective roles and responsibilities. Conversely, when an accurate and efficient interactive memory system exists in a team, communication becomes more streamlined, allowing for the assimilation of implicit information without the need for explicit communication.

Conclusion and Research Outlook

Research Findings

This study transforms qualitative interview data into quantitative data by quantifying the direction and quantity of inter-conceptual "relationships". Employing an explanatory structural modeling approach, the study distills the chain of conflict processes in a multi-team system, including "conflict latency → conflict perception → conflict management → conflict outcome → conflict feedback". The chain of "conflict latency → conflict perception → conflict management → conflict outcome → conflict feedback" is extracted, and the interrelationships between the stages of conflict processes among teams are assessed. Specifically, the following findings were obtained:

1) Team goal identification is a crucial underlying source of conflict, especially in facilitating the transition from "latent conflict" to "perceived inter-team cognitive conflict".

2) The multiplicity of team roles is another significant underlying source of conflict, acting as a key driver in the shift from "latent conflict" to "perceived inter-team process conflict".
3) Team capabilities and inter-team relationships play a multi-stage role in the evolution of conflict. They act both as antecedent influencers of inter-team collaborative behaviors and as significant factors in inter-team conflict management. Enhanced team capabilities simplify the resolution of complex issues, while strong inter-team relationships reduce the likelihood of conflict perception.
4) System goals, inter-team heterogeneity, team-affiliated organizations, and types of inter-team conflict are key determinants in managing inter-team conflict. System goals influence conflict management through the specificity and binding nature of objectives. Inter-team diversity primarily impacts conflict management in terms of status diversity and organizational background diversity. Team-affiliated organizations influence conflict management by providing support and through the infusion of organizational culture. Different conflict types often necessitate varied management approaches; resolving inter-team cognitive conflicts typically requires external intervention, whereas addressing inter-team process conflicts often depends on the conflict's intensity and the power dynamics between teams.
5) Different inter-team conflict management behaviors yield varied outcomes. At the team level, the impact requires consideration of the time factor, while at the system level, the focus should be on the motivation behind the conflict management behaviors.
6) The results of system-level conflict management can trigger team learning behaviors. Facing temporary project setbacks often stimulates a team's learning drive, prompting them to analyze failure causes and address shortcomings. Positive outcomes at the system level can lead teams to inadvertently accumulate successful experiences, creating a positive feedback loop.
7) Inter-team communication is a crucial factor influencing the outcomes of conflict management. The more capable and suitably-personalitied boundary managers are, and the less heterogeneity exists among managers from different teams, the more effective the communication between teams. There is a reciprocal enhancement effect between the inter-team interactive memory system and inter-team communication.

Top of Form

Theoretical Contributions

The issue of conflict has long been a focal point of research in the field of organizational management. Considering that inter-team conflict comprises various factors at the individual, team, system, and organizational levels, the existing theories on interpersonal conflict processes fall short in adequately explaining the intricacies of inter-team conflict processes. In light of this, this study undertakes a stage-based analysis of the conflict process in teams, examining the interrelationships between these stages. Accordingly, a novel model for the development of the conflict process is constructed, thereby advancing the understanding of inter-team conflict in the broader framework of conflict theory.

Moreover, this paper adopts a conflict-oriented analytical perspective to explore inter-team collaboration within multi-team systems. As noted by Davison et al, a notable limitation of their research on inter-team collaboration lies in the lack of systematic observation of inter-team conflict and competitive behavior. They suggest that future research should aim to bridge this gap.[25] Conflict, as a pivotal event, exerts a significant influence on inter-team collaboration and shapes its mechanisms of action on system performance. Previous studies have overlooked the need to differentiate between pre-conflict collaboration and post-conflict collaboration in inter-team settings. By including the impact of inter-team collaboration on both conflict occurrence and conflict management, as well as post-conflict inter-team collaboration, this study offers a qualitative depiction of this crucial yet underexplored phenomenon. Therefore, it introduces a fresh research perspective for future empirical studies into the effects of inter-team collaboration.

Thirdly, this study has contributed to the development of theories pertaining to interactive memory systems, role theory, and boundary management theory. Delving into the realities of multi-team collaboration, it carried out an in-depth exploration grounded in classic theories. This research involved extensive substantive coding and theoretical coding, anchored in the principles of interactive memory systems, role theory, and boundary management theory. Therefore, it is

accurate to state that this study has expanded the application of these theories in the field of multi-team systems, thus broadening their scope of application

Management Insight

In practical scenarios, many objectives frequently necessitate collaborative efforts across multiple teams. The organizational structure of a multi-team system has been extensively and successfully implemented in various sectors. Within such systems, teams, each possessing unique knowledge and functions, often encounter conflicts due to divergences in objectives, cultural norms, and values. These inter-team conflicts inevitably impact the achievement of individual, team, and overall system goals. Addressing and managing these conflicts is a crucial aspect of multi-team system operations. Drawing from empirical evidence, this paper develops a multi-level structural model focused on in-depth collaboration among diverse teams. It identifies critical pathways and determinants in the evolution of inter-team conflicts within multi-team systems, offering the following insights for their practical management:

1) Early reinforcement of mutual recognition among teams regarding individual and system-wide goals is essential. This involves team leaders developing goal-oriented strategies and reinforcing adherence to system objectives. Adequate inter-team communication is necessary to build a consensus on these goals, aiding team members in understanding and aligning with them.
2) It is important to clearly define the roles and task assignment of each team within the system, clarifying their specific tasks. This approach helps prevent process conflicts that arise from unclear roles.
3) The influence of inter-team relationships has a cross-stage characteristic and should be considered comprehensively. Besides, it is beneficial to foster friendly and equitable cooperative relationships, assisting team members in appreciating the significance of other teams and striving to maintain a positive reputation for their own team. Conversely, while teams with stronger relationships tend to avoid conflicts more efficiently under similar conditions, it is necessary for teams with weaker connections to strengthen these relationships. This can be achieved by promoting communication and enhancing trust among teams.
4) Team capability also has a cross-stage impact. Collaborating with high-capability teams can more easily earn the trust of others, playing a beneficial role in conflict management throughout the process. Besides, it is vital to address psychological imbalances among members of these teams and give thorough consideration to their interests and rewards.
5) Specific conflict management measures should be taken for different conflict types. This may involve methods such as expert consultation or group discussions. In multi-team systems with diverse team statuses and organizational affiliations, a broad, macro-level control is essential. While changing these factors can be challenging, establishing clearer delineations of rights and responsibilities, implementing more detailed division of labor, enhancing communication methods, and fostering a cooperative cultural environment can mitigate their negative impacts to a degree.
6) Regarding conflict results, it is crucial to fully understand the motivations and demands behind each team's conflicts. Teams should manage conflicts with the overall system's welfare in mind, rather than compromising due to the interests of other teams. The results of conflict management often extend beyond immediate multi-team collaborations, potentially leading to future opportunities for cooperation based on positive experiences or explorations. Thus, teams should view cooperation from a long-term perspective, rather than focusing solely on the results of current collaborations.
7) Employ boundary managers with high technical and communication skills, while striving to minimize excessive diversity among them. Choose boundary managers that align well with team characteristics, and focus on developing accurate and effective inter-team interactive memory systems. This approach can facilitate more efficient communication between teams and, to some extent, prevent conflicts and their adverse consequences.

Top of Form

Shortcomings and Prospects

Research limitations and research insights of this study: The research method of rooted theory is adopted in this study, which determines that the contribution of this study in the exploration of real-life predicaments and the explanation of management phenomena through the conduct of in-depth studies into multi-team collaborative real-life scenarios, albeit within a restricted number of cases. The corresponding drawback arises from the inability to assess a broader sample due to constraints in energy and research resources. Therefore, future research should seek to validate the theories constructed in this study quantitatively, employing statistical tests on extensive samples, thereby enhancing the generalizability of the conclusions. Furthermore, this study employed an explanatory structural model approach to analyze the correlation between the stages of the inter-team conflict process in a multi-team system. However, the approach's limitations in analyzing the moderating role have left several paths in ambiguity. For instance, the motivations underlying conflict management behaviors exhibit heterogeneity, leading to diverse conflict outcomes; however, the precise mechanism through which conflict management motives operate remains unknown. Hence, future research should incorporate an analysis of conflict management motivations to appraise their moderating role in relation to power perceptions and conflict management behaviors. Furthermore, the analysis of the explanatory structural model revealed the simultaneous influence of numerous factors on conflict perception and conflict management. This study postulated that boundary managers with high power perceptions exhibit weaker perceptions and place less emphasis on conflict. Hence, future research could employ a longitudinal analysis from a process perspective to analyze the longitudinal influence mechanism of power on conflict perception, conflict management, and conflict outcomes.

Conclusion

As multi-team systems find increasing application across various fields, the management of inter-team conflicts has emerged as a critical issue, emphasizing the importance of studying these conflicts. Grounded in theory and employing the interpretive structural model, this paper probes into the real-world context of collaborative multi-team development, examining the progression and influencing factors of inter-team conflicts within these multi-system environments. This exploration leads to the formation of a novel theoretical model, which in turn facilitates the derivation of coping strategies and recommendations, offering significant insights for both theoretical and practical applications. A key finding of this study is that inter-team conflicts within multi-systems follow a developmental sequence: "conflict latency → conflict perception → conflict management → conflict outcome → conflict feedback". This process is shaped by various factors, including team goal alignment, the diversity of team roles, inter-team relationships, team competencies within the multi-system, types of inter-team conflicts, team heterogeneity, the organizational affiliations of the teams, the overarching objectives of the system, and the efficacy of inter-team communication.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Statement

Our study is in compliance with the Declaration of Helsinki, and it was conducted with the informed consent of the participants. Furthermore, it has received approval from the Internal Review Board of the College of Management at Hebei University (GL202201003).

Consent for Publication

Informed consent was obtained from all the participants included in the study.

Disclosure

The authors report no conflicts of interest in this work.

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