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Review and Prospect of Divisive Faultlines in Technological Innovation Networks

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Abstract: *With the continuous acceleration of technological innovation and increasingly fierce market competition, technological innovation network has become a new type of cooperative innovation mode to solve the problem of technological uncertainty, resource scarcity and limited internal innovation capability. However, due to the divisive faultlines caused by the difference in the degree of aggregation of relevant attributes among network enterprises, the bipolar characteristics of similarity and complementarity among enterprises have gradually come to the fore, making the technological innovation network often show loose coupling characteristics, which will have an important impact on the performance of enterprises' cooperative innovation. In order to explore the divisive faultlines, which is a key feature of technological innovation network, this paper reviews the related literature research, summarizes the dimension division, result mechanism and action mechanism of divisive faultlines from the connotation evolution of divisive faultlines, and finally proposes the future research direction of divisive faultlines in technological innovation network.*

Keywords: *Divisive Faultlines, Technological Innovation Networks, Evolution of Connotations, Mechanisms*

1. Introduction

Facing the opportunities and challenges brought by the new era of economic globalization, enterprises have been placed in more intense market competition, and high-yield and intensive technological innovation activities have gradually become the key to the survival and development of enterprises. In recent years, the characteristics of innovation network are increasing, and industrial clusters, industry-university-research cooperation and so on are the practice products of innovation network. For technology innovation enterprises, the construction of innovation network breaks through the previous atomic innovation process and realizes the network innovation process of close cooperation. Therefore, the technological innovation network has become the key for innovation subjects to break through the internal innovation limitations, and achieve spatial extension. How do firms in a technological innovation network choose their partners in order to enhance cooperative innovation performance? Are firms more likely to innovate when they have complementary capabilities, or are they more likely to cooperate when they have similar backgrounds? Many dilemmas need to be addressed.

Among the many problems of collaborative innovation, the root of the problem lies in the aggregation and differentiation of the attributes of technological innovation network firms, and the divisive faultlines is the key to this phenomenon. As the divisive faultlines makes network firms aggregate similarities, thus creating network subgroups, the choice of cooperation within or between subgroups is a process of similarity and complementary partnership. The research on divisive faultlines is relatively abundant, but the research on divisive faultlines of technological innovation network has emerged in recent years, and the research results are relatively scarce, and the relevant theoretical research is still a gap.In order to improve the theoretical research system of divisive faultlines in technological innovation network, this paper combines the existing research on divisive faultlines, discusses the connotation and categorization of divisive faultlines, and mainly comprehends the result mechanism and action mechanism of divisive faultlines, so as to put forward the direction of future research on divisive faultlines in technological innovation network.

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2. Connotation of divisive faultlines

2.1 Team level

Divisive faultlines originated when Lau and Murnighan introduced the phenomenon of geological faults into team diversity research in 1998, and defined its concept as an imaginary demarcation line where individuals subjectively divide a group into multiple subgroups based on demographically relevant attributes. Based on this, scholars have further explained and expanded the connotation of team fault lines. Similarity selection complements faultline theory, in which individuals choose to ally with those who have similar attributes to themselves, thereby increasing the internal cohesion of the faction.The diversity perspective is an extension of faulting theory;Van expanded faulting theory with the principle of normative fit from the faulting perspective of diversity[1].Ren argued that faulting is a potentially inherent attribute that results from diversity among individuals[2].

2.2 Organizational level

Lawrence and Zyphur extended the concept of team faults to the organizational level based on latent clustering analysis, and they argued that organizational faults are the aggregation of attributes in a large group, whose boundaries are determined by the number of other people known to the individual[3]. However, organizational-level faults have not attracted more attention; scholars still conduct research based on individual attributes, and there is no clear demarcation line between team faults and organizational faults. For example, Bezrukova argue that faultlines are based on a bottom-up process from individuals to groups to organizations, and that organizational faultlines stem from team faultlines[4].

2.3 Network level

Thatcher and Patel called for scholars to pay more attention to the phenomenon of faultlines in alliances, social networks, and interorganizational behavior[5]. Later, Heidl extended the concept of faultlines to the level of inter-firm alliances, explored the phenomenon of divisive faultlines in multi-partner alliances, and argued that divisive faultlines are built on the basis of the strength of the relationship between the partners, which is essentially caused by the difference in the degree of shared experience between the partners[6]. On this basis, Dang extended the divisive faultlines to the level of technological innovation network based on the perspective of network embeddedness, and argued that the divisive faultlines of technological innovation network refers to "the tendency of internal differentiation of the overall network due to the difference in the degree of shared experience among network nodes and organizations"[7].

3. Dimensionalization of divisive faultlines

3.1 Demographic characteristics

Lau and Murnighan were the first to apply fault lines to team diversity and refined the study of fault lines based on demographic attributes [9]. The initial study of fault lines based on demographic attributes was gradually extended to team dynamics research and proposed more different kinds of fault lines. For example, Chung proposed two types of faults: relationship-oriented faults and task-related faults[10]; Richard also divided faults within teams into demographic-based faults and task-related-based faults[11].

3.2 Performance status

Divisive faultlines are formed as a result of the shared history of network members and their evolution over time. At a certain time, the divisive faultlines may be in a budding state, which does not have a significant impact on the whole network; however, as time passes, the effect of divisive faultlines will appear, and the whole network members will have a tendency to split. Based on this, the triggering of divisive faultlines has attracted the attention of scholars, and divisive faultlines have been divided into dormant faults and activated faults.Lau and Murnighan realized that there are dormant and activated faults in demographics when they introduced the concept of faults[9]. Since then, dormant and activated faults have been widely recognized and distinguished[12].

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3.3 Network attribute characterization

Divisive faultlines is a kind of technological innovation network key features, the whole technological innovation network is distributed with significant differentiation of enterprises, including embodied in the different network status, the relationship strength difference between the enterprises in the network, the difference in the innovation ability between enterprises, etc., and these network attribute features may be the elements of the formation of divisive faultlines. Based on this, Dang divided divisive faultlines into pre-relational divisive faultlines and multiple relational divisive faultlines based on the network embeddedness perspective[9].Shi and Zhang divided the divisive faultlines in the characterization of the innovation network caused by the differences in the strength of inter-organizational relationships and differences in the status of inter-organizational status into the relationship divisive faultlines and status divisive faultlines[13].

4. Outcome mechanisms of divisive faultlines

4.1 Executive team decision-making

Due to the existence of multiple demographic characteristics differences among corporate executive team members, divisive faultlines are prone to arise within the executive team, leading to the formation of internal cliques, which in turn affects the internal decision-making of the executive team. Richard found that TMT relationship divisive faultlines negatively affect the direction of corporate strategic change, while the TMT task divisive faultlines, however, positively affect corporate strategic change[11]. Shin and You predicted and verified that demographic characteristics-based divisive faultlines hinders the board's ability to decide to fire the CEO; whereas information-based divisive faultlines can improve the board's ability to fire the CEO executive officer's ability[14].

4.2 Organizational performance

In the context of collaborative innovation, divisive faultlines, as a tendency to cause internal divisions in technological innovation networks, are widely considered to be detrimental to the creation of collaborative environments, impede cross-functional cooperation within organizations as well as cross-organizational cooperation, and have a significant impact on organizational performance.Based on multilevel theory, Bezrukova found that team divisive faultlines are negatively related to team performance; organizational divisive faultlines are also negatively related to Organizational performance is also negatively related; at the same time, divisive faultlines are more harmful to organizational performance in organizations with higher pay levels[4].Valls found that divisive faultlines have a significant negative impact on organizational performance by acting on task conflict, team reflection, and negative team emotions[15].

4.3 Enterprise innovation

In the context of technological innovation networks, divisive faultlines deepen the process of generating modular and factionalized network subgroup structures through similarity selection and local search mechanisms. Firms within the same subgroup tend to share similar technological paradigms and innovation capabilities, and the network cross-subgroup cooperation behavior is intensified, which has an important impact on firm innovation. Guo and Wang verified that the impact of network divisive faultlines on the S&T innovation capability of gazelle firms has an inverted U-shape relationship[16]. Wei verified that divisive faultlines as the overall network differentiation tendency caused by the difference of shared experience among members have a positive effect on enterprise transgression innovation[17]. Kang and Liu verified that technology innovation network divisive faultlines have a positive effect on enterprise innovation exclusivity by taking the group of high-tech enterprises participating in cooperative R&D as the research object[18].

5. Mechanisms of action of divisive faultlines

By summarizing the relevant literature, it is found that there is a paucity of studies that use divisive faultlines as mediating variables.Yu found that both technology innovation network relationship divisive faultlines and innovation divisive faultlines play a partial mediating role between psychological distances and intra-subgroup reciprocity, while they do not play a mediating role between psychological distances

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and inter-subgroup reciprocity[8].

In this paper, we categorize studies involving divisive faultlines as moderating variables into two groups: performance perspective, and innovation perspective. From the performance perspective, Calabro found that knowledge-based divisive faultlines positively moderated the positive impact of entrepreneurial orientation on family firm performance[19]. Mach and Baruch verified that diversity divisive faultlines negatively moderated the relationship between team trust and team performance[20]. From the innovation perspective, Shi and Zhang empirically found that the network relationship splitting fault and status splitting fault positively moderated the relationship between firm network embeddedness, firm structural embeddedness, and breakthrough innovation capability, respectively[13]. Wei and Dang explored that divisive faultlines negatively moderated the relationship between selective patchwork and innovation catalysis, while they did not significantly moderated the relationship between parallel patchwork and innovation catalysis[21].

6. Summary and prospect

In this paper, through the form of literature review, the research related to the divisive faultlines of technological innovation network is systematically sorted out, and the following conclusions are drawn: scholars mainly define it from the three levels of team, organization and network. The dimensional division of divisive faultlines is mainly carried out from three aspects, namely, demographic characteristics, performance status and network attribute characteristics. The outcome mechanism of divisive faultlines focuses on executive team decision-making, organizational performance and corporate innovation. Regarding the research on the action mechanism of divisive faultlines, it is currently focused on discussing its regulating mechanism, and mainly from the perspectives of performance and innovation. However, considering the divisive faultlines as a new structural feature of technological innovation network, which can be explored in the following aspects in the future.

First, extending the connotation of divisive faultlines in relation to network subgroups. The current connotation of divisive faultlines at the network level focuses on the tendency to differentiate within the network. Combining the theory of faults and the theory of cohesive subgroups, it can be seen that the core mechanism of faults is the possibility of subgroup formation and the clarity of the boundaries between subgroups. Therefore, how to consider the importance of network subgroups in the extension of divisive faultlines connotation is an important direction for future research.

Second, it explores the basis for the divisive faultlines division of micro attributes in network inter-firms. Existing research based on the dimensional division of macro attributes among network enterprises, often taking the technological innovation network as a reference basis, considering the overall situation among enterprises, has certain limitations. The value concept, development potential, employee quality and other meso-micro attributes of network enterprises better reflect the similarity of inter-enterprise selection, and more satisfy the deep-seated factors of the divisive faultlines dimension division.

Third, expanding the mechanism and application scope of divisive faultlines. Currently, empirical research on divisive faultlines focuses on the outcome mechanism and the regulating mechanism, and the scope of application focuses on enterprise performance and innovation. In the future, we should strengthen the investigation of the antecedent and mediating mechanisms of divisive faultlines, and expand the scope of research to the overall effect of technological innovation networks, for example, to explore the impact of divisive faultlines on network strength, network density, and network subgroups.

Fourth, research on the time effects of reinforced divisive faultlines. Existing empirical studies mainly focus on activated divisive faultlines. However, the cyclic process from inactivated to activated to inactivated requires the regulation of time. Therefore, the divisive faultlines is not static, but a cyclical evolutionary process, and the future should focus on exploring the possible temporal effects of the divisive faultlines and the impacts it brings.

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