

## ANALYSIS OF BENEFITS AND RISKS OF STAKEHOLDERS IN SHARED PARKING SPACES BASED ON SEM MODEL

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**ABSTRACT.** *In recent years, the development of the sharing economy has promoted exchanges between industries and promoted the upgrading and transformation of traditional economic models. With the development of urbanization, the problem of shortage of parking space resources urgently needs to be solved, and the shared parking space model has been widely proposed and applied. In this paper, the SEM model is used to study the influence of the three parties on the willingness of parking space sharing from the perspective of the sharing benefits and risks of the three parties. The results show the following: revenue and risk have a significant impact on the sharing willingness of parking space suppliers, the data are 0.81, -0.37; the revenue and risk have a significant impact on the sharing willingness of parking space managers, the data are 0.44, -0.72; the revenue and risk have a significant impact on the sharing willingness of the government, the data are 0.58, -0.60.*

**Keywords:** Shared parking space, SEM model, Shared revenue and risk

**1. Introduction.** With the development of China's economic level, in recent years, the number of motor vehicles continues to grow, and the proportion of private car travel is also increasing. However, due to the limitation of land resources and price, the supply of parking facilities cannot meet the parking demand, which leads to the imbalance of parking supply and demand, and the parking problem is becoming increasingly serious. Therefore, parking space sharing has been paid more and more attention and has gradually become a hot spot of academic research. This paper summarizes the relevant research status at home and abroad.

In 1983, the American Urban Land Research Institute first proposed the theory of berth sharing. In 1984, Lalani [1] conducted an in-depth study on land types suitable for shared parking, and the study showed that shared parking can be used for cinemas, restaurants and hotels. Chen et al. [2] put forward the concept of building parking space sharing, analyzed the applicability of external sharing according to the parking peak of different land use, and put forward relevant suggestions for the existing problems of parking space sharing in reality. Li [3] proposed the concept of parking hours by comparing the spatial and temporal differences of parking demand between residential land and other land. By sharing the parking space in different time zones, a new idea is provided to solve the problem of parking difficulty. In 2011, Ran et al. [4] proposed a two-level decision-making model for parking sharing measures based on parking space allocation simulation. Based on the parking space sharing theory, Xiao et al. [5] proposed a parking demand prediction model and method based on parking lot sharing under the mixed land use mode, and applied the parking sharing theory to a certain area of Wuxi City.

The shared berth mode involves many stakeholders, such as the supplier, the demander, the manager, the platform and the government. Its risks and interests are different. There are many contradictions in the distribution of interests and the assumption of risks, which is the fundamental reason why the shared berth mode has not been widely promoted. Only some scholars have studied and analyzed the risks and benefits of shared berths. Zhou [6] made an empirical analysis from the perspective of the supplier and demander of private parking space, and analyzed the influencing factors of the sharing intention of private parking space owners and the influencing factors of travelers' choice intention to the mode. Xie [7] and other scholars have studied the impact of the benefits and risks of suppliers and managers on the promotion of shared parking mode, but the stakeholders in the study are not comprehensive. Therefore, this paper takes the berth supplier, the berth manager and the government as the stakeholders of shared berth mode, subdivides the categories of interests and risks of all parties, discusses the influence of all parties on the promotion of shared berth mode, and puts forward corresponding implementation suggestions, so as to provide theoretical support for the promotion of shared berth mode.

## 2. Benefit and Risk Analysis of Stakeholders Sharing Parking Spaces.

**2.1. Analysis of benefit and risk categories.** Firstly, the sharing of parking spaces increases the economic benefits of the suppliers and increases their willingness to participate in the sharing of parking spaces; secondly, the promotion of shared parking spaces brings risks and challenges to the management, which reduces their willingness to implement this measure. Finally, the measure of sharing parking spaces has brought a lot of benefits to the society, such as the improvement of the utilization rate of social resources, the alleviation of the problem of parking difficulty, and the improvement of traffic order, which increases the willingness of the government to promote the mode. However, in order to promote this mode, the government has to invest a lot of money in the previous period, which affects its promotion intention. The benefit and risk categories of the three parties are summarized in Table 1.

**2.2. Quantification of benefit and risk factors of stakeholders sharing parking spaces.** This paper uses the scale to score the profit and risk of the three parties. The shared revenue of berths is assigned 5, 4, 3, 2 and 1 from "very agree" to "very disagree", and the risk of shared berth is assigned as -5, -4, -3, -2, -1 from "very agree" to "very disagree". 503 questionnaires were distributed through the network, including 445 valid questionnaires, which met the requirements of the number of modeling samples.

## 3. Analysis of Sharing Parking Space Willingness Based on SEM Model.

**3.1. SEM model of parking space sharing intention.** SEM model [8] is a statistical method to analyze the relationship between variables based on the covariance matrix of variables. In SEM model, the independent variable is called exogenous variable, and the dependent variable is called endogenous variable. Exogenous variables cannot be explained in the model, while endogenous variables can be explained from the model. In the model, both endogenous and exogenous variables are latent variables, which are measured by multiple observational variables. SEM model includes measurement equation and structural equation, and the mathematical equation is expressed as follows:

$$x = \Lambda_x \xi + \delta \quad (1)$$

$$y = \Lambda_y \eta + \varepsilon \quad (2)$$

$$\eta = B_\eta + \Gamma \xi + \zeta \quad (3)$$

$x$  is the exogenous observation variable vector;  $\xi$  is the exogenous latent variable vector;  $\Lambda_x$  is the relationship between the exogenous observation variable and the exogenous latent variable, and is the factor load matrix of the exogenous observation variable on

TABLE 1. Influencing factors of shared parking spaces

Stakeholders	Potential variables		Observation variables	Number
Parking space supplier	Benefit	Economic level	Collection of shared parking fee	X <sub>11</sub>
		Social level	High utilization rate of social resources	X <sub>12</sub>
			Alleviating the problem of “parking difficulty”	X <sub>13</sub>
			The improvement of national life quality	X <sub>14</sub>
			Provide basic guarantee for the harmonious environment of society	X <sub>15</sub>
	Risk	Cost risk	Increase of monitoring equipment cost	X <sub>21</sub>
			Increase of parking lot renovation cost	X <sub>22</sub>
			Increase in property management fees	X <sub>23</sub>
		Security risk	Traffic safety	X <sub>24</sub>
			Privacy security	X <sub>25</sub>
	Management intention		Willingness to share parking space supply	A
Parking management	Benefit	Economic level	Increase in personnel wages	X <sub>31</sub>
		Social level	High utilization rate of social resources	X <sub>32</sub>
			Alleviating the problem of “parking difficulty”	X <sub>33</sub>
			The improvement of national life quality	X <sub>34</sub>
			Provide basic guarantee for the harmonious environment of society	X <sub>35</sub>
	Risk	Managing risk	Increase of supervision and management of foreign vehicles	X <sub>41</sub>
			Increase of traffic diversion work in the community	X <sub>42</sub>
			Increased work on handling parking conflicts	X <sub>43</sub>
	Management intention		Shared berth management intention	B
	Government	Benefit	Economic level	The increase of local fiscal revenue
Social level			The improvement of the utilization rate of social resources	X <sub>52</sub>
			Alleviating the problem of “parking difficulty”	X <sub>53</sub>
			The improvement of national life quality	X <sub>54</sub>
			Provide guarantee for the harmonious environment of society	X <sub>55</sub>
Risk		Cost risk	Financial subsidies to the platform side	X <sub>61</sub>
			Financial subsidies to suppliers	X <sub>62</sub>
		Other risks	A series of other problems	X <sub>63</sub>
Promotion intention			Sharing parking space promotion intention	C

the exogenous latent variable;  $\delta$  is the residual vector of exogenous observation variables;  $y$  is the vector of endogenous observation variable;  $\eta$  is the vector of endogenous latent variable;  $\Lambda_y$  is the relationship between endogenous observation variable and endogenous latent variable, which is the factor load matrix of endogenous observation variable on endogenous latent variable;  $\varepsilon$  is the residual vector of endogenous observation variables;  $B$  is the relationship between endogenous latent variables;  $\Gamma$  is the influence of exogenous latent variables on the values of endogenous latent variables; and  $\zeta$  is the error term of structural equation.

3.2. Analysis on the results of SEM model of sharing parking spaces.

3.2.1. Model parameter estimation. Through AMOS24.0 operation, the initial parameters of the model are estimated. Combined with theory and practice, the model is constantly revised. Finally, the fitting index meets the standard requirements, as shown in Figure 1.

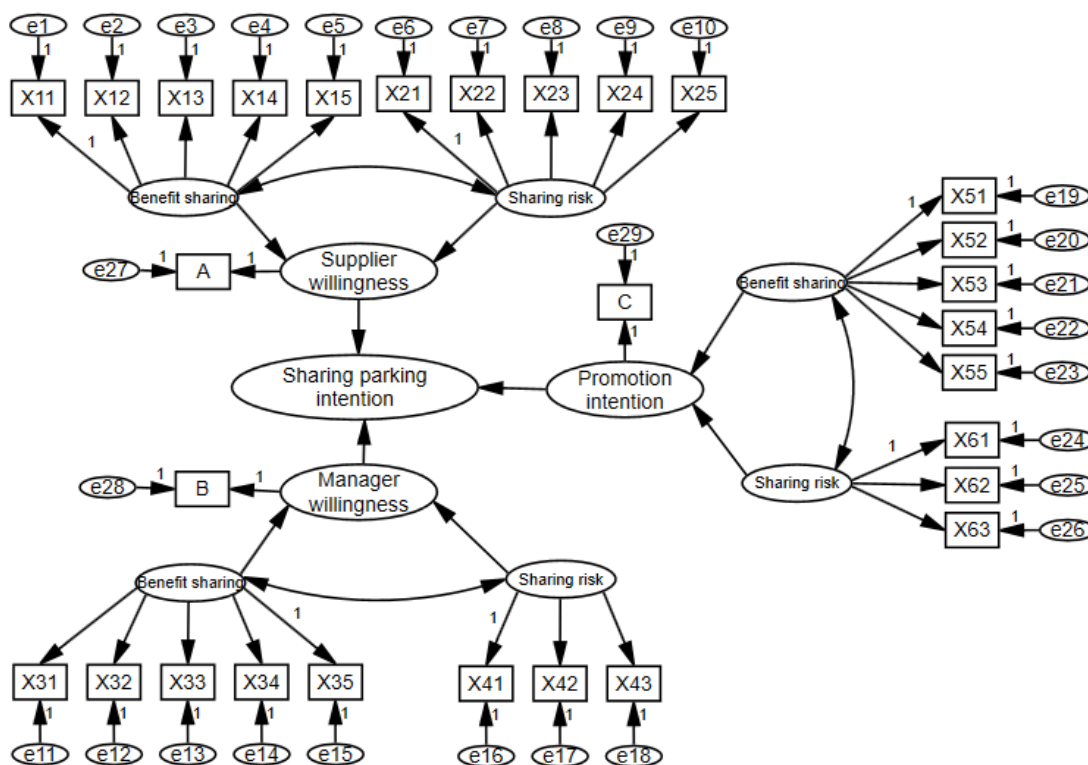


FIGURE 1. Model path and parameter estimation

3.2.2. Analysis of parking supplier sharing willingness model. In AMOS, when the CMIN/DF, RMSEA and other fitting indicators meet the requirements of the standard reference value, it shows that the model has good fitting degree, and the results of the model can be used. The fitting index meets the reference value requirements, which indicates that the analysis model of suppliers' willingness to share has good fitting degree, as shown in Table 2.

As shown in Table 3, the  $P$  values of the path hypothesis in the table are all \*\*\*, that is, the path is significant at the 0.1% level and has passed the significance test; among them, the standard path coefficient of sharing benefits and suppliers' willingness is 0.814, with significant  $P < 0.001$ , that is, with the increase of sharing benefits, the willingness of suppliers also increases significantly; the standard path coefficient of sharing risk to supplier's willingness is  $-0.373$ , significant  $P < 0.001$ , that is, with the increase of sharing income, the supplier's willingness is significantly reduced; the correlation between sharing

TABLE 2. Comparison of fitting index results

Fitting index	Index value	Reference value
CMIN/DF	2.228	< 5.0
GFI	0.964	> 0.9
NFI	0.975	> 0.9
IFI	0.986	> 0.9
CFI	0.986	> 0.9
RMSEA	0.053	< 0.1

TABLE 3. Test results of model path coefficient

	Estimate	Standard value	S.E.	C.R.	P
Benefit sharing → Willingness of suppliers	0.653	0.814	0.049	13.449	***
Sharing risk → Willingness of suppliers	-0.349	-0.373	0.054	-6.465	***
Benefit sharing ↔ Sharing risk	-0.296	-0.327	0.05	-5.903	***

income and sharing risk is -0.327, significant  $P < 0.001$ , that is, with the increase of sharing income, the sharing risk is significantly reduced.

3.2.3. *Analysis of parking management sharing willingness model.* The index values of each fitting index meet the requirements of the standard reference value, which indicates that the analysis model of management’s willingness to share has a good fitting degree, and the model can better reflect the analysis results of this study, as shown in Table 4.

TABLE 4. Comparison of fitting index results

Fitting index	Index value	Reference value
CMIN/DF	1.828	< 5.0
GFI	0.977	> 0.9
NFI	0.988	> 0.9
IFI	0.995	> 0.9
CFI	0.995	> 0.9
RMSEA	0.043	< 0.1

As shown in Table 5, the  $P$  values of the path hypothesis in the table are all \*\*\*, that is, the path is significant at the 0.1% level and has passed the significance test; among them, the standard path coefficient of sharing benefits and managers’ willingness is 0.441, with significant  $P < 0.001$ , that is, with the increase of sharing benefits, managers’ willingness also increases significantly; the standard path coefficient of sharing risk to manager’s willingness was -0.721, with significant  $P < 0.001$ , that is, with the increase of shared income, manager’s willingness decreased significantly; the correlation between shared income and shared risk was -0.439, significant  $P < 0.001$ .

TABLE 5. Test results of model path coefficient

	Estimate	Standard value	S.E.	C.R.	P
Benefit sharing → Willingness of management	0.328	0.441	0.053	6.211	***
Sharing risk → Willingness of management	-0.56	-0.721	0.055	-10.231	***
Benefit sharing ↔ Sharing risk	-0.472	-0.439	0.061	-7.763	***

3.2.4. *Analysis of the government sharing willingness model.* The index values of each fitting index meet the requirements of the standard reference value, indicating that the analysis model of government promotion willingness has a good fitting degree, and the model can better reflect the analysis results of this study, as shown in Table 6.

TABLE 6. Comparison of fitting index results

Fitting index	Index value	Reference value
CMIN/DF	1.462	< 5.0
GFI	0.982	> 0.9
NFI	0.991	> 0.9
IFI	0.997	> 0.9
CFI	0.997	> 0.9
RMSEA	0.032	< 0.1

As shown in Table 7, the  $P$  values of path hypothesis in the table are all \*\*\*, that is, the path is significant at the level of 0.1%, and has passed the significance test; among them, the standard path coefficient of sharing income and promotion intention is 0.583, with significant  $P < 0.001$ , that is, with the increase of sharing benefit, the promotion intention also increases significantly; the standard path coefficient of sharing risk to manager's willingness was  $-0.596$ , with significant  $P < 0.001$ , that is, with the increase of sharing income, the promotion willingness decreased significantly; the correlation between shared income and shared risk was  $-0.449$ , significant  $P < 0.001$ .

TABLE 7. Test results of model path coefficient

	Estimate	Standard value	S.E.	C.R.	$P$
Benefit sharing $\rightarrow$ Promotion intention	0.419	0.583	0.043	9.716	***
Sharing risk $\rightarrow$ Promotion intention	$-0.548$	$-0.596$	0.059	$-9.352$	***
Benefit sharing $\leftrightarrow$ Sharing risk	$-0.478$	$-0.449$	0.059	$-8.038$	***

**4. Suggestions on Implementation of Shared Berth Mode.** Based on the research results of the sharing willingness of parking space suppliers, management and government, in order to promote the promotion of shared parking space mode, this paper puts forward the following suggestions.

1) Increase the salary of management personnel and improve the sharing economic benefits. The promotion of shared parking space mode will inevitably bring the corresponding work pressure to the managers, increase the salary of management personnel, encourage the management of residential areas, and then reduce the sharing concerns of parking space managers.

2) Establish and improve the relevant laws to reduce the risk of sharing security. The government needs to improve the relevant laws to ensure that the relevant personnel are found and the corresponding rewards and punishments are carried out. If the promotion of shared parking space mode affects people's normal life, residents can get partial compensation, and those who violate relevant regulations will bear corresponding punishment and be included in personal parking credit system.

3) Strengthen publicity and promote the new mode of shared berths. As shared parking is a relatively new parking mode for most parking people, most people may choose a wait-and-see attitude because they do not understand the mode enough. Through news, advertising, short video and other publicity methods, we can publicize the mode of shared parking space, and improve the parking people's trust in the mode.

**5. Conclusion.** In this study, the parking space supplier, management and government are the main research objects to clarify the profit and risk categories of the three parties under the shared parking mode. On this basis, the model data is obtained through questionnaire survey and field investigation, SEM model is established by AMOS24.0 software to quantify the benefits and risks of the three parties, and the results are as follows: Sharing benefits and risks have a significant impact on the sharing willingness of parking space suppliers, with the data of 0.81 and  $-0.37$ , respectively; sharing benefits and risks have a significant impact on the sharing willingness of parking space managers, with the data of 0.44 and  $-0.72$ , respectively; the sharing benefits and risks have a significant impact on the government's willingness to share, and the data are 0.58 and  $-0.60$  respectively. Finally, according to the research results, the paper puts forward some suggestions on the promotion of shared parking space mode.

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