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## **Revisiting Job Performance in Biotechnology Industry: Evidence from SEM and fsQCA**

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### **Abstract**

Because of the broad applications and compelling advantages, biotechnology successfully draw the attention of investors and scientists in the past two decades. The highly research/skill-intensive nature of biotech industry makes it highly capital-intensive and human resource-dependent. According to the resource-based theory, organizational behavior plays a critical role in sustaining an above-average performance. Based on these regards, in this study we investigated the identifying antecedents or determinants affecting employee's job performance in biotechnology industry, with a special focus on the relationships among innovation, leader-member exchange, task conflict, job satisfaction, and job performance. An online questionnaire survey method was employed to collect primary data from employees of biotechnology industry. To explore the gap between symmetric and asymmetric thinking in data analysis, two methods, structural equation modeling (SEM) and fuzzy set qualitative comparative analysis (fsQCA), were applied and their results were compared. The results of SEM indicated that both innovation and leader-member exchange have significant effects on task conflict and job satisfaction. Task conflict and job satisfaction are associated with job performance. The results of fsQCA proposed that employee can achieve high job performance when high level of leader-member exchange with high innovation.

**Keywords:** Innovation, leader-member exchange, job performance, SEM, fsQCA

### **1. Introduction**

The biotechnology industry is a highly valued industry in recent years. Sun (2010) expresses that the 21st century is a bio-economic era, and almost all biotechnology-related products and companies, such as diseases, food, energy, environment and medicine. Both need biotechnology to solve. Biotechnology research has had a major impact on the environment, medicine, agriculture, and food in recent years. Biotechnology has made great strides in drug, energy and technology reforms that benefit human health and survival (Yeung et al. 2019). Biotechnology is not only helpful for human survival, but according to Lokko et al. (2018) suggests that biotechnology can promote national development and inclusiveness, especially food, health, industrial innovation, consumption and production.

Deng et al. (2019) indicates that most countries have already planted biotech-modified crops, which can increase crop productivity and increase global competition opportunities. Biotechnology can be of great help to developing countries. Biotechnology not only solves global problems in agriculture, health care and energy production but also prevents the loss of biological biodiversity (Ocana et al. 2019). Based on these regards, this study focuses on biotechnology industry.

In addition, employee differs greatly from robot. In the context of employee's behavior, researchers in the fields of human resource management or organizational behavior theory have focused on job performance and paid much attention to explore the antecedents, consequences, and typologies of job performance. For instance, Alegre, Mas-Machuca, and Berbegal-Mirabent (2016) further suggest that job performance is one of the important roles that influences personnel decisions (e.g., salary, employee advancement and retention). Accordingly, job performance can play a critical role in human resource or organizational behavior, and this study contributes to identify antecedents or determinants leading to employee's job performance in biotechnology industry.

Several researches proposed that innovation and leader-member exchange (LMX) might be key factors or major antecedents of job performance. In discussing work performance, innovation and LMX are the main variables. Innovation is the main driver of economic growth and productivity. Innovation can create jobs and promote economic development. In general, innovation can solve many countries facing Problems and challenges (Avenyo, Konte, & Mohne, 2019). And at the enterprise level, innovative and lasting letters are a fundamental source of strength for long-term competition (Guarascio & Tamagni, 2019). Some studies suggest that these sources of competitive advantage stem from the results of organizational innovation-promoting technologies (Wang & Chen, 2019). Arranz, Arroyabe, and de Arroyabe (2019) expresses the company uses organizational innovation to achieve its goals, including operational efficiency, quality control, product and process innovation. Therefore, innovation is the most important means of company performance. LMX emphasizes that people like to communicate with different types of people who can benefit from them and support them (Berg et al. 2017). Positive LMX can increase employee creativity. DeConinck (2009) represents that the quality of LMX will affect job performance, citizenship behavior, job satisfaction, organizational attitude and salary satisfaction. Therefore, innovation and LMX can affect the performance of human resources and organizational behavior. Through research innovation and LMX, it is helpful to understand the factors that employees mainly influence the performance of employees in the biotechnology industry.

Studies advanced that task conflicts and job satisfaction are affected by innovation and LMX, ultimately affecting job performance, so task conflicts and job satisfaction may be secondary factors in job performance. Task conflict and job satisfaction see secondary causes, Rose et al. (2007) indicates that task conflict can reveal differences. The point of view, which leads to a more comprehensive consideration of things and can make better decisions. Task conflict can provoke critical thinking to prevent premature conclusions (Jimmieson, Tucker, & Campbell, 2017). Li, Li, and Lin (2019) shows that conflict can promote communication between members so that they can understand tasks more. Ozpehlivan and Acar (2015) represent that job satisfaction is one of the important structures of organizational culture, which can provide long-term productivity for the organization. Companies can learn about employee separations and organizational commitments through job satisfaction surveys (Macintosh & Krush, 2014). The job satisfaction survey can be used to assess the employee's work experience and emotional state, and the company can be informed of the employee's emotional state (Alegre, Mas-Machuca, & Berbegal-Mirabent, 2016). As stated above, the employee's task conflict and job satisfaction will affect the relationship between the superior and the subordinates, product innovation and employee innovation, and ultimately affect the employee's work performance.

The biotechnology industry is centered on job performance because work performance is one of the influences of personnel decisions and job performance can be seen by employees' ability to see employees' work ability. Innovation and LMX are the main reasons for job performance because innovation is long-term competition. One of the sources of strength and innovation is the most important means of company performance, and LMX is the degree of harmony between company organizations, and the quality of LMX will affect job performance. Task conflict and job satisfaction are secondary causes because task conflicts can drive communication, reflect and promote organizational performance, while job satisfaction can understand employee emotions and job quality and can affect job performance.

## 2. Literature review and hypotheses development

The relationship between innovation and conflict can be known from previous literature. Clercq and Belausteguigoitia, (2017) expresses that one of the factors that indicates the effectiveness of a company's innovation is conflict. When there is a conflict between the company's shareholders and shareholders, it may affect the company's decision-making because of the conflict, which affects the company's investment in innovation (Cucculelli & Peruzzi, 2020). Clercq et al. (2008) indicates that the company can increase the relationship between innovation policies and performance. However, when innovation is affected by conflict, conflict can lead to negative emotions for employees, making it impossible for employees to think or execute innovative decisions (Wang, Su, & Guo, 2019).

Based on previous research, we can understand the relationship between innovation and job satisfaction. For instance, Jensen, Liu, and Schott (2017) shows that when companies have innovative jobs, they can evoke positive emotions and increase job satisfaction. Lee et al. (2017) suggests that when employees are eager to innovate, the company's impact on innovation will have a greater impact on employee job satisfaction.

The company's innovative activities will lead to increased job satisfaction for researchers and employees will be committed to innovation (Cheng, Lai, & Wu, 2010). Neto, Rodrigues, and Panzer (2017) indicates that the company's innovative entrepreneurial activities can effectively improve employee job satisfaction. Innovative and flexible organizational culture can increase employee job satisfaction (Islam et al., 2014). Based on these studies, we propose the following hypotheses to explore the relationships among innovation, conflict, and job satisfaction.

H1: Innovation is associated with task conflict.

H2: Innovation can enhance job satisfaction.

Predecessors can learn about the relationship between LMX and conflict. Boss and subordinates have high-quality LMX to reduce conflicts at work (Huang et al., 2008). LMX can alleviate the problems and conflicts between the boss and the subordinates. The higher the quality of LMX, the work. There will be fewer conflicts (Montani, Courcy, & Vandenberghe, 2017). Hooper and Martin (2008) shows that in the team, bosses and employees can increase LMX through respect, trust and resource allocation. When LMX is reduced, the positive relationship between teams will decrease, leading to conflicts. Liao et al. (2017) expresses that when employees can accept the difference with their superiors, they will receive more attention from their superiors and better relations with their superiors, while employees who cannot receive them will. Differences in LMX can lead to conflicts in the team. The quality of LMX and the clear role of subordinates can reduce conflict or turnover intentions (Tastan & Davoudi, 2015).

Research in recent years has understood the relationship between LMX and job satisfaction. LMX will increase quality with good communication between superiors and subordinates, and will increase performance, commitment and job satisfaction, etc., making the relationship between superiors and subordinates better (Volmer, Spurr, & Niessen, 2012). Harris, Wheeler, and Kacmar, (2009) suggests that the quality of LMX is enough to improve communication and rewards. When the quality of employees' LMX is improved, they will improve their job satisfaction and performance. Cogliser et al. (2009) indicate that the superiors in the LMX relationship have a good relationship with the subordinates, which will make employees have higher job satisfaction. Therefore, the following hypotheses are developed.

H3: LMX can reduce task conflict

H4: LMX can enhance job satisfaction

The relationship between conflict and job performance can be understood from previous studies. Karatepe and Kilic (2007) shows that conflicts can have a negative impact on employee performance and reduce employee performance. Eddleston, Sieger, and Bernhard (2019) suggests that task conflicts can affect employee performance, because meeting family or play needs can result in reduced time or effort, resulting in a significant drop in employee performance. Increasing conflicts can lead to increased employee pressure, declining employee performance and increasing turnover intentions (Mulki, & Wilkinson, 2017).

The relationship between job satisfaction and job performance can be known from recent studies. Job performance and job satisfaction are positively related (Hayati, & Caniogo, 2012). In addition to understanding the status of employees at work, employees' job performance can be known, and employee satisfaction can lead to declining employee performance (Lu, Zhao, & While, 2019). Ismayilova and Klassen (2019) indicates that when employees are satisfied with stress and the work environment, Increasing jobsatisfaction will increase job performance. When satisfaction is high, employees will Being more active and improving job performance (Graces, & Ferreira, 2019). Lambert et al. (2019) suggests that increasing job satisfaction can reduce the company's chances of employee turnover and improve job performance. Based on these regards, this study develops the following hypotheses to explore the relationships among task conflict, job satisfaction, and job performance.

H5: Task conflict is associate with job performance

H6: Job satisfaction can enhance job performance

### 3. Method

#### 3.1 Measure development

The definition of innovation of this study is the implementation of a new or significantly improved management, work concept, product, process, marketing or organization.

Innovation can solve social problems more quickly, effectively and continuously than existing solution based on Arranz et al. (2019), Guarascio and Tamagni (2019), and Wang and Chen (2019). According to Bodlaj, Maglajlic, and Vida (2019), this study focused on product innovation and service innovation to measure innovation, and developed eight items to measure product innovation and service innovation. This study defines LMX as a quality of relationship between supervisors and subordinates. This relationship is also called "vertical dyad Linkage". According to Dai et al. (2019), SchwepKer and Good (2017), we developed five items to measure LMX. The definition of task conflict in this study is that members have disputes when they perform tasks, work development, resources and work assignments, strategies, benefits, opinions and opinions, resulting in tension between teams. Based on Li et al (2019), and Rose et al. (2007), we developed five items to measure task conflict. Job satisfaction is defined as the degree of employee that satisfies with interpersonal relationships, role requirements, job quality, environment, salary, and outcomes. According to Kwak et al. (2019), we developed six items to measure intrinsic job satisfaction and extrinsic job satisfaction. Job performance is defined as the extent to which employees perform behaviors, abilities, and outcomes under normal work conditions. According to Clercq and Belausteguigoitia (2017), Lee et al. (2017), Li et al. (2019), and Rose et al. (2007), we developed five items to measure job performance.

#### 3.2 Sampling design and sample

The structure of this study was established by the relationships among innovation, LMX, task conflict, job satisfaction, and job performance. We used online surveys to collect primary data from people that had work experience in biotech industry to evaluate the applicability of conceptual model. The survey was created using Google Forms. Participants need to evaluate their idea of the project according to the 7-point Likert scale (i.e., 1 means strongly disagree and 7 means strongly agree). The questionnaire was sent via Line, E-mail, and Facebook. The sampling process runs from October 2019 to October 2020. Finally, 222 valid samples were obtained. Table 1 shows the basic attributes of the subjects. In this study, more than 53.6% of the subjects are male (119 males, 53.6%). Most subjects are unmarried (125 single, 56.3%). Biotechnology (e.g., research assistants, R&D staff, and so on.) and other occupations account for the most (i.e., Biotechnology 72 people, accounting for 32.4%; other 56 people, 28.8%, and the sum is 61.2%). More than 61.3% of subjects are 21 to 35 years old (i.e., 57 people are 21 to 25 years old, 25.7%; 83 people are 26 to 35 years old, 37.4%, and the sum is 61.3%). More than 72.5% of the subjects' highest academic qualifications are college or university and graduate school (i.e., college or university 106 people, 47.7%; Graduate school 55 people, 24.8%, and the sum is 72.5%). More than 50.3% of subjects' annual income are USD \$25,000 to \$45,000 (i.e., 120 people, 54.0%). Accordingly, we can identify the main attributes of the sample structure in this study.

Table 1 Sample structure

Variable	Option	Frequency	Valid Percent	Cumulative Percent
Gender	Male	119	53.6	53.6
	Female	103	46.4	100.0
Marriage	Married	97	43.7	43.7
	Single	125	56.3	100.0
Occupation	Student	27	12.2	12.2
	Retail/Customer service	34	15.3	27.5
	Government	25	28.8	38.8
	Employee/Teacher	72	11.3	71.2
	Biotechnology (ex.: R & D staff ...)	64	32.4	100.0
	Others	64	32.4	100.0
Age	< 21 years old	9	4.1	4.1
	21~25 years old	57	25.7	29.7
	26~35 years old	83	37.4	67.1
	36~45 years old	30	13.5	80.6
	46~55 years old	32	14.4	95.0
	56~65 years old	9	4.1	99.1
	> 65 years old	2	0.9	100.0
Education	High school (include under)	53	23.9	23.9
	College/University	106	47.7	71.6
	Graduate school	55	24.8	96.4
	Doctor	8	3.6	100.0
Average annual income (USD)	under \$25,000	23	10.4	10.4
	\$25,001- \$35,000	66	29.7	40.1
	\$35,001- \$45,000	54	24.3	64.4
	\$45,001- \$55,000	35	15.8	80.2
	over \$55,001	44	19.8	100.0

#### 4. Results of data analysis

Factor analysis focuses on identifying common factors of each research construct (i.e., innovation, LMX, task conflict, job satisfaction, and job performance). Based on Hair et al. (2019), this study employs rules including values of KMO (Kaiser-Meyer-Olkin) must be greater than 0.5, preferably between 0.5 and 0.8, and most preferably greater than 0.8. Table 2 shows the results of factor analysis and reliability analysis. These results show that the five research constructs' values of KMO are greater than 0.8. Therefore, the confirmation data is consistent with factor analysis. Eigenvalues of five research constructs are over 3.5, cumulative(%) are greater than 70%, and values of Cronbach's alpha are over 0.89. In other words, items of innovation, LMX, task conflict, job satisfaction, and job performance have high validity and consistency.

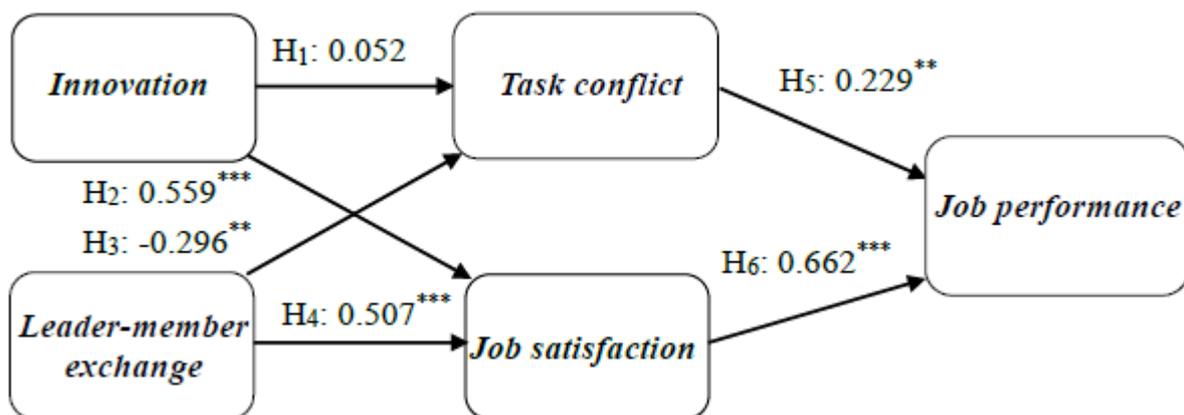
**Table 2 Results of factor analysis and reliability analysis**

Constructs	Items	Values of KMO	Eigenvalue	Cumulative (%)	Cronbach's alpha
Innovation	8	0.902	4.075	81.496	0.942
Leader-member exchange	5	0.874	3.729	74.573	0.914
Task conflict	5	0.884	3.829	76.586	0.923
Job satisfaction	6	0.862	3.597	71.939	0.902
Job performance	5	0.838	3.508	70.161	0.891

Figure 1 show the results of the structural equation modeling in Biotechnology. According to Hair et al. (2019), the model fit indexes in this study including Minimum value of discrepancy, C, divided by its degrees of freedom (CMIN / DF) value is less than 3 (i.e., 1.043), Goodness of fit index (GFI) value is greater than 0.9 (i.e., 0.913), Adjust goodness of fit index (AGFI) value is greater than 0.9 (i.e., 0.908), Comparative fix index (CFI) value is greater than 0.9 (i.e., 0.992), and Root mean square error of approximation (RMSEA) value is less than 0.08 (i.e., 0.025). Based on these results, the research framework of this study has a good model fit in group of biotechnology.

In addition, results of path analysis indicate that innovation is not associate with task conflict (i.e., H1 is not supported, standardized regression weight is 0.052, C.R. is 0.369, and p-value is 0.712), but innovation can enhance job satisfaction (i.e., H2 is supported, standardized regression weight is 0.559, C.R. is 4.974, and p-value is 0.000). Leader-member exchange can reduce task conflict (i.e., H3 is supported, standardized regression weight is -0.269, C.R. is -2.051, and p-value is 0.040), and leader-member exchange can enhance job satisfaction (i.e., H4 is supported, standardized regression weight is 0.507, C.R. is 4.719, and p-value is 0.000). Task conflict is associate with job performance (i.e., H5 is supported, standardized regression weight is 0.229, C.R. is 2.360, and p-value is 0.018). Job satisfaction can enhance job performance (i.e., H6 is supported, standardized regression weight is 0.662, C.R. is 4.504, and p-value is 0.000).

Figure 1 Results of SEM in Biotechnology



Notes: \* indicates p-value < 0.1; \*\* indicates p-value < 0.05; \*\*\* indicates p-value < 0.01

Table 3 show the results of fsQCA in Biotechnology. The present study transforms ordinary data into fuzzy sets, recognizes configurations, employs standard analysis, and provides the intermediate solution to combine relevant antecedents (i.e., innovation, LMX, task conflict, and job satisfaction) into various causal recipes to explore the configurations for achieving high job performance based on user's guide of fsQCA.

According to Ragin (2017), the value of solution coverage must greater than 0.1 and the value of solution consistency must greater than 0.6. Table 3 indicate value of the solution coverage is 0.866 (>0.1), and value of solution consistency is 0.979 (>0.6). Based on results, there are three sufficient conditions (i.e., 1A, 1B, and 1C) found to achieve high job performance in Biotechnology, and these configurations have good coverage and consistency. Path 1A indicates that low leader-memberexchange (i.e., LMX), high task conflict (i.e., TC), and low job satisfaction (i.e., JS) can reach high level of job performance (i.e., JP). Path 1B shows height level of LMX, TC, and JS can reach high level of JP. Finally, path 1C represents that high innovation (i.e., IN), high LMX and high JS also can reach high level of JP.

**Table 3 Results of fsQCA in Biotechnology**

Path NO.	Antecedent				Coverage	Consistency
	IN	LMX	TC	JS	Raw	
1A		○	●	○	0.231	0.969
1B		●	●	●	0.488	1.000
1C	●	●		●	0.820	0.986
Solution	Coverage				0.866	
	Consistency				0.979	

5.

Not: IN means Innovation; LMX means Leader-member exchange; TC means Task conflict; JS means Job satisfaction. black circles “●” indicate the presence of causal conditions (i.e., antecedents). White circles “○” indicate the absence or negation of causal conditions. The blank cells represent “don't care” conditions.

## Discussion

### 5.1 Conclusion

In terms of Biotechnology, path analysis of Biotechnology indicate that innovation is not associate with task conflict (i.e., H1 is not supported.), but innovation can enhance job satisfaction (i.e., H2 is supported.). Leader-member exchange can reduce task conflict (i.e., H3 is supported.), and leader-member exchange can enhance job satisfaction (i.e., H4 is supported.). Task conflict is associate with job performance (i.e., H5 is supported.). Job satisfaction can enhance job performance (i.e., H6 is supported.). In terms of non Biotechnology, path analysis indicate that innovation is associate with task conflict (i.e., H1 is supported.), and innovation can enhance job satisfaction (i.e., H2 is supported.). Leader-member exchange can reduce task conflict (i.e., H3 is supported.), and leader-member exchange can enhance job satisfaction (i.e., H4 is supported.). Task conflict is not associate with job performance (i.e., H5 is not supported.). Job satisfaction can enhance job performance (i.e., H6 is supported.). Based on results, in biotechnology, innovation is not affect task conflicts, and task conflicts improve job performance. The opposite is true for non-biotechnology. In non-biotechnology, innovation is increase task conflicts and task conflicts have no significant impact on job performance.

The fsQCA results show that in biotechnology, there are three groups of sufficient conditions 1A, 1B and 1C, and in non-biotechnology, there are four groups of sufficient conditions 2A, 2B, 2C and 2D. In the biotechnology and non-biotechnology groups, only 1A and 2C have the same sufficient conditions, and the other five groups have different sufficient conditions. In biotechnology, tack conflict in the sufficient condition of 1B and innovation in the sufficient condition of 1C are alternative. When the sufficient conditions have high leader-member exchange and high job satisfaction, the lack of high innovation can be used to increase task conflict instead of increasing job performance. On the other hand, when the sufficient conditions have high leader-member exchange and high job satisfaction, lack of high tack confliction can be used to improve innovation increase job performance.

## 5.2 Managerial implications

The results of path analysis show that innovation can increase job satisfaction. According to the SEM results, I02 (Our company use the fewest amount of materials to include the products for conducting the product development or design.) has the lowest average value (i.e., Mean = 4.79) and has the most growth potential. Therefore, companies can increase innovation by reducing the number of materials used in product development or design. For example, some laboratories reuse frozen centrifuge tubes after high-pressure and high-temperature sterilization; some laboratory products are manufactured by recycling waste. In addition, according to the descriptive statistical analysis results, the lowest standard deviation of I06 (Our company continuously improve old and services and raise the quality of new products.) (i.e., Standard deviation = 1.29) represents the highest consistency of opinion.

As a result, companies can increase innovation by adding or changing services. For example, a company can provide sample sampling, add service locations in various locations, or provide online services. LMX can improve job satisfaction and reduce job conflicts. According to the SEM results, the average value of LMX03 (My supervisor understands my potential.) is the lowest (i.e., Mean = 4.92). Companies that want to reduce job conflicts or increase job satisfaction should focus on understanding their potential. For example, supervisors should communicate more with their subordinates and get along with their subordinates; supervisors can conduct more ability assessments on their subordinates. According to the descriptive statistical analysis results, LMX05 (I am willing to apply extra efforts, beyond those normally required, to meet my supervisor's work goals.) has the lowest standard deviation (i.e., Standard deviation = 1.31), which indicates that the opinion has the highest consistency. Boss can trust the ability and attitude of subordinates. For example, the boss can explain more things to his subordinates. Task conflict can improve job performance.

According to the SEM results, TC04 (There is tension between me and my colleagues.) has the lowest average value (i.e., Mean = 3.62). When the company wants to improve work performance, it can increase competition among employees. For example: the boss proposes to let the employees think of the plan and choose the best; the company can let the employees propose new product ideas. According to the descriptive statistical analysis results, the lowest standard deviation (i.e., Standard deviation = 1.61) of TC05 (My opinion or thoughts about teamwork are different from my colleagues.) indicates that the opinion consistency is the highest. In a team situation, task conflicts among employees increase. For example, when employees must operate the instrument together or discuss experimental issues together, conflicts may arise due to different methods or different ideas. Job satisfaction improves job performance. According to the SEM results, the average value of JS05 (The prestige of my position inside the company (that is, the regard received from others in the company).) is the lowest (i.e., Mean = 4.88), and respect between colleagues or supervisors will affect to job satisfaction. For example, the supervisor's attitude towards subordinates will affect the subordinates' completion of work.

According to the descriptive statistical analysis results, the lowest standard deviation (i.e., Standard deviation = 1.27) of JS04 (The opportunity in my work position to give help to others.) Represents the highest consistency of opinion. Mutual help from bosses or employees can increase job satisfaction. For example, the supervisor can allocate some work to his subordinates when he has too much work to bear. According to the results of fsQCA, task conflict is most important in the biotechnology industry, and innovation is most important in the non-biotechnology industry.

## 5.3 Limitation and future research

The research objects, research period, research method and research structure are the three research limitations of this research. In terms of research object, the research objects of this research are the biotechnology industry and the non-biotechnology industry. In the follow-up or future research, the non-biotechnology industry can be changed to a specific industry (for example: technology industry, service industry, etc.) In the limitation of research period, the research time of this research is from October, 2019 to October, 2020. The follow-up study can be extended to one or two years to explore the long-term relationships among research constructs. Among the limitations of the research methods, this study uses multivariate analysis and online questionnaires. In subsequent studies, qualitative research and other multivariate analysis methods can be considered and data can be collected using interviews or telephone interviews.

Finally, within the limitations of the research structure, the research framework of this research is innovation, leader-member exchange, task conflict, job satisfaction, and job performance. Other factors (such as environmental factors, work-family conflict, subjective well-being, etc. personality traits, etc.) can be added to subsequent studies.

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