A Research on R&D Efficiency of New Products by Cross-functional Collaboration: Taking Yunnan Characteristic Industry as an example

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Abstract. In order to research on the impacts of communication, cooperation degree and knowledge sharing on the R&D efficiency of new products during the process of cross-functional collaboration, this paper selected ten R&D teams from Yunnan characteristic industries and enterprises to conduct the questionnaires and interviews with an aim of structuring theoretical model by means of structural equation model(SEM) and obtained data from surveys. After the analysis of model, it showed that communication did positive and remarkable impact on cooperation degree, knowledge sharing and R&D efficiency of new products, knowledge sharing did so on cooperation degree and the latter did so on R&D efficiency of new products.

1. Introduction
Recently under the high attention paid by Yunnan Provincial Government, Yunnan characteristic industries such as biological agriculture, biological medicines, bio-energy have achieved the remarkable development due to rely on the distinctive climate condition, geographical environment and ethnic flavor. However, most Yunnan characteristic industries faced the tough situation in the fierce environment of competition because of the limitations such as the loss of core techniques, the weakness of innovation and so on. At present, few researches on cross-functional collaboration in external or internal R&D team of new products in Yunnan characteristic industries could be referred to, this paper tried to analyze the influence mechanism of communication, knowledge sharing and cooperation degree on the R&D efficiency of new products in accordance with the results of surveys and interviews with those ten teams, and proffer the theoretical base for enhancing the R&D efficiency of new products of Yunnan characteristic industries.

2. Research model and assumption
At the early phase, the subject group illustrated the major factors impacting on the cross-functional collaboration of Yunnan characteristic industries were communication, cooperation degree and knowledge sharing. In order to research on the relations between these three factors as well as the influence mechanism of R&D efficiency of new products, the subject group, on the basis of referring to a large amount of relevant research findings and combining the features of Yunnan characteristic industries, structured the theoretical model( Table 1) and put forward six assumptions H₁:
communication revealed the positive impact on the cooperation degree between functions; H2: communication did positive impact on R&D efficiency of new products; H3: communication exerted the positive influence on knowledge sharing between functions; H4: knowledge sharing exerted positive impact on R&D efficiency of new products; H5: knowledge sharing revealed positive impact on cooperation degree between functions; H6: cooperation degree did positive impact on R&D efficiency of new products.

Table 1: Theoretical Model of this research.

| Path Relationship                                      | Corresponding Assumption |
|---------------------------------------------------------|--------------------------|
| Communication → Cooperation Degree                     | H1                       |
| Communication → R&D efficiency of new products          | H2                       |
| Communication → Knowledge sharing                      | H3                       |
| Knowledge sharing → R&D efficiency of new products      | H4                       |
| Knowledge sharing → Cooperation Degree                  | H5                       |
| Cooperation Degree → R&D efficiency of new products     | H6                       |

3. Research Design

This study selected ten enterprises in fields of biological agriculture, biological medicine, bio-energy and etc., which showed willingness to work in with this subject research in Kunming, Yuxi, Wenshan, Dali, Lijiang and other districts in Yunnan. The survey was conducted in the form of questionnaires, designating the main participants and middle and senior executives of the enterprises as well as the participants of departments involved in R&D of new products for getting the high-quality data. 175 pieces of questionnaires has been given out, in which the valid ones amounted to 152 pieces with the valid recovery being 86.9% after the contradictory data and 13 pieces with obvious errors being deleted.

Likert 7-point Scale was adopted as the measure of questions in this questionnaire, number 1 indicated totally unmatched, number 7 represented totally matched, number 4 represented medium indicator. With regard to the questionnaire, ten experts (two professors and eight project leaders dealing with new products R&D) mainly started from cross-functional collaboration of internal and external R&D team of new products, and then discussed about the formation on the basis of the obtained maturity scale and substantial references after check and rectification. Finally, this questionnaire was made up of 12 questions. In detail, the communication part consisted of four measuring indexes: the valid exchange between R&D team, between departments of enterprises, with the suppliers and the clients; cooperation degree consisted of four indexes: the manufacturing department participated in the new product R&D process, the key clients took part in the new product R&D process, the long-term cooperative suppliers and the marketing department reflected the information of users and products promptly; knowledge sharing consisted of four indexes: the sharing of valid knowledge in R&D team, the new product training for marketing personnel held by R&D department, the R&D team knew about the latest technique level of manufacturing department and the R&D department mastered the latest product function and development trend from the suppliers, the R&D efficiency of new products consisted of four indexes including the date of new arrivals, amount, market reaction and users’ satisfaction.

4. Study result

In order to test the raised theoretical model, this paper adopted AMOS17.0 to analyze the structural equation, and SPSS19.0 to process other data.

The analysis of SEM mainly meant the inspection of the fitting between theoretical model and practical data from the aspect of the integrated model collocation degree. Regarding the integrated model collocation degree, it usually adopted the absolute collocation degree, incremental collocation degree and concise collocation degree as the evaluating factors. Table 2 referred to the evaluation of the integrated model collocation degree of SEM, from which the conclusion that the fitting degree of the integrated model of theoretical model was well could be led to.
Table 2: Evaluation of the Integrated Model Collocation Degree of SEM.

| Evaluating Indicator | Statistical Test | Collocation Standard | Fitting value of model |
|----------------------|------------------|----------------------|------------------------|
| Absolute Collocation Degree | $\chi^2$/df | $\leq$3.00 | 1.69 |
| | GFI | $>0.90$ | 0.91 |
| | RMSEA | $<0.05$ | 0.06 |
| Incremental Collocation Degree | NFI | $>0.90$ | 0.95 |
| | IFI | $>0.90$ | 0.97 |
| | CFI | $>0.90$ | 0.97 |

According to Table 3, all the assumptions were found to have passed the test except H4. Communication exerted the positive impact on cooperation degree, knowledge sharing and R&D efficiency of new products, in which knowledge sharing influenced cooperation degree while the latter affected R&D efficiency of new products likewise.

Table 3: Path Coefficient of Theoretical Model and Analysis of Assumptive Test Results.

| Path Relationship | Path Coefficient | P Value | Test Result |
|-------------------|------------------|---------|-------------|
| Communication $\rightarrow$ Cooperation Degree ($H_1$) | 0.18 | 0.01 | Supportive |
| Communication $\rightarrow$ R&D efficiency of new products ($H_2$) | 0.12 | 0.04 | Supportive |
| Communication $\rightarrow$ Knowledge sharing ($H_3$) | 0.55 | 0.00 | Supportive |
| Knowledge sharing $\rightarrow$ R&D efficiency of new products ($H_4$) | 0.09 | 0.32 | Unsupportive |
| Knowledge sharing $\rightarrow$ Cooperation Degree ($H_5$) | 0.70 | 0.00 | Supportive |
| Cooperation Degree $\rightarrow$ R&D efficiency of new products ($H_6$) | 0.78 | 0.00 | Supportive |

Note: Path coefficient is standardized value

From Figure 1, it revealed that cooperation degree exerted the largest impact on R&D efficiency of new products. Regarding communication, it not only had the direct impact on R&D efficiency of new products, but also indirect impact on R&D efficiency of new products by promoting knowledge sharing and cooperation degree. The direct impact of knowledge sharing failed to pass the evaluating indicator and this table affirmed that knowledge sharing did the indirect impact on R&D efficiency of new products by improving the cooperative relation.

5. Conclusion and Discussion

This paper analyzed the impact of three factors including communication, cooperation degree and knowledge sharing of cross-functional collaboration in R&D team of Yunnan characteristic industry on R&D efficiency of new products by means of SEM and theoretical model structure, and brought forth the following conclusions:
Communication is the core factor affecting R&D efficiency of new products. In accordance with Table 3 and Figure 1, it could be deduced that communication not only exerted the direct impact on cooperation degree, knowledge sharing and R&D efficiency of new products, but also had the indirect impact on it from the aspect of the advancement of knowledge sharing and cooperation degree. For the R&D team in Yunnan characteristic industries, they should focus on the communicative strategy between the external group, other functional departments in enterprises, the suppliers, the clients as well as scientific research institute to gain more innovative information, enhancing mutual cooperative relationship, improving the transformation and absorption of knowledge as well as keeping strengthening the R&D ability of new products. Besides, during the survey and discussion, the communication mode was confined to the forms of meeting, mutual visit and reports, and the amount and frequency of attendants were relatively low, which needed the enhancement furtherly.

Cooperation degree revealed the largest impact on R&D efficiency of new products. According to Figure 1, it was clear that cooperation degree showed the remarkable and direct impact on R&D efficiency of new products, the influence of which came as the largest among those three factors. Good cooperation relation was not only the passport to realize the expected work goal, but also the engine to promote the transformation and absorption of knowledge with an aim of converting to the innovative knowledge of new products.

Knowledge sharing exerted the indirect impact on R&D efficiency of new products. The invalid assumption shown in H4 illustrated that knowledge sharing failed to directly affect R&D efficiency of new products, while Figure 1 indicated that knowledge sharing was enabled to influence R&D efficiency of new products indirectly via cooperation degree, which confirmed that sharing knowledge could not be used to promote R&D efficiency of new products only if the valid absorption and cooperation were realized. A great amount of knowledge was the key factor in R&D efficiency of new products, but if the enterprises lacked the ability of utilization, transformation or absorption of knowledge, they would fail to apply the knowledge in R&D of new products. Hence, on premise of a great amount of knowledge and the good cooperation between R&D team and other functions, converting the obtained knowledge and recognizing innovation, the R&D team could apply the obtained knowledge in the R&D process of new products.

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