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Conflict coping strategy evolution of top management team members in China's family enterprises

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Abstract

Purpose – Conflicts among top management team (TMT) members have a significant impact on sustainable development of family enterprises in China. The complex attributes of different kinds of conflicts in a TMT have dual effects on firm performance and its stability. Thus, avoiding conflicts in a TMT through a systematic conflict management strategy is very important. This paper aims to therefore investigate how to maximize the performance and income level of the TMT in family enterprises through managing conflict systematically, while adopting the best conflict coping strategies.

Design/methodology/approach – In this study, the authors apply conflict coping strategies as a useful tool of conflict management and propose five kinds of dynamic conflict coping strategies among TMT members. Repeated game and multi-agent simulation by computer experiment are used to dynamically simulate the rules and evolution of individual conflict coping strategy choices.

Findings – It is found that with the passage of time, different conflict coping strategies have different effects on earnings of individuals and teams at different conflict levels. It is also revealed that conflict coping strategies affect not only the earnings of individuals and teams but also their distribution; it also reflects the conflict level in TMT of a family enterprise but in reverse.

Originality/value – This study contributes to the existing literature on conflict management in relevance to the choice and revolution of conflict coping strategies in a Chinese business culture context. It focuses on strengthening the unity and cooperation of TMT members. Controlling the conflict level of TMT members at a reasonable level, investigating the primary cause of conflict and identifying its nature lead to better performance of the TMT and the sustainable development of Chinese family enterprises. Based on these outcomes, different conflict coping strategies can be appropriately used to solve TMT conflicts.

Keywords Computational experiment, Conflict coping strategy, Conflict level, Multi-agent simulation, Repeated game, TMT members

Paper type Research paper

Introduction

Over the past three decades, the tremendous growth performance of China's economy has made China the fastest growing emerging economy in Asia. With the structural adjustment

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of China's economic growth, family enterprises play a vital role in the growth of the Chinese economy. The role of successful family enterprises is the most important element that attracts great foreign attention and promotes export. In the 1980s, Hambrick and Mason (1984) proposed the "upper echelon theory", which examines the strategic decision to transfer the family business from the sole entrepreneurs to a top management team (TMT). In a transitional economy, "there's only perfect team rather than perfect individual" is a faith to lead the operation of the business. The success of family enterprises relies mainly on the technical expertise and leadership styles of TMT members and human capital. Conflicts in the TMT are inevitable because of different interests and different leadership styles, which differentiate their overall objectives for the enterprise.

Conflict management serves an important role when a family enterprise needs to make strategic decisions about a company's long-term goals, as well as its routine operations. Appropriate conflicts management strategies are useful for the sustainable development of family enterprises. Studies have found that appropriate conflicts coping strategies can inspire employee interest and curiosity to produce better ideas and promote the business. Hoffman and Maiern (1961) investigate how group members with different interests show stronger ability in developing new ideas and solving problems. Amason (1996) shows that cognitive conflict affects the quality of decision-making positively, whereas emotional conflict jeopardizes the decision-making process. Similarly, many studies consistently agree that an appropriate conflict level has a significant positive impact on decision-marking, financial performance, innovation of enterprises and their organizational performance (Jehn and Mannix, 2001; Simons and Peterson, 2000; Ensley *et al.*, 2002; Du and Chen, 2009; Zhang *et al.*, 2011). However, Parayitam and Dooley (2011) observe that an appropriate conflict level benefits team performance up to a certain point, but an increase in conflict level beyond that leads to reduction of positive impact because of excess team members' cognition. It also hinders the efficiency of information processing. According to contingency theory (Jehn and Bendersky, 2003), the positive effect of conflict will fully materialize once it is effectively managed in an appropriate way and language. Here the question arises whether team conflict shows a constructive effect, and this largely depends on the way team members manage or cope with conflict (Tjosvold *et al.*, 2006; Behfar *et al.*, 2008; Tjosvold, 2008). Conflict levels influence the conflict management strategies that TMT members choose and vice versa.

Although many researchers have studied conflict management, most studies have used quantitative and qualitative methods that are relatively isolated and static (Euwema, 2014). However, some have dynamically studied TMT members' conflict coping strategy choices (Tessier *et al.*, 2006). In addition, in recent years, the development of computational experiments and evolutionary game theory has enriched research methods for TMT conflict and conflict management strategies (Sheng, 2011). Keeping in view this previous work, this study proposes five conflict coping strategies for TMT members, based on a computer simulation and using the Chinese business culture environment. Furthermore, this research builds a model of multi-agent artificial bodies based on abstracted personality traits and behavior rules. To simulate the evolution of conflict coping strategies of TMT members we use computational experiments. Through the analysis of the micro-individual and "emergence" phenomenon, this research paper explores the evolution of TMT members' conflict coping strategies and behaviors. We also study their corresponding earning arising from different conflict coping strategies under different conflict levels and in different cycles with the help of computational experiments on the multi-agent system (MAS) modeling technique.

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Literature review

Top management team

TMT first appeared in the strategy management-related works in the 1970s, and the TMT has been seen as an organization operation center. They affect the company's strategic direction and realize the growth and value of enterprise through strategic decision-making (Hambrick *et al.*, 2015). It is the TMT of the strategic decision-making in the organization, which is the core factor affecting enterprise development and determining enterprise performance (Qian *et al.*, 2013). Hambrick and Mason (1984) argued that the heterogeneity of TMT members means that the members have different views and perspectives on the same one problem, so the choice of conflict management strategy is not the same. Organizational learning theory points out that the relationship between enterprise growth, strategic decision-making and the professional experience of TMT is consistent with the path of learning (Levinthal, 1997). In the network theory, the close connection between TMT members may hinder exploration but promote development (Coleman, 2003). On the contrary, structural holes promote the ability to explore and acquire diverse information (Goyal and Vega-Redondo, 2007). The enterprise's TMT is the core of enterprise strategic decision-making, and it plays an important role in helping the enterprise identify the relevant market and technical opportunities outside (Ou *et al.*, 2017). The literature of the existing upper echelon theory indicates that the characteristics of TMT members will significantly affect the judgment of the enterprise's ability and the understanding of the external environment of the enterprise, which affects the direction of enterprise strategic decision-making (Wong *et al.*, 2011). According to the study of sociology, the social characteristics based on the similar age and experience background can form a social fault line in the TMT. It will impede the formation of a unified and consistent social cognition, but it can help enterprises make breakthrough in the exploration-style innovation decision-making. From the perspective of cognitive perspective, it shows that the internal differentiation in cognition of the TMT can effectively prevent the collective cognitive defects. It is easy for TMT to challenge traditional models and techniques to explore innovation (Eesley *et al.*, 2014).

Conflict of top management team

Conflict as a common and inevitable phenomenon exists at all levels of enterprises' management (individual, team or group, organization level, etc.) and has recently received more attention from researchers and practitioners. Policymakers require considerable time to deal efficiently with conflicts. McDonald and Bendahmane (1987) argue that conflict among TMT members is a deadly game. Jehn and Mannix (2001) explore team conflict as a perception of different cognition among the team members that leads to uncommon and inconsistent goals for the firm within team. In addition, some scholars argue that team conflict refers to incompatible and inconsistent goals, interests and cognition among team members, resulting in psychological or behavioral conflict and leading to contradiction and disputes. The study of Amason (1996) found that conflict has its own specific reasons, and unresolved conflict will reproduce new conflict. Team conflict is a process where an individual senses a threat to his/her own interests or psychological abuse because of other team members. Team conflict is a "double-edged sword". On the one hand, it produces diverse ideas and innovative plans. On the other, it fosters interpersonal tension and conflict between team members. The TMT has the responsibility of decision-making and dealing with more complex professional environment. Interactions between TMT members not only affect team effectiveness and performance but also determine the development and destiny of the

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enterprise through its strategy development and strategic choices (Hambrick and Mason, 1984). In the strategic decision-making process for enterprises, it is the responsibility of the TMT to inform everyone about decision-making and task assignments and to deal with conflict if that arises in the process. Task conflict and relationship conflict among team members often occur and are hard to avoid. Conflict in teams is inevitable. Hence, how to effectively inhibit the negative impact of conflicts is a challenge for the TMT.

Conflict management and conflict coping strategies

Zhang *et al.* (2011) investigate conflict management as an important part of the team's daily management, and it is also the main factor that impacts interaction and communication within a team. Tjosvold *et al.* (2003) explore how using the right conflict management strategy can effectively alleviate the negative impact of destructive or dysfunctional conflict, which further leads to good team management and brings effectiveness to the organization. Rahim (2002) concludes that conflict management should try to reduce conflict that has a negative influence on organizational and individual performance and to maintain proper conflict management that has a positive effect. Group members should take constructive ways to deal with conflict. Early studies of conflict management strategies were more focused on one dimension, which meant that when conflict was encountered, management chooses between competition and cooperation (Gleditsch *et al.*, 2014). Blake and Mouton (1964) proposed the managerial grid model and initially argued that conflict management was "a two-dimensional square lattice model", they divided the conflict management model into five conflict management strategies: confrontation, smoothing, forcing, withdrawal and compromising. It also included two dimensions of "concern about people" and "concern about production" (Figure 1).

A subsequent series of related studies (Thomas, 1992; Montoya-Weiss *et al.*, 2001; Somech *et al.*, 2009; Tjosvold *et al.*, 2016) interpreted and classified these five coping behaviors from different perspectives, although there were differences in the definitions and classification in the dimension of conflict management strategies. The two-dimensional conflict management model has become mainstream in current research. Different approaches, which classify conflict management, are like the two sides of a coin: the only difference is perspective. Existing conflict management strategies have been relatively isolated and static in their approach. If each activity of a team is seen as a conflict process, then conflicts certainly often occur in a team. Once conflict occurs, it may lead to a series of other conflicts, and all conflicts will have relationships among themselves. This will lead to severe conflict in the TMT. TMT members will use different conflict management strategies for different people and at different times to avoid the occurrence of severe conflict between different groups. We can dynamically simulate various conflict coping strategies that TMT

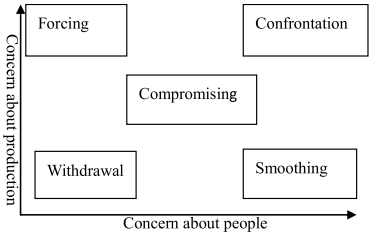

Figure 1.
Conflict management strategies

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members will use under different circumstances in real situation. Thus, this paper proposes five conflict coping strategies for TMT. The five types of strategies are observed and developed from reality and the Chinese traditional philosophy. We also consider the different personality traits of TMT members. We therefore innovatively establish the dynamic conflict coping strategy spaces (TFT, D, C, C1 and C2); Tit-For-Tat (TFT) is from a famous experiment. D (Defection) and C (Cooperation) are derived from different personality traits. C1 (compromise once) and C2 (compromise twice) are from Chinese traditional philosophy of "Three Strikes and You Are Out" and also considering the personality traits (Table I).

Of the strategies in Table I, TFT is from a famous experiment[1]. This strategy shows a superior performance in experiments and reveals why self-interested individuals choose cooperation (Axelrod, 1997). Cooperation is an important way to maximize self-interest and the profitability of the firm. At the same time, this strategy also reflects the Chinese philosophy of "Beat Someone at Their Own Game", and it motivates others to cooperate and work toward common company goals. Defection (D) is a typical behavior, which often emerges in the team and leads to severe conflict. Individuals usually adopt an uncooperative attitude of escaping or retreating when they are faced with conflicts and difficulties. Cooperation (C) reflects a positive attitude toward conflict. TMT members in family enterprises tend to choose the strategy of cooperation for smooth functioning. It has been observed that in a complex game environment, cooperation is not always the only best choice. C1 means he will choose corporate strategy once even if his neighbor chooses defection. If the second time his neighbor still chooses defection, he will change to defection too. It means he will forgive the other once. C2 means he will choose corporate strategy twice even if his neighbor chooses defection. If the third time his neighbor still chooses defection, then he will change to defection too. It means he will forgive the other twice. Strategies – compromise once (C1) and compromise twice (C2) – not only reflect personality traits when coping with conflict but also fit the Chinese traditional philosophy of "Three Strikes and You Are Out".

Methodology

Description of top management team members' game relationship

The snowdrift game can be described as follows. Two cars are driving in the same direction on the same road. A snowdrift blocks the road. Only by shoveling the snowdrift aside can the two vehicles continue to move on. If two people shovel the snowdrift together, they will pay cost c. If only one shovels the snowdrift, he/she needs to pay cost b, and $b > c$, and smoothing the road will bring benefit p to everyone ($p > b > c$). If they shovel the snowdrift together, their earnings are $R = p - c/2$ (each bears the cost of $c/2$). If only one person shovels the snowdrift, although both people can move on, the benefit for the defector is $T = p$, while the cooperator's earning is $S = p - b$. If both choose defection, their vehicles will not

Table I. Conflict coping strategies of TMT members

No.	Conflict coping strategies	Mark	Brief description
1	Tit-for-tat	TFT	Treat others in the same way as they treat you
2	Defection	D	Always in opposition state
3	Cooperation	C	Always in cooperation state
4	Compromise once	C1	When conflict occurs, forgive other person once
5	Compromise twice	C2	When conflict occurs, forgive other person twice

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move forward, and the benefit for both is $P = 0$ (Hauert and Doebeli, 2004). The pay-off matrix of the two players in the snowdrift game is shown in Table II.

If one chooses defection (does not shovel the snowdrift), then the best strategy for the other is getting out of the car to shovel the snowdrift aside because the income ($p - b$) of getting home on time is more than the income from defection (staying in the car). Conversely, if the other chooses to shovel the snow, then the best strategy for the second person is to stay in the car comfortably. This is like the game relationship of an enterprise's TMT members in their work. If TMT members work together, work can be successfully and quickly completed, compared with working alone and waiting for others to complete the task. The amount of cost paid will reduce, as $b - c$. Members of the TMT who appreciate higher risk may have other ideas (such as hitchhiking as a solution in the game example), thinking that eventually others will complete all the tasks, and so they are likely to adopt a defection strategy and believe that they may not be observed doing so or be punished for their behavior. They can get income of p without any payment. If both the players adopt this attitude, this may lead to the task remaining unfinished: ultimately, these two players may get zero income.

The snowdrift game describes two people facing a same problem and choosing mutual cooperation to obtain a common benefit or to cheat one another. There are two Nash equilibrium strategies in the snowdrift game, namely, (C and D) and (D and C), which do not lead to cooperation in the system. At the same time, cooperation is more likely to emerge in the snowdrift game compared with the prisoner's dilemma problem. The snowdrift game reveals the contradiction between individual rationality and group rationality, and this fits the game relationship of TMT members perfectly (Souza *et al.*, 2009).

The multi-agent model of top management team members in family enterprises

Simplification of the reality system and model assumptions. For further research and simulation, we choose a relatively typical family enterprise, which is involved with mobile communication products. This is a kind of distribution industry located in the Yangtze River Delta region in China. For convenience, we refer to the enterprise as X enterprise. The enterprise consists of eight TMT members. The members can be numbered from A to H. The relationships among these eight members are analyzed through a field survey without considering hierarchy and the importance of their position. This study uses a schematic model, which shows the real relationship among the eight members, as shown in Figure 2.

In the schematic model of eight TMT members' relationship presented in Figure 2, there is an interrelation of Member A with B, C, D, E, G and H. There is also an interrelation between Member B and Members A, E, F and H. Member C has a relationship with Members A, F and H, and Member D with Members A, E and G. Similarly, Member E directly relates to Members A, B, D and G. Member F directly relates to Member B, C and H. Member G directly relates to Members A, D and E. Member H and Members A, B, C and F are interrelated. Thus, we can build a relationship model of TMT members as shown in Table III.

Table II. Pay-off matrix of the two players in snowdrift game

	Player 2	
Player 1	Cooperation(C)	Defection(D)
Cooperation(C)	$p - \frac{c}{2}, p - \frac{c}{2}$	$p - b$ and p
Defection (D)	p *and* $p - b$	0 and 0

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It can be seen from Table III that the relationships between TMT members have typical nonlinear characteristics. If we simplify the structured relationship between the eight members to multiple sub-relationships, each sub-relationship consists of only two members. At the same time, during the team operation process, each specific task or each communication activity is an important task for the team. This can be viewed as a collection of sub-tasks. Each member of the sub-relationship participates in it. We observe that each sub-task corresponds to a game between two members. The conflicts of TMT members can be decomposed into a large number of pair-wise game relationships. Each member is the node in one or more games.

According to self-organization attributes of family enterprises, the TMT members' constitution has the characteristics of knowledge sharing, special affiliation and specific properties of demography and tasks other than normal organizational operations. As a result, this study considers individual members in family enterprises as different network nodes. Furthermore, the relationship between Members A and B will be treated as the connection of nodes. On the basis of that, we can describe the relationship between team members with the help of a network diagram. This research paper demonstrates the intrinsic links between team members' personal and relational information effectively. It explores the effective mechanism of how the link influences conflict through further analysis. Therefore, the computational experiment model for the game relationship of TMT members in family enterprise can be described according to the following basic assumptions:

- The number of TMT members is N. Every member has a task or interpersonal relationship with not less than one other member. The number of total relationships in the system is M, which can be described as$M = C_N^2/2$. The number of team relationships that actually exists is m ($m \leq M$). In the initial phase, the system generates the interrelationship between members at random. In the actual operation

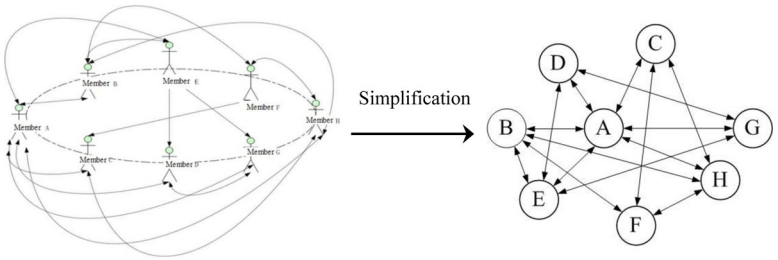

Figure 2.
Schematic model of TMT members' relationship

TMT Member's name	The members have relationship	The no. of relations
Member A	Member B, C, D, E, G and H	6
Member B	Member A, E, F and H	4
Member C	Member A, F and H	3
Member D	Member A, E and G	3
Member E	Member A, B, D and G	4
Member F	Member B, C and H	3
Member G	Member A, D and E	3
Member H	Member A, B, C and F	4

Table III.
Relationship model of TMT members

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of the TMT, various tasks generally have specific characteristics. These are determined by the different duties and working style of each TMT member. Therefore, the relationships between team members are fixed within every cycle of the business task. This means that the number of sub-tasks is determined in every cycle and the number of nodes is twice the number of sub-tasks.

- There are three different conflict levels in the system: strong conflict, medium level conflict and weak conflict. The initial conflict coping strategies are (TFT, D, C, C1 and C2) of two players in one task relationship that depends on different conflict levels in each sub-task. The proportions of individuals' conflict coping strategies under three different conflict levels are shown in Table IV.
- There is a snowdrift game in a sub-relationship in its corresponding sub-task. After completing a sub-task, both participants can obtain corresponding benefits, including psychological satisfaction, in achieving corporate goals and bonuses for themselves. Conversely, their benefits may be zero and the goal of the enterprise cannot be achieved.
- In each operation cycle, the members who were directly involved in sub-task relationships will choose conflict coping strategies based on certain rules. When both the members choose cooperation strategy, the required cost is equal to c, for example. When one chooses cooperation and the other one chooses defection. The cost of cooperation one to complete the task is b (where $b > c$). When both choose defection, the amount of cost is 0. If the task is completed, the benefit is p; otherwise, it is 0. Thus, we can get the following pay-off matrix of each TMT member, which describes the cost and benefit for members:

$$\begin{pmatrix} p-\frac{c}{2}, p-\frac{c}{2} & p-b, p \\ p, p-b & 0, 0 \end{pmatrix} \tag{1}$$

- The equation for team overall revenue for each work cycle is:

$$\mu = \sum_{j} \mu_j \tag{2}$$

$$\mu_j = \begin{Bmatrix} \gamma A_j{}^{\alpha} & sub-task\ has\ done \\ o & sub-task\ unfinished \end{Bmatrix} \tag{3}$$

Strategy	Weight	Strong conflict	General conflict	Weak conflict
TFT	$\omega 1$	0.2	0.2	0.2
D	$\omega 2$	0.4	0.2	0.15
C	$\omega 3$	0.15	0.2	0.4
C1	$\omega 4$	0.2	0.2	0.2
C2	$\omega 5$	0.05	0.2	0.05

Table IV. The proportions of individuals' conflict coping strategies under three different conflict levels

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where j is the number of the sub-task, corresponding to the one game relationship. Similarly, μ_j is the overall revenue of the team in one game and μ is the overall revenue of the team in a cycle. A_j is the team's value when sub-task j is completed. γ and α are constants greater than zero, reflecting the discounted value to the enterprise when sub-task j is completed successfully.

- Under the realistic scenario, each TMT member has several friends and relatives. Their identity will affect the member's strategy selection in the game. We assume that each member has no more than k ($0 \leq k \leq n$) friends in the system. The system randomly distributes friends of members at the beginning. This ensures that the friend relationship during each cycle is always stable in the game. The feedback information between friends is transparent. Friends learn from each other according to the principle of profit maximization. All this will reflect the abilities of an individual's self-adaptation and self-learning.

Multi-agent model building of top management team members based on repeated game

Experiment and the process design. The MAS (Lux and Marchesi, 1999; Olfati-Saber *et al.*, 2007) is composed of a large number of agents. Their characteristics are that they are autonomous, intelligent, interactive, self-organizing and self-learning. Each agent can complete its work according to appointments and can learn through information exchange with other agents to coordinate and solve problems in the system. As a sophisticated simulation modeling technique, the MAS has been widely used in the field of ecology, economics and social science research (Kim *et al.*, 2016). It can be followed and duplicated by the following process. The model in this research uses Delphi XE2 as the main development tool and the Oracle 11g database to store TMT members' initial personality traits, task relationship, the cycle interaction, the information of the learning process, the game decision-making process and income. The complex TMT member and game relationship of multiple agents, relationships agent and nodes agent are built in a systematic way. Each agent sets a unique identification number, maps the members' personality traits and assigns behaviors to the attributes and the rules of the agent. The multi-agent model is a kind of cycle game model. The total number of cycles is T ($t = 1, 2, \ldots, T$). On the basis of one's own property, the agent simulates other individual behaviors according to certain rules. It will play multi-agent repeated games with other agents in accordance with the rules of interaction that are regulated in advance. At the same time, the agents remember their previous game experience and earnings. They compare these with the cumulative earnings of all the other agents and their related friends in each cycle. They learn conflict coping strategies from friends and gradually adjust to improve their own strategy decisions. The system will observe and record the decision rules of each agent in each cycle. The model simulates the interaction process of TMT members' conflict relations in the real world and observes the changes of each member's strategy at the micro-level. This also analyzes evolutionary mechanisms of overall revenue at macro-level. The initialization stage will produce a certain number of different artificial key personnel with properties of personality traits, decision rules and the number of friends, according to system assumptions. For each scenario, according to the specified period cycle, the system will simulate the game process of agents and will save the process and the resultant data to the historical information database. Through the statistical analysis of historical data, we can observe the micro-expression of the participants and the macroscopic emergence of the system.

The work flow diagrams of the model are shown in Figure 3.

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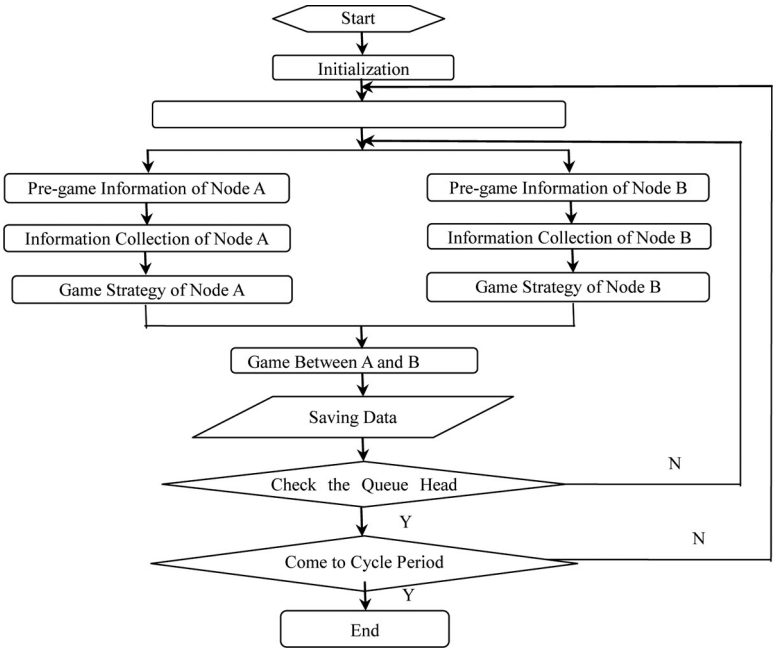

Figure 3.
Work flow diagrams of the model

According to the system hypothesis, at the initial stage, a certain number of agents with different personality traits, artificial decision-making rules, number of friends and different properties are generated. For each scenario, according to the specified process of the game cycle, the game relationships between artificial bodies are simulated. At the same time, we save the process and the resultant data to the historical information database. The micro performance and macro "emergence" of the system can be observed by analyzing the statistical and historical data.

Rules of the game. Definitions of the five kinds of conflict coping strategies are shown in Table V, which also shows the conflict coping strategies and their corresponding behaviors between Agents A and B.

The parameters of the system. "Agent" here represents the TMT members who have independent decision ability. The network is the working environment of agents. The nodes in the network are the real agents. One agent is associated with his/her friends, family and neighbors. When setting the public parameters, which are needed by the system simulation, for the individual parameters of the TMT, their relationship and personality traits, we try to consider the objective prototypes, which we received from the field survey. For some difficult to quantify parameters (such as labor quantity, cooperative income, etc.), it is observed that the value from reality that is obtained is different from that received from multiple training and tests in the system. The system parameters and initial assignment rules are shown in Tables V and VI.

Analysis of experimental simulations and results

A perfectly rational person existing in the real world is a rarity. The information between TMT members in family enterprise is incompletely transparent. The

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Table V. Corresponding behaviors and their corresponding behaviors between agents a and B

Strategy A	Strategy B	Behavior A	Behavior B	Task result	Strategy A	Strategy B	Behavior A	Behavior B	Task Result
TFT	TFT	Cooperation	Cooperation	Finish	C1	C	Cooperation	Cooperation	Finish
		Defection	Defection	Failure			Defection	Cooperation	Finish
	D	Defection	Defection	Failure		C1	Cooperation	Cooperation	Finish
	C	Cooperation	Cooperation	Finish				Defection	Finish
	C1	Cooperation	Cooperation	Finish			Defection	Cooperation	Finish
		Defection	Defection	Failure				Defection	Failure
	C2	Cooperation	Cooperation	Finish		C2	Cooperation	Cooperation	Finish
		Defection	Defection	Failure				Defection	Finish
D	TFT	Defection	Defection	Failure			Defection	Cooperation	Finish
	D		Defection	Failure				Defection	Failure
	C		Cooperation	Finish	C2	TFT	Cooperation	Cooperation	Finish
	C1		Cooperation	Finish			Defection	Defection	Failure
			Defection	Failure		D	Cooperation	Defection	Finish
	C2		Cooperation	Finish			Defection	Defection	Failure
			Defection	Failure		C	Cooperation	Cooperation	Finish
C	TFT	Cooperation	Cooperation	Finish			Defection	Cooperation	Finish
	D		Defection	Finish		C1	Cooperation	Cooperation	Finish
	C		Cooperation	Finish				Defection	Finish
	C1		Cooperation	Finish			Defection	Cooperation	Finish
	C2		Cooperation	Finish				Defection	Failure
C1	TFT	Cooperation	Cooperation	Finish		C2	Cooperation	Cooperation	Finish
		Defection	Defection	Failure				Defection	Finish
	D	Cooperation	Defection	Finish			Defection	Cooperation	Finish
		Defection	Defection	Failure				Defection	Failure

Variables/ parameters	Meaning	Value	Assignment rules
n	Number of members	8	Fixed value
m	Total number of relationship	20	Fixed value
P	Individual revenue	20	Fixed value
C	Cost needed for completing the task cooperatively	15	Fixed value
B	Cost needed for completing the task alone	17	Fixed value
A	Contribution to the team when the task is finished	50	Fixed value
k	Largest number of friends	5	Generated between 1 to 5 randomly
γ	First discount parameter of task value corresponding to the corporate earnings	1	Fixed value
α	Second discount parameter of task value corresponding to the corporate earnings	1	Fixed value

Table VI. The system parameters and initial assignment rules

personality traits and the attitude to tasks can affect an individual's learning and decision-making. This study classifies team members into three categories because of their personality traits by reference to reality and previous studies (Burgman and Yemshanov, 2013): conservative, neutral and flexible members. A conservative member insists on his/her previous strategy even if he/she knows the other strategy is better than the one he/she thinks of. A neutral person does not blindly follow a strategy which is of high benefit; that person will comprehensively think about others' strategies and his/her own historical information; for a different strategy, he/she will choose a different strategy or their previous strategy if the different strategy is not distinct from his/her own strategy. A flexible person prefers a strategy with high benefit and changes strategy easily. Conservative members will mainly adopt their original game strategies, but will also be influenced by surrounding friends to a very small degree of probability (the system sets this probability as equal to 10 per cent). Neutral members will have a 50 per cent probability of adopting their friend strategy. The flexible person will compare his/her earning of with those of friends. He/she will have a higher probability (90 per cent) of choosing the higher earning strategy. The individual's learning and adopting mechanism was introduced to adjust the individual's learning rules and sets the cycle T = 100 in the experiment. The system takes bounded-rationality personality traits into consideration to simulate the game process of team members.

Distribution of top management team members' different conflict coping strategies

Distribution of TMT members' conflict coping strategies at different conflict levels are shown in Figure 4, which consider the personality traits of bounded-rationality persons. Figure 4(a) describes the conflict coping strategies distribution and evolution at a "strong conflict level". Figure 4(b) describes the distribution at a "general conflict level". Similarly, Figure 4(c) describes the distribution at a "weak conflict level". The horizontal axis of the figures is the cycle period. The vertical axis is the conflict coping strategy distribution of TMT members, where the value 0-1 represents strategy of TFT, the value 1-2 represents strategy of D, the value 2-3 represents strategy of C, the value 3-4 represents the strategy of C1 and value 4-5 represents the strategy of C2.

Figure 4, considering bounded-rationality characteristics, shows that distributions of TMT members' conflict coping strategies are obviously different because many members

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choose Strategy D at the beginning and combine it with TFT strategy. This will lead all the game players to choose Strategy D. Hence, members who choose the TFT strategy decline with the passage of time at the three conflict levels, which is particularly obvious in "strong conflict" and in "weak conflict". Specifically, with the passage of time, more members choose strategies C and C2 in "weak conflict" teams. The probability of choosing Strategy D is more at the beginning, which results in a member's average income close to 0. Hence, at the subsequent game, the number of members who choose D is greatly reduced and more are likely to choose C or C1 and almost none choose C2 in "strong conflict" team. Because of its relatively flexible game environment, members in the "general conflict" team will seek to maximize their own interests, and their strategy choices are well diversified. At the general conflict level, numbers of members who choose strategies of TFT, C2, C and D are all relatively higher. At the same time, the experimental results also show that we can estimate the team's conflict level through the distribution of team members' conflict coping strategies. Hence, we can resolve and alleviate conflict through different strategies to enhance the team's cohesion and improve the proportion of cooperation between team members.

The average earning of top management team members of different strategies under different conflict level

TMT members' average earnings through different strategies at different conflict levels and at different cycle periods are shown in Figure 5, where the horizontal axis represents the cycle period and the vertical axis shows the earnings. In Figure 5 (a), (b) and (c), earnings of Strategy D fluctuate greatly at different conflict levels: higher in the early stages of the game, but, with the passage of time, high earnings in early stages will decline rapidly, which is more obvious in "weak conflict level" and "strong conflict level" teams. The earnings of Strategy D gradually decline to 0. Ultimately, Strategy D disappears from teams. TMT members' average earnings from Strategy C decline over time in "weak conflict level" teams, and remain relatively stable in "general conflict level" teams. However, there is a waved increasing trend in "strong conflict level" teams. This is because the average earnings of Strategy C in one game are lower than in multiple games. Similarly, if Strategy C is only slightly changed by team members, this strategy will bring greater earnings, especially in "strong conflict level" teams. Strategy C can attract more cooperative members who choose Strategy C1. The waved increasing tendency of C earnings indicates that this is the best way to resolve conflict and increase revenue and cooperation in the TMT. The earnings from TFT and C1 also fluctuate across different conflict level teams. C1 rapidly disappears in "weak conflict

Figure 4.
Distribution of TMT members' conflict coping strategies at different conflict levels

Notes: (a) Weak conflict; (b) general conflict; (c) strong conflict

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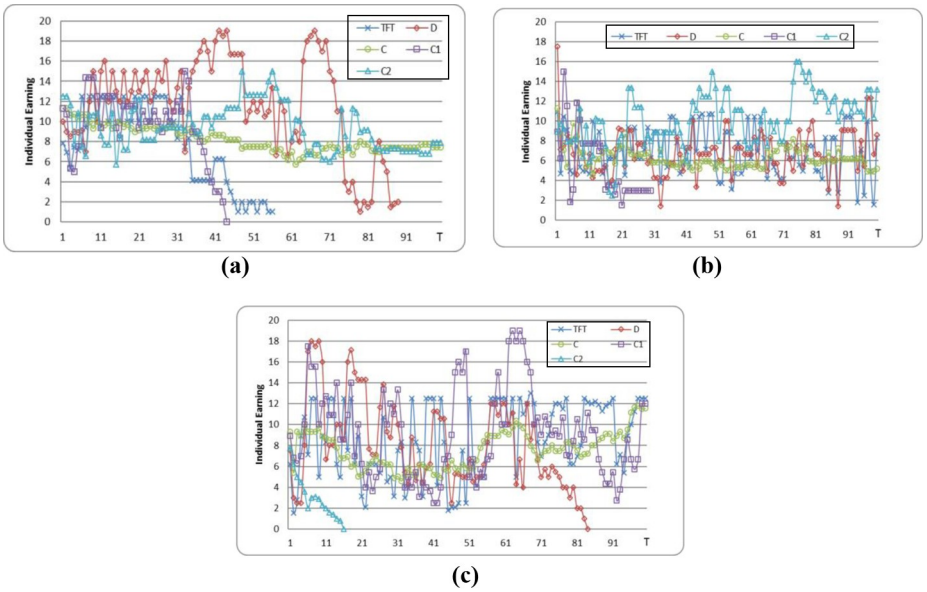

Figure 5.
TMT Members' average earnings through different strategies at different conflict levels

Notes: (a) Weak conflict; (b) general conflict; (c) strong conflict

level" and "strong conflict level" teams. Earnings from C2 fluctuate in "weak conflict level" and "strong conflict level" teams, and it is always expected to be high in "general conflict level" teams. From Figure 5(a), (b) and (c), we can see that TMT members' average earnings decrease with an increase in conflict levels, and vice versa, this holds true for the same relationship across the conflict levels.

Earnings of cooperators and defectors in different conflict coping strategies

The earnings of cooperators and defectors in different conflict coping strategies in different conflict levels are calculated in three dimensions of the team, which are presented in Table VII. Data in Table VII show that the maximum earnings of defectors are up to 20. However, the high variance indicates the higher level of risk of obtaining maximum earning. This also holds true for the famous saying of "the higher the risk, the higher the return". The maximum earnings of cooperators can achieve earning value of up to 12.3. Defectors who choose Strategy D can achieve the highest average earnings. The average earnings of cooperators who choose strategies of TFT and C2 in "weak conflict level" teams are assumed to be high. Members who choose Strategy C receive the minimum earnings with low risk. Hence, from the perspective of the individual, although defectors can get maximum earnings because of the high level of risk, the strategy of cooperation is the best choice for team members rather than strategy of defection. The number choosing cooperation in "weak conflict level" team is greater than that in "strong conflict level" and "general conflict level" teams. The number choosing cooperation is less than the number choosing defection in "strong conflict level" and "general conflict level" teams. The number choosing cooperation is higher than the number choosing defection in "weak conflict level" teams, which is different in "strong conflict level" teams.

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Table VII. Earnings of cooperators and defectors in different conflict coping strategies in different conflict levels

		Game players								100 periods cycle	
		Cooperators				Defectors					
Conflict levels	Conflict coping strategies	Maximum earning	Minimum earning	Average earning	Variance	Maximum earning	Minimum earning	Average earning	Variance	No. of cooperation	No. of defection
Weak conflict	TFT	12.5	12.5	12.5						124	58
	D					20		12.84	91.94		324
	C	12.5	3	8.33	22.23					1682	
	C1	12.5	3	12.4	0.93	20		7.04	91.22	96	54
	C2	12.5	12.5	12.5		20		7.9	95.61	364	1298
General conflict	TFT	12.5	12.5	12.5						382	339
	D					20		6.69	89.04		1211
	C	12.5	3	6.23	20.25					1121	
	C1	12.5	3	7.82	22.56	20		1.67	30.56	67	36
	C2	12.5	3	11.06	11.63	20		9.86	99.98	79	765
Strong conflict	TFT	12.5	12.5	12.5						271	164
	D					20		7.54	93.93		881
	C	12.5	3	8.01	22.49					1587	
	C1	12.5	3	9.71	18.74	20		7.93	95.71	17	1072
	C2	12.5	3	7.75	22.56					4	4
Avg.		12.5	6.17	10.11	17.67	20		7.68	86		

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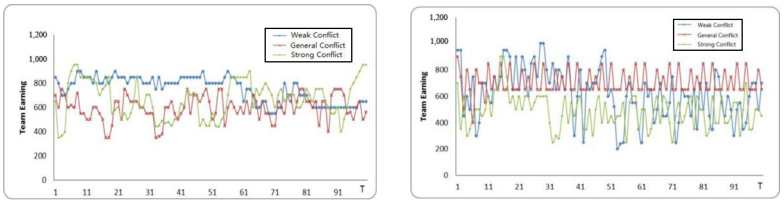
Total revenue of different conflict levels

Total revenue at different conflict levels, considering personality traits and not considering them, is shown in Figure 6, where the horizontal axis represents the cycle periods and the vertical axis represents total revenue.

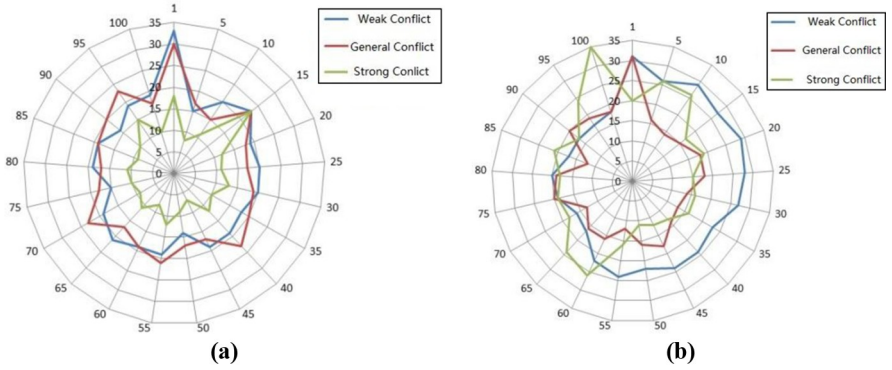
The cooperation times in different cycles at different conflict levels

Radar charts of cooperation in different cycles at different conflict levels are presented in Figure 7, one aspect of which considers personality traits. In Figure 6, when considering personality traits, total revenue at a "strong conflict level" is improved greatly compared with total revenue in Figure 6(a) (no personality traits). This is up to the total revenue at the "general conflict" level with no personality traits, but the fluctuation is highly significant. Total revenue at the "general conflict" level in the earlier stage is high, but at the later stage, it declines. Total revenue at the "general conflict" level considering personality traits decreases compared with no personality traits. The change in total revenue at different conflict levels is because of personality traits, which leads team members to assess their revenue and conflict coping strategies. This also reflects the contradiction between individual rationality and team rationality. Overall, total revenue at a "weak conflict" level is higher than at a "strong conflict" and "general conflict" level. Total revenue at a "weak conflict" level is relatively stable, but there is a decreased trend at the later stage. This shows that conflict has a positive



Notes: (a) No personality traits; (b) considering personality traits

Figure 6.
Total revenue at different conflict levels



Notes: (a) No personality traits; (b) considering personality traits

Figure 7.
Radar charts of cooperation in different cycles at different conflict levels

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effect, but excess conflict leads to "collective blindness", which is bad for the team performance. The key point, then, is how to realize the unification of individual interest and team interest and to realize the win-win benefit between individuals and teams. Compared with Figure 7(a), which does not consider personality traits, the cooperation times in different cycles at a "strong conflict" level in Figure 7(b) are greatly increased. This is because the frequency of change of their strategies decreases for profit maximization. On the whole, cooperation times at a "weak conflict" level are higher than at "general conflict" and "strong conflict" levels.

The contribution of different conflict coping strategies to team earnings

The contribution of different conflict coping strategies to team earnings, considering members' personality traits at different cycle periods, is shown in Figure 8, where the horizontal axis represents the cycle periods and the vertical axis represents the average contribution to team earnings. It is obvious from Figure 8 that the contribution of Strategy C to the team average earnings is always the largest, no matter what the kind of conflict level. The contribution of D is certainly lowest. We conclude from Figure 8 (a), (b) and (c) that the contribution of conflict coping strategies (except for C) to team earnings is in the range 15-25 in "weak conflict" teams. The contribution of conflict coping strategies (except for C) is in the range 7-20 in "general conflict" teams. The contribution of conflict coping strategies (except for C) is in the range 5-15 in "strong conflict" teams, which shows that, with an increase of conflict level, the contribution of conflict coping strategies (except for C) to team earnings has a negative relationship and decreased tendency. In general, the contribution of Strategy C leads to high team earnings, and vice versa. However, the contribution of Strategy D is certainly the least. This is because of the inhibitory effect of TFT on D. The contribution of Strategy D disappears, and the strategies of C1 and TFT in the end become more

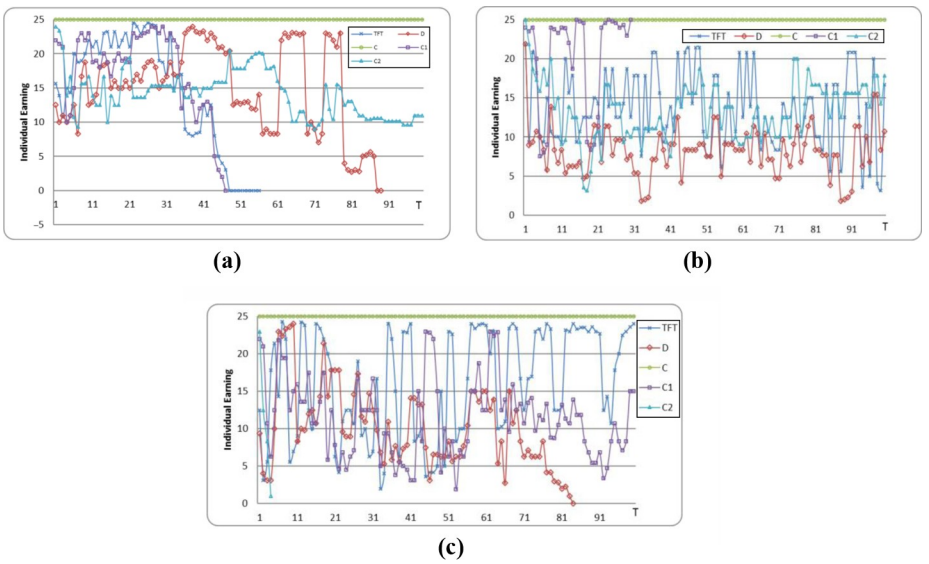

Figure 8.
The contribution of different conflict coping strategies to team earnings

Notes: (a) Weak conflict; (b) general conflict; (c) strong conflict

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contributory at the "strong conflict" level. Similarly, the contribution of Strategy C2 to team earnings is greater than from any other strategies at the "general conflict" level in the last stage of the process.

Discussion and conclusion

Conclusion

This study proposes a series of conflict coping strategies based on the Chinese business cultural context and Western conflict management strategies, which are both dynamic. The snowdrift game, as a game of relationships among TMT members in their tasks of a family business, is introduced. A TMT member adopts different conflict coping strategies, based on the game strategy of other TMT member players. Then multi-agent modeling experiments and numerical simulation are used to simulate the conflict coping strategy choice of TMT members and the evolution of the average income of TMT members and the team. The average income of TMT members and the team is simulated under different conflict coping strategies. This examines the evolutionary rules of members' conflict coping strategies and behaviors at different conflict levels and different cycle periods at the macro-level when considering the different personality traits of members. The effect of conflict coping strategies on the earnings of members and teams are also studied at the micro-level, as explained below.

First, the study shows that different conflict levels have a highly significant impact on team members' conflict coping strategies; for example, the agents who choose compromise are those members who more likely to choose C1 in "strong conflict" teams and those who choose C2 are in "weak conflict" and "general conflict" teams. These strategy choices have significant positive effects on the improvement of team cooperation level and team performance. Results for other conflict coping strategies also show that different strategies have different effects on team performance. Obviously only managers who can grasp the nature of conflict comprehensively can use a variety of conflict coping strategies properly, solve conflicts effectively and improve the cooperation behaviors and the cohesion of a team.

Second, different coping strategies impact on members' average earnings. Earnings from Strategy D fluctuate greatly. This is higher in the early stage of the game, but with the passage of time, high earnings at the early stage decline rapidly, which is more obvious in "weak conflict" and "strong conflict" teams. Earnings gradually decline toward 0. TMT members' average earnings from C decline over time in "weak conflict" teams and remain relatively stable in "general conflict" teams. However, this shows a waved increasing trend in the "strong conflict" team. Hence, D is not the best choice. The best way to solve conflict and increase revenue is cooperation among team members.

Third, contributions of different conflict coping strategies to team earnings vary based on different behavior approaches. In general, the contribution of Strategy C to team earnings is highest. The contribution of Strategy D to team earnings is least.

Finally, different conflict levels can impact two kinds of important relationships:

(1) conflict coping strategies and members' average earnings; and

(2) contributions of different conflict coping strategies to team earnings.

Members' earnings and team earnings are both related to the good performance of the organization. TMT members' average earnings and contributions of different conflict coping strategies to team earnings increase with a decrease in conflict levels, which also leads to increase in the collective team performance and can help achieve organizational objectives.

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Management implications

In this paper, dynamic conflict management strategies based on the Chinese business cultural context and Western models are proposed. The different conflict coping strategy choice of TMT members at different conflict levels are simulated by means of multi-agent computation experiments. The income level of TMT members and teams is also explored through the analysis of micro individual agents and the macro "emergent" phenomenon in the MAS. The following management suggestions are offered.

First, the conflict level of the TMT should be exactly identified. A high conflict level is not conducive to increase in individual and team income. Therefore, the conflict level of the TMT should be controlled within a reasonable range. Necessary conflict coping strategies should be used to control that conflict level. Furthermore, based on this research, the conflict level of TMT can be recognized by observing the distribution of conflict coping strategies adopted by TMT members.

Second, appropriate conflict coping strategies should be adopted to meet the recognized conflict level of the TMT to optimize the income of TMT members and the income of the team. Only by identifying the conflict level of the TMT and using a variety of conflict coping strategies appropriately can cooperation frequency be improved and conflict be managed effectively. The cohesion of the TMT in the family enterprise can be improved. Furthermore, this will be conducive to the improvement of TMT performance and the sustainable development of family enterprises.

Third, no matter what kind the conflict level of the TMT is, with the evolution of time, betrayal is not the best choice. Cooperation is the best way to resolve conflicts and improve income for TMT members. Therefore, to maximize the overall interests of the TMT in family enterprises and to improve the performance of the TMT, the family owners or the CEO should focus on strengthening the unity and cooperation of TMT members. In addition, they need to control the conflict level of TMT members at a reasonable level and learn the primary cause of conflict to take necessary measures for identifying the nature of conflicts. Based on these conceptions, different conflict coping strategies can be used appropriately to solve contradiction or conflict among TMT members. These strategies increase the cohesion of a team. Increasing cohesion leads to achievement of the enterprise's main goals of growth and profit maximization (Wu *et al.*, 2015).

Limitations and further research

The properties of the agents are abstracted from reality in this study, but this study did not consider all the demographic characteristics of agents, such as age, importance of TMT members' positions and their impact on their conflict coping strategy choice. To a certain extent, this reduces the verifiability of the agents' information. In addition, although the relationship between the TMT members in the family enterprise is real, the research conclusion of this study is based on theoretical analysis and computer simulation. This can be further researched in future through case studies, root theory and empirical research, to support and improve the results of this paper.

Note

1. The Tit-for-Tat experiment was conducted by Professor Robert Axelro at the University of Michigan.

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