Solutions of Co-opetition in Building and Sharing Smart Campus

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ABSTRACT

Taking a practice of a higher vocational college and three major operators in the construction of information campus infrastructure as an example, this paper introduces the promotion effect of the co-construction and sharing model on the construction of smart campus, analyzes the co-opetition relationship between school and the operators, and discusses how school can play a leading role in the construction of a smart campus and achieve a win-win situation for all parties involved.

Keywords: Smart campus, co-opetition, education informatization

1. INTRODUCTION

Smart campus is the upgrading of digital campus. Through the integrated application of Cloud Computing, Big Data, IOT(Internet of Things), Mobile Internet, AI(Artificial Intelligence) and other technologies, it can realize the comprehensive perception, interconnection, resource sharing, system cooperation in the fields of education and scientific research, school management and service, promote the integration and innovation of core elements of school, and Build a new campus form characterized by smart technology, smart education, smart humanity, smart service, smart management and smart life for green, smart and sustainable development.

2. PROBLEMS IN THE CONSTRUCTION OF SMART CAMPUS

In the process of construction and operation of smart campus, we need to deal with three tasks: first, financing, second, the main body of project construction and cooperation mechanism, and third, long-term development Effective operation management. Generally, the following two problems will be encountered in the construction of smart campus.

From the perspective of construction funds, school has limited funds and needs social capital support. With the rapid development of information technology and short iteration period, the construction of smart campus needs a large amount of capital investment for a long time. The capital for running schools is usually limited. On the one hand, the construction of smart campus needs to actively apply for special funds for educational informatization, on the other hand, it needs to seek external investment.

From the perspective of technical support, schools and enterprises have their own advantages. Schools are institutions engaged in public service, focusing on human-oriented elements. The construction and operation management personnel of schools are technically inadequate. Their energy is diverted for teaching and scientific research tasks. The business field pays attention to profits and efficiency. The technical personnel of professional enterprises will be more familiar with mature technical solutions in the business field. The construction of smart campus carries out multi-party cooperation in the field of technology, which is conducive to achieving the same goal of intelligent teaching, life and learning environment.

3. MODEL OF BUILDING AND SHARING SMART CAMPUS

Among the elements of smart campus, the construction of information infrastructure is the cornerstone of smart campus. Transforming the basic network and improving the coverage of wireless broadband network are the preconditions for developing the upper application of smart campus. The construction of fixed network and wireless network is the main part of information infrastructure construction, which is consistent with the main business of communication network operators. The university market has the advantages of large scale, strong stickiness, good growth, high concentration and high return on investment. In recent years, operators pay more and more attention to and invest in this market. On the premise that the construction of smart campus needs attracting investment, most schools and operators negotiate around the "franchising".

According to the investors, the financing sources of the construction of smart campus can be divided into: school own capital investment, operator investment, third-party enterprise investment. Among them, the investment of operators can be divided into the investment mode of one operator or multiple operators. After the implementation of

the investment funds, according to the main body of construction project management, it can be divided into: school self-construction, operator construction (including construction by one operator alone and construction by multiple operators in blocks), and construction by a third-party company. The operation and maintenance after the completion of the project can be divided into: school self-maintenance or service outsourcing, operation and maintenance by the operator, and operation and maintenance by a third-party company jointly entrusted. In the smart campus co-construction and sharing project, the above investment, construction, operation and maintenance have a variety of combinations. The specific selection shall be determined according to the actual needs and project situation.

4. PRACTICE OF CO-CONSTRUCTION AND SHARING

Since 2015, Wuxi City College of Vocational Technology has cooperated with three major operators to build a smart campus project and put it into operation, realizing the "3 + 1" co-construction of information infrastructure, and the multi win cooperation of sharing resources such as campus fixed network and wireless network. The practical experience is summarized as follows.

4.1. Make the Top-Level Design of Smart Campus Scientifically

Avoid repeated construction and waste of resources due to poor clarity and coherence of top-level design. On the basis of the intelligent campus construction scheme designed by information technology experts, the information leading group will organize relevant departments of the College to discuss, go to brotherhood colleges and enterprises for on-the-spot investigation, invite the expert group with famous university experts as the main members to demonstrate the scheme, form a more scientific top-level design scheme, and lay the foundation for the subsequent co-construction and sharing.

4.2. Establish a Construction Team Led by the College

The construction of smart campus involves a wide range of aspects. No matter what kind of co-construction mode is adopted, an organization structure of centralized management should be established to avoid low efficiency cooperation such as prevarication and wrangle caused by the different interests of participants and different working methods. Prior to the commencement of the project, the CIO of the College shall take the lead to establish a project leading group with multiple parties participating in the project, exchange information, eliminate contradictions, and make unified scheduling. The minutes of the meeting shall

be well prepared and countersigned to ensure that the process of joint construction and sharing can be traced and clearly recorded.

4.3. Fair Competition, Block by Block Contract

WBS decomposition shall be carried out for the smart campus co-construction project, which shall be reasonably divided into project package and operation section according to the top-level planning, and the investor shall be invited to negotiate with each other to form the subcontracting scheme and bidding scheme recognized by all parties. This process must be fair and open. We must not only give full play to the economic and technological advantages of investors, but also form a unified understanding of win-win cooperation.

4.4. Technological Innovation

The process of building smart campus is gradual, new systems and old systems need to be integrated continuously, information infrastructure integration, software platform unification, smart teaching reform and so on are all continuous optimization processes, which need to be supported by new technologies and new processes. For example, by setting up BRAS, the higher vocational college realizes the connection between the Radius within school as the Radius Client and the Radius/Radius Proxy of the operator, achieves flexible billing, and provides technical support for shared resources.

Next, we will discuss how to achieve win-win situation of competition and cooperation.

5. ANALYSIS AND SOLUTIONS

Co-opetition is a business strategy based on game theory, which combines cooperation and competition. The traditional market competition is zero sum game, and the co-construction and sharing project is positive sum game. Through scientific design and technological innovation, the total income of all players is greater than the total input of players into the game.

There are many stakeholders involved in building and sharing of smart campus. For the convenience of analysis, we simplify the classification of cooperation and competition into two categories: between schools and operators, and between different operators. During the period of "franchising", operators gain profits through operation, generally by selling campus communication packages and collecting communication traffic fees. It can be regarded as a derivative mode of BOT (i.e. Build-Operate-Transfer). Due to the short iteration cycle of information technology products, often at the end of "franchising", the invested equipment can no longer carry the high-level application of smart campus, and the operation and maintenance costs are rising. Generally,

schools and operators want to maximize the total profit of "franchising" projects, and their goals are the same. Therefore, it can be considered that the game parameters between schools and operators are mainly the term of "franchising" and the total investment.

$$\max_C U(P,C) = \int_0^P [R - E(C,t)]dt - C \qquad (1)$$

The above Eq. 1 is the expression of the operator's profit maximization within the period of "franchise". C is the total investment of the operator, R is the income, E is the maintenance cost, P is the period of "franchise", $P = \lambda P_1$, $(0 < \lambda < 1)$, where P_1 is the effective operation period (i.e. the operation and maintenance cost $E(C,t)$) is not greater than the average annual income), and λ is the incentive coefficient, indicating that the period of "franchise" P is the effective operation An interval of P_1 in the camp period. During the effective operation period, the relationship between P_1 and operator's investment C is $\partial^2 P_1/\partial C^2 < 0$, and P_1 decreases with the decrease of C. As for the operation and maintenance cost $E(C,t)$, set $E(C,t) = kC^{-\alpha}t^\beta (k > 0, \beta > \alpha > 0)$. The parameters k, α, β in the above operation and maintenance cost are determined by data statistics and fitting based on the completed and delivered projects. To sum up, the optimal investment is Eq. 2:

$$C = C(\lambda, R) = [h\{\lambda\}]^{\frac{\beta}{\beta-\alpha}}\bar{C}(R) \ (\bar{C}(R) = k^{\frac{-1}{\beta-\alpha}}\left(\frac{\alpha}{\beta+1}\right)^{\frac{-\beta}{\beta-\alpha}} R^{\frac{\beta+1}{\beta-\alpha}}) \qquad (2)$$

If λ is increased, the term P of "franchise" is extended, then the operator's investment C will also increase. When $P = P_1$, C is the maximum. When the R (value of earnings) is small, the operators may give up cooperation or reduce investment after the expiration of the term of "franchise". In this case, on the basis of traditional information infrastructure co-construction and sharing, operators should actively expand other value-added services in smart campus co-construction and sharing projects, and carry out business model innovation; schools should continue to increase the size of students, improve the overall quality of smart campus, and improve the income R. Give full play to the advantages of all parties, and better provide smart campus services for teachers, students and the public.

Due to the continuous innovation of high-level applications of smart campus, school may choose to develop part of its own, cooperate with operators to build part, and other professional suppliers provide part of the experimental exploration methods. In this case, in terms of high-level application business of smart campus, operators, schools and other professional suppliers form a competitive and cooperative relationship. Traditional businesses of operators provide rental income and provide bottom-level support for high-level businesses; high-level homogeneous services constitute competition, but can only develop relying on multi-party cooperation. Set the original revenue of the operator as R_1, and the original revenue of other smart campus professional suppliers as R_2, When all parties do not cooperate, there will be no excess revenue. If they cooperate, there will be excess revenue R_h, set the distribution coefficient of excess revenue as μ, the excess revenue of other smart campus professional suppliers as μR_h, and the excess revenue of the operator as $(1 - \mu)R_h$. When one party cooperates and the other party does not cooperate, the non cooperator will also enjoy the additional income R_{e1} or R_{e2}. In addition, the total investment of high-level business (excluding information infrastructure investment) is C_h, the investment allocation coefficient is δ, the investment of other smart campus professional suppliers is δC_h, and the investment of operators is $(1 - \delta)C_h$. The profit matrix of competition and cooperation game between operators and other smart campus professional suppliers is as follows:

The construction of smart campus is in line with the development trend of education reform, is conducive to improving learning methods and teaching methods, is conducive to optimizing school management and improving school running level. In the construction mode of smart campus, the co-construction and sharing mode has advantages in investment, operation, management and other aspects, and has achieved results in practice.

Table 1 Profit matrix of competition and cooperation game between operators and other smart campus professional suppliers

	Operator cooperate	Operators do not cooperate
Other supplier cooperate	$R_1 + (1 - \mu)R_h - (1 - \delta)C_h$ $R_2 + \mu R_h - \delta C_h$	$R_1 + R_{e1}$ $R_2 - C_h$
Other supplier do not cooperate	$R_1 - C_h$ $R_2 + R_{e2}$	R_1 R_2

Table 1 shows, in the multi-party game, school should play a guiding role in reducing the investment cost of high-level business, one is to increase users and promote high-level applications; the other is to carry out business innovation of smart campus, so as to improve the excess return and the probability of cooperation. For example, in the IOT project of smart campus, based on the campus information infrastructure, the introduction of IOT professional companies to generate excess revenue through business innovation and share with operators can achieve a win-win situation of multi-party cooperation.

6. CONCLUSION

In the smart campus co-construction and sharing project, should take innovation as the starting point, coordinate the interests in all parties and handle the contradictions of all parties. Fully integrate the competitive and cooperative advantages of all parties, make up for the lack of financial funds, improve the project operation efficiency and service quality, form complementary advantages in mechanism, and achieve the effect of " $1 + 1 > 2$ " Through the study of the allocation and sharing of public resources in the process of smart campus construction, the author hopes to explore the macro strategy from the local perspective, and provide reference to public service innovation and public management innovation.

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