Analysis of Influencing Factors of Campus Recyclable Express Package Promotion based on Linear Regression

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Abstract: In this paper, we study the influencing factors of promoting recyclable express parcels on campus. Specifically, we conducted a descriptive statistical analysis on gender, monthly delivery volume, attitude-related variables, subjective norm-related variables, and convenience-related variables. However, we conducted a cross-contingency table analysis on the differences between gender and delivery volume. The logistic regression method is used to study the influencing factors of personal attributes on the volume of express delivery, and the customer's express delivery behavior is clustered. Finally, we conduct a linear regression analysis on the influence of customers' habits and environmental awareness on the degree of support for recyclable express packages.

1. Introduction

In recent years, the rise of Internet giants such as JD.com and Taobao has given birth to the rapid development of the express delivery industry. With the popularity of online shopping, the express delivery industry has become an emerging industry with a rapid development momentum and has always maintained high popularity [1]. The enthusiasm for online shopping has stimulated the development of the express delivery industry, especially during the Double Eleven shopping carnival, the day's turnover reached tens of billions of yuan. The express delivery industry has created huge wealth for society as a tertiary industry. While constantly exploring the benefits it can produce, we should also pay close attention to a series of problems such as the rapid growth of express packaging waste and the excessive packaging of express delivery [2].

According to data released by the country Post Bureau, in 2020, there will be more than 50 billion express parcels in China, a year-on-year increase of 26.6%, ranking first in the world for five consecutive years. It is expected that in the next five years, the country's express delivery volume will continue to maintain a growth rate of more than 20%, and online shopping has gradually become an indispensable part of people's lives. The packaging process of online shopping needs to consume many consumables such as cartons, plastic bags, foam plastics, tapes, etc. The current express packaging recycling system is not perfect, resulting in many materials that can be recycled and reused after being discarded after one-time use.

At the same time, many e-commerce companies will over-pack the goods to ensure that the goods are not damaged, and buyers also hope that the protective packaging of the goods they buy is as safe as possible. As a result, we often see three layers and three layers outside when picking up express delivery Layers of packaging sometimes the packaging can even account for more than half of the entire package volume. Recyclable packaging can greatly solve this problem, but its promotion faces many obstacles. Using new degradable materials to make express packaging can achieve energy saving and environmental protection, but its high cost discouraged many express companies. On the other hand, without a perfect express packaging recycling system, even if recyclable packaging is successfully implemented, it is a difficult problem that cannot be ignored.

College students are the main group of online shopping, and campus express delivery has been developing continuously in recent years, and various express delivery companies have paid more and more attention to the express delivery market of college campuses. Meanwhile, the student's awareness

of environmental protection is relatively high, and they have put forward higher and higher requirements for express packaging, service, distribution, and other links. Based on ensuring the convenience and speed of express delivery, they are further required to achieve energy saving and environmental protection. The green development model of campus express is a new express model that specifically serves school students and teachers, transports and sustainably distributes goods, and considers environmental and social benefits [3]. We found many studies on the green development model of express delivery companies or a certain area by reviewing the literature. However, there are few studies on express delivery models specifically for campuses, and campus express delivery has the characteristics of large numbers but scattered sources. It is essential to study the green development model of the express delivery industry in university campuses in its specific circumstances.

2. Descriptive Statistical Analysis

2.1 Analysis of gender and monthly delivery volume

We conducted a descriptive statistical analysis of gender and monthly delivery volume through the survey, which is shown in Fig.1.

As shown from Fig. 1, girls generally use express delivery more frequently than boys, and among the people who send and receive express delivery over 16 per month, more boys than girls. However, considering that this is only a minimal number of people, it may be because of some commercial activities through express delivery [4]. The main reason for this phenomenon is that girls have a greater demand for clothing than boys in the group of college students, and they often buy some cosmetics online. On the other hand, girls are more careful in shopping, and shopping online is usually cheaper, which results in girls using express delivery more frequently than boys.

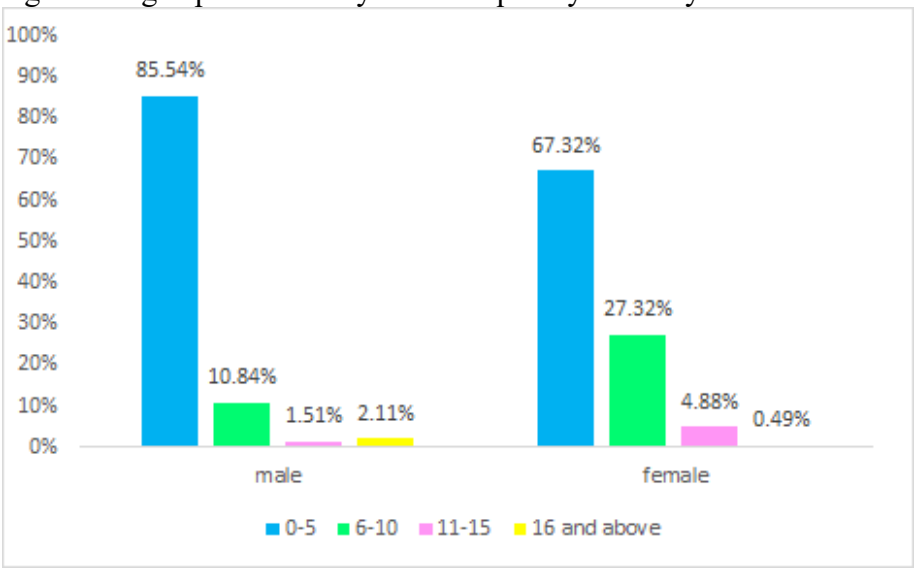

Figure 1 Comparison of the number of express deliveries sent and received by men and women each month

2.2 Analysis of Attitude-Related Variables

The scores of the questionnaire survey data were qualitatively transformed into five items of "very support," "comparative support," "indifferent," "not very support," and "not support," and the results of the attitude variable survey are shown in Fig. 2. As can be seen from Fig. 2, in the entire group, most people support the use of recyclable express packaging, but there are still nearly 20% of people who do not care or support it. Looking at the longitudinal comparison, the proportion of support among the female group is larger, with less than 4% expressing disapproval.

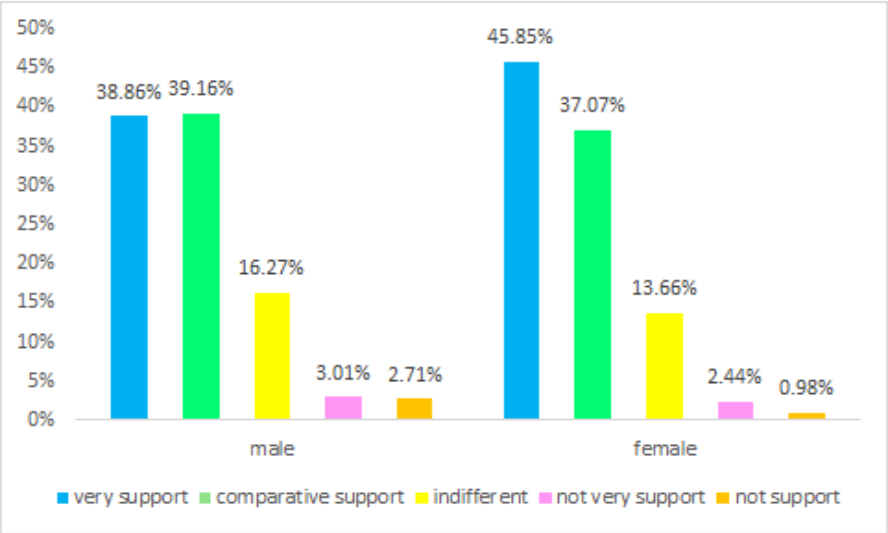

Figure 2 Survey results of attitude variables

The obtained attitude and willingness to use statistical results are shown in Fig. 3. From Fig. 3, it can be seen that most people have the intention to use recyclable express packaging, and the group with higher support in the attitude variable has the highest proportion of willingness to use. Although some people do not support the recycling of express packaging, some people are still willing to try new recyclable packaging, but the proportion is small. From this, it can be inferred that attitude significantly impacts the willingness to use recyclable express packaging.

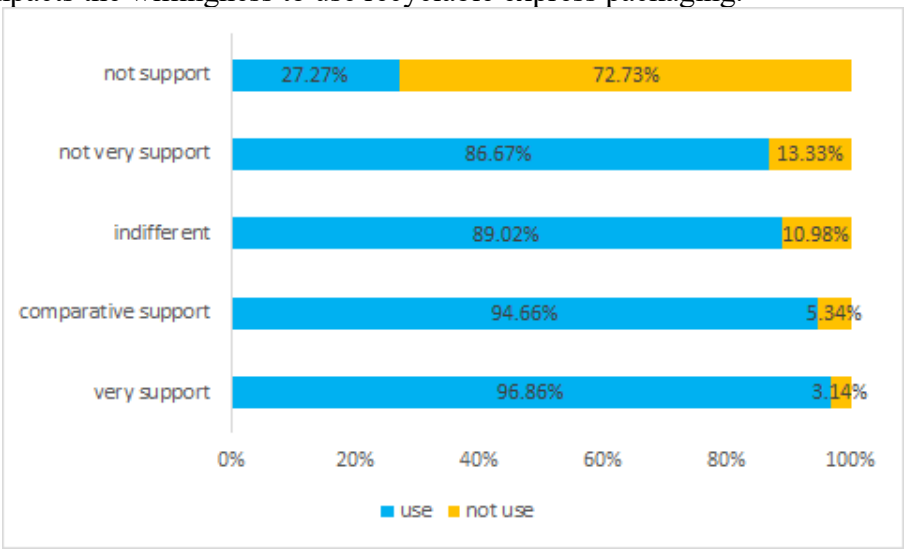

Figure 3 Statistical results of attitude and willingness to use

The results obtained from the analysis of subjective norm-related variables are shown in Fig. 4. From Fig. 4, it can be seen that more than half of the people believe that the current disposable express packaging has a serious impact on the environment, and the non-recyclable express packaging has a stronger intention to use recyclable express packaging for people with serious environmental pollution.

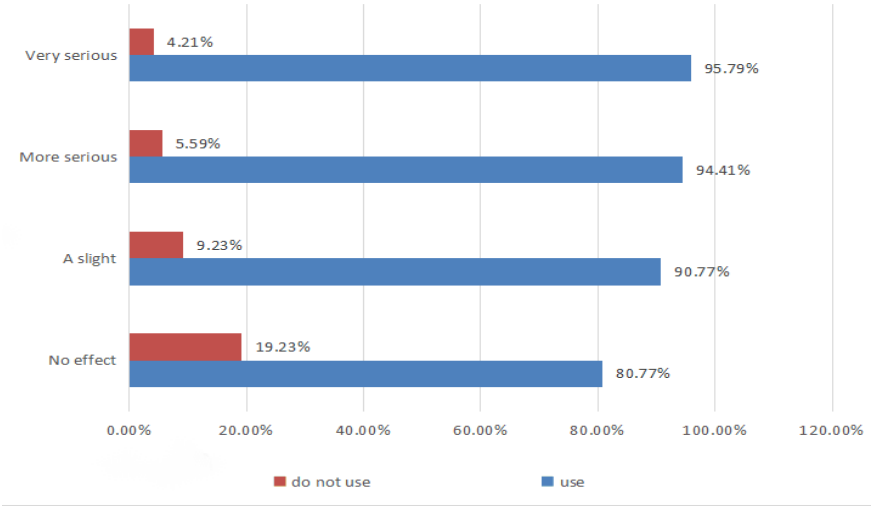

Figure 4 Statistical results of the survey on the degree of environmental impact and the willingness to use

The results obtained from the analysis of convenience-related variables are shown in Fig. 5. From Fig. 5, it can be seen that each factor has a particular impact on the promotion of recyclable express packaging, but among the people who believe that a perfect management system has not been formed. The promotion is restricted. The group has the strongest will to use it, which also shows from the side that the management system has more resistance in the implementation. It is small and easy to implement, so several other constraints should be given more attention in developing the strategy.

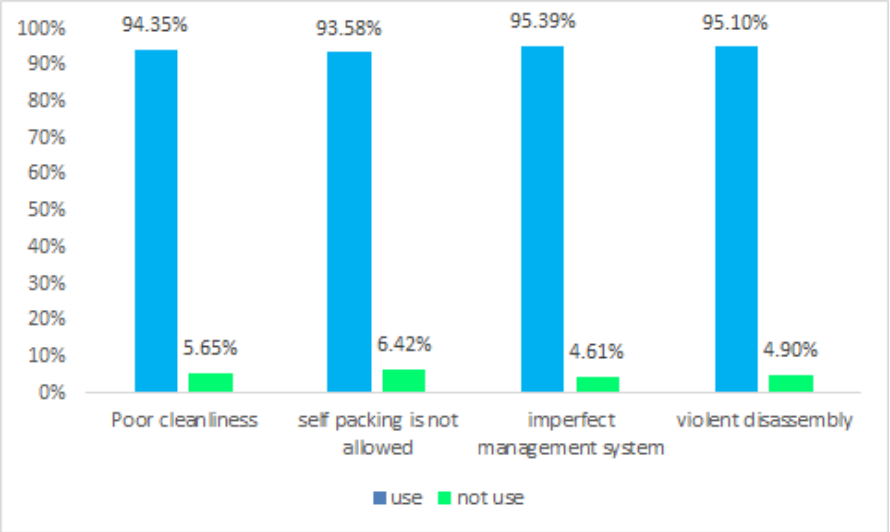

Figure 5 Statistical results of restrictive factors and willingness to use recyclable express

3. Cross-Contingency Table Analysis

We use the cross contingency table to analyze the mutual influence and relationship between variables and grasp their joint distribution characteristics [5]. The chi-square test was used to determine whether there was a significant effect. Using the survey data of campus express delivery, we analyzed whether students of different genders received the same number of deliveries per month. The conclusions obtained are shown in Fig. 6.

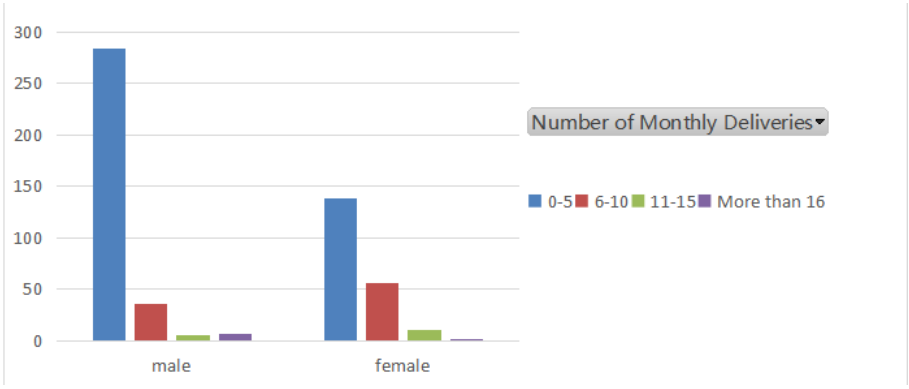

Figure 6 Bar chart for case study

It is verified by the method of chi-square test, and the mathematical definition of likelihood ratio chi-square is:

$$T = 2\sum_{ij} f_0 \ln \frac{f_0}{f_c} \tag{1}$$

When the number of samples is large, the likelihood ratio chi-square is very close to the Pearson chi-square, and the test conclusions are usually consistent.

The linear correlation chi-square, also known as the Mantel-Haenszel chi-square, tests the linear correlation of the row and column variables in the contingency table. The null hypothesis is that the row and column variables are zero correlation, which is only applicable to ordinal variables. In this example, the probability p-value of the linear correlation chi-square is less than the significance level a, the null hypothesis should be rejected, and the row and column variables are considered linearly related.

The data analysis results are in line with our daily cognition. Girls generally use express delivery more frequently than boys. The main reason for this phenomenon is that girls have a greater demand for clothing than boys in the group of college students, and they often buy some cosmetics online. On the other hand, girls are more sensitive to the price of items, and shopping online is usually cheaper, resulting in girls using express delivery more frequently than boys.

4. Logistics Regression Analysis

The explained variables in the data set are multi-type variables, which do not meet the requirements of the general linear regression model for the value of the explained variables and violate the premise and assumptions of the regression model. Therefore, multinomial logistic regression analysis is used. This section builds unsaturated models to analyze the independent effects of explanatory variables on the explained variables. Mainly carry out case analysis, model fitting information analysis, parameter estimation, and generalized logit model sample prediction analysis.

According to the analysis objectives and data, the monthly number of express deliveries and deliveries was selected as the explained variable, and grade and gender were selected as the explanatory variables. Three generalized logit equations can be obtained from the parameter estimates:

The natural logarithmic model of the probability ratio between 0-5 and 6-10 express deliveries per month, which can be expressed as:

$$\text{Logitp}_A = \ln \frac{P(y=B|X)}{P(y=A|X)} = -0.221 - 1.227X_1(1) - 0.956X_2(2) - 0.669X_2(3) - 0.492X_2(4) \tag{2}$$

When the grades are the same, the ratio of males to the natural logarithm of females (reference class) is reduced by an average of 1.227 units, the probability ratio of males is 0.293 times that of females, and the ratio of males receiving 0-5 parcels per month is lower than that of females.

When the gender is the same, the ratio of the natural logarithm of grades 1 to 4 is 1.357, 0.956, 0.669, 0.492 more than that of grade 5 (reference class). The number of couriers sent and received monthly is 6-10, with the most graduate students, followed by the fourth, third, second, and first studies.

1) The natural logarithmic model of the probability ratio on the number of express deliveries per month are between 0~5 and 11~15 can be expressed as:

$$\begin{aligned}\mathrm{Logitp_A} = \ln\frac{\mathrm{P(y=C|X)}}{\mathrm{P(y=A|X)}} = -1.663 - 1.497\mathrm{X_1}(1) - \\ 1.535\mathrm{X_2}(1) - 1.245\mathrm{X_2}(2) - 1.029\mathrm{X_2}(3) - \\ 0.940\mathrm{X_2}(4)\end{aligned} \tag{3}$$

When the grades are the same, the probability ratio of males is 0.224 compared with females, and the number of females sending and receiving pieces is more statistically significant in the interval of 11-15 pieces.

When the gender is the same, the probability ratios of grades 1-4 compared with grade 5 (reference class) are 0.215, 0.288, 0.357, and 0.391, respectively, and the number of postgraduates sent and received is more significant in the range of 11-15.

2) The natural logarithmic model of the probability ratio of the number of express deliveries is per month between 0 and 5 and 16 and above, which can be expressed as:

$$\begin{aligned}\mathrm{Logitp_A} = \ln\frac{\mathrm{P(y=D|X)}}{\mathrm{P(y=A|X)}} = -3.146 - 1.022\mathrm{X_1}(1) - \\ 2.187\mathrm{X_2}(1) - 19.440\mathrm{X_2}(2) - 2.566\mathrm{X_2}(3) - \\ 2.341\mathrm{X_2}(4)\end{aligned} \tag{4}$$

When the grades are the same, the probability ratio for males is 2.780 for females, and the statistical effect is more significant when the number of mails sent and received by males is above 16.

When the gender is the same, the probability ratios of grades 1-4 compared with grade 5 (reference class) are 0.112, 3.607×10-9, 0.077, and 0.096, respectively, and the number of postgraduates sent and received is more significant than 16.

5. Cluster Analysis

Hierarchical clustering method is used, Euclidean distance is used for the distance between individuals, and the average chain distance of components is used for the distance between classes. Based on the number of couriers sent and received each month, the processing method of express packaging, and the commonly used shipping methods, 537 questionnaire survey individuals are divided into four categories and analyzed the results, which is shown in Fig.7.

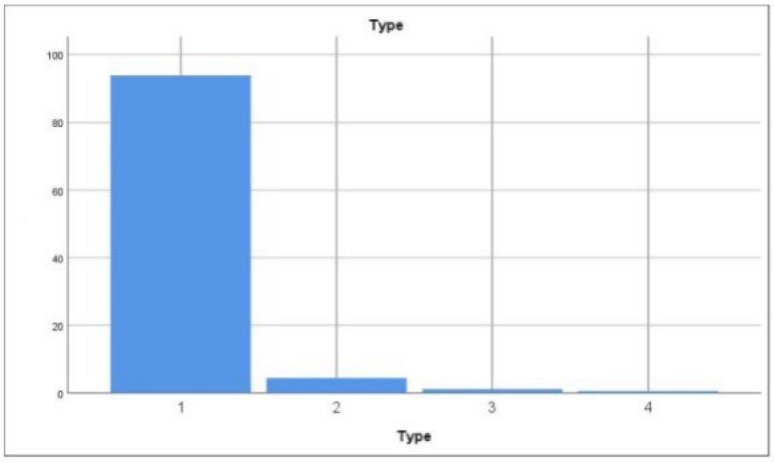

Figure 7 Statistical bar chart of clustering results

It can be seen from Fig. 7 that in the clustering results of 537 individuals, 93.9% of the individuals were classified into the same class. While 4.5% of the individuals were classified into the second class, the third class accounted for 1.1% of the total, and the fourth class accounted for the total of 0.6%.

6. Linear Regression Analysis

According to the results of sample cluster analysis, the survey group was screened, the first and second types of individuals were retained for linear regression multivariate analysis, and the invalid data represented by the third and fourth types of individuals were reasonably excluded to ensure the accuracy of data analysis [6]. SPSS linear regression analysis was carried out with the opinion of the practical groups on the recyclability of express packaging as independent variables, the frequency of express packaging damage, the integrity of the received packaging, the group's commonly used packaging methods, and the group's perception of the impact of express packaging on the environment as the dependent variable. In the analysis process, stepwise regression was performed to eliminate the less significant factors. Then, multi-factor linear regression analysis was performed on the remaining factors to obtain the analysis results.

Through data analysis, the final regression equation can be obtained as:

$$\hat{y} = 20.357 + 0.421x_1 + 1.231x_2 \tag{5}$$

Through linear regression, the customer's personal habits and environmental awareness are used to guide and suggest the promotion of recyclable express packages. We find no linear relationship between the customer's daily habits of handling express packaging and the requirements for cleanliness and aesthetics to whether they are willing to support the promotion of recyclable express packages. It is shown that the promotion of this measure among college students is not affected by students' daily habits. The implementation of certain incentive policies will be able to promote the implementation more smoothly. The frequency of packaging damage negatively correlates with the support degree of circular packaging. Customers' perception of the environmental impact of express packaging has a positive correlation with the support degree of circular packaging, and both constitute a linear relationship and are more pronounced. Through linear regression analysis, it can be concluded that the pilot implementation of the recyclable package initiative on university campuses is mainly affected by the frequency of packaging damage and customers' environmental protection concepts and is less affected by its habits. Therefore, the promotion of this initiative should focus on strengthening express packaging recycling. Environmental protection propaganda, express companies, and relevant packagers should also strengthen the monitoring and implementation of package protection, supplemented by appropriate participation incentives, which will effectively promote the practice of recyclable express packages on campus.

In the current express operation mode, the express delivery points are basically delivered by teachers and students on university campuses, and the express delivery points provide the packaging for sending out the express delivery. In the research process, we find that some express delivery points in a university will dispose of the intact paper express packaging discarded in the garbage bin at the entrance and reuse it [7]. In this mode, the express packaging manufacturer is responsible for producing recyclable express packaging, which is supplied to the express company, while the recycling and reuse of the packaging are completed by the express company and the express point.

Under this model, the recycling of campus express delivery is mainly completed by express delivery points. The delivery method of an express delivery on a university campus is mainly used for customers to go to express delivery points by themselves, and there are very few door-to-door services. Therefore, the express delivery point should remind customers to dismantle the package reasonably when the customer picks up the express delivery and promote the system of express packaging in exchange for points. Meanwhile, considering that some express users who bring packages back to their residences will discard the express packages due to the long distance of the express points, express package recycling points should be set up in dormitory areas, classrooms, teachers' apartments, etc., which can be combined with artificial intelligence technology. To save manpower and material resources and better realize the recycling of packaging.

On the other hand, even if the recyclable express packaging is durable, it is difficult to avoid damage in the transportation and distribution links. The packaging that is not seriously damaged should be sent to the repair shop in each area for repair, and the express packaging that is seriously damaged beyond repair. It should be handled centrally to prevent environmental pollution. The campus express has the

characteristics of more parcels and less express delivery. Therefore, the insufficient capacity of this part can be reasonably used for the delivery and processing of express packaging.

In the current express delivery market, third-party recycling companies rarely participate in the operation of the express delivery model, but in the green development model of the express delivery industry, third-party companies can play a better role. Third-party recycling companies are mainly responsible for the recycling and reuse of express packaging. Because recycling services are a major industry for third-party companies, they are also more knowledgeable about the repair and disposal of packaging. In this model, the express company does not need to pay attention to dealing with the packaging. A third-party company contracts the whole recycling process. Third-party company to repair and deal. Here, third-party companies have to take specific measures to ensure the packaging recycling rate. After all, if the recycling rate is low, the express delivery point needs to repurchase many new packaging, and the cost of the new packaging is much higher than that of recycled packaging. It can also stimulate the development of the green model of the express delivery industry from another perspective.

7. Conclusion

In this paper, by investigating express delivery on campus and processing the data, we can learn about the factors that hinder the implementation of the green development model of campus express delivery and the significance of each factor. Combining with the existing development model of express delivery industry learned from the visit and survey, it is putting forward targeted countermeasures and suggestions from the perspectives of the government and enterprises, and planning and designing a feasible scheme for express delivery on a university campus to accelerate the development of a green development model of express delivery industry on university campuses and promotion.

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