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Towards a Personalized Seat Selection System of High-Speed Rail Based on Feasibility and Desirability

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Abstract: To conduct this research, we identified the current high-speed rail (HSR) market and passenger experience satisfaction with HSR. Then, we developed a personalized seat selection system that could assign passengers to different seats based on their own preferences by collecting their basic information. In the current HSR field, the existing research mainly focuses on improving hardware, such as seat comfort, high-speed rail traveling speed, and high-speed rail traveling smoothness. It does not consider travelers' environmental preferences and individual needs to a great extent. After several weeks of market research through the questionnaire and 4P model study, we concluded that the vast majority of passengers are dissatisfied with the current travel environment full of interruptions and are really willing to use a system that will improve their travel comfort. Therefore, the system will be added to a few major OTA platforms as a plug-in in order to reach a large number of potential customers. After that, we designed many features for our system based on the needs and interests of our target customers, as shown in the survey results, to confirm the desirability and feasibility of our product.

Keywords: high-speed rail, seat allocation, personal preferences, human comfort, confirm feasibility

1. Introduction

In the fast-developing high-teach era, big data technology has been developing rapidly. All industries need professional talents to improve technology informatization, marketing, and enterprise management [1]. In the era of big data, all data can be accurately analyzed and aggregated. For many enterprises, this is a good way to get an accurate picture of customers' consumption preferences. However, in many fields, big data has not yet been realized. For example, in the field of high-speed rail, which we are currently studying, we have not been able to allocate seats to consumers according to their environmental preferences. Our team is trying to outline how we intend to develop a platform. This platform will enable passengers to tailor their preferences and requirements during their high-speed rail journeys. Subsequently, using big data analytics, we will assign them to the most

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appropriate seats with the primary goal of enhancing the overall user experience. In this article, we discuss the market space for personalized platforms for high-speed rail seat selection.

2. Methodology

Jinglin Nan mentioned some of the improvements made to passenger comfort on passenger railways, including the introduction of nondisruptive services in carriages and the prohibition of uncivilized behaviors such as shuttle hawking that affect the rest of the passengers [2]. However, the behaviors prohibited by these measures are not the main factors affecting passenger comfort at present. The series of measures already in place have not accurately addressed the existing pain points in HSR operations. Therefore, in this study, our team first found out the existing pain points of this industry, such as noise disturbance from nearby passengers, crowded conditions, and lack of information about passengers' experiences on high-speed rail.

Thinking about the possibility of bringing this designed product to market, our team initiated the project with internet research to understand the existing landscape of the seat selection system.

In our study, we formulated certain hypotheses, speculating that passengers, when confronted with the aforementioned interruptions, would show an increased inclination to use our platform. Furthermore, we postulated that users' willingness to use our platform would be correlated with their frequency of high-speed rail use.

To test our hypotheses, we created a market research survey focused on a diverse demographic with latent needs, with the goal of gauging the public's sentiment toward integrating our platform to enhance their high-speed rail experience. The questionnaire was published online on popular social media platforms with a sample size of 66. It includes both quantitative and qualitative questions.

During this comprehensive survey, we initiated our inquiry by delving into various aspects of user demographics, geographic locations, motivations driving their selection of High-Speed Rail (HSR) as a preferred mode of travel, and the primary purposes underlying their HSR journeys. Our overarching objective is to construct a multifaceted user profile via meticulous data analysis. To discern the geographical distribution of respondents, we sought to ascertain whether they resided in regions endowed with extensive HSR networks. Furthermore, we inquired about the frequency with which respondents avail HSR services annually, with an intent to explore potential correlations between travel frequency and the inclination to utilize our seat selection platform.

Undesirable stimuli from outside (e.g., disturbances such as noisy and crowded carriage environment) will reduce passengers' comfort and easily stimulate passengers' negative emotions, which in turn will affect passengers' evaluation of and trust in the HSR and lead to bias in their evaluation of the HSR [3]. In the central segment of our study, our investigation centered on assessing whether participants had encountered interruptions during their HSR travels. We invited respondents to elucidate the types of disruptions they had most frequently experienced. Furthermore, we probed the significance of these disturbances from the users' perspective by asking them to elucidate the factors of paramount concern during their HSR journeys.

Our survey also delved into the realm of user preferences and willingness to pay for the features of the platform we have designed. We inquired whether respondents would be inclined to incur a fee for utilizing the platform and explored their preference between a fixed fee or a percentage-based charge linked to the ticket's face value. Additionally, we embarked on an exploration of the users' expectations regarding the additional features and functionalities they envisage in our platform. This multifaceted inquiry framework enables us to offer a comprehensive overview of the user landscape, their needs, and their attitudes toward the innovative HSR seat selection platform.

In conclusion, our survey is structured with a twofold purpose. Firstly, it is designed to gather fundamental customer details, including location and age group, in order to provide us with valuable insights into their preferences, dissatisfied experiences, and their receptiveness to enhancing their

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railway journeys through the acquisition of our products. Secondly, the survey encompasses a segmentation strategy where users are categorized by age group and the primary purpose of their high-speed rail travel. This division allows us to delve deeper into user pain points, which are subsequently utilized to inform the personalized seat allocation process based on individual preferences and needs, thereby aiming to optimize their overall railway experience.

3. Results

The 4P model, first summarized in McKinsey's book Basic Marketing, also known as the marketing mix, is a basic framework in marketing that consists of four key elements. If a company produces the right products, sets the right prices, uses the right distribution channels, and is supported by the right promotional activities, then the company will be successful [4]. We will illustrate our findings using this particular model.

Overall, 66 people have participated in our questionnaire survey. Since the aim of our product is to allocate passengers to the seats that would satisfy their needs to the maximum extent, this survey serves the purpose of better identifying the potential customers and their preferences. According to the results (see Appendix A), all our participants aged from 18 to 44 of which the majority seems to be between the ages of 18 to 24, accounting for 75.76%. Regarding locations(see Appendix B), results show that nearly 40% of our participants are located in more developed regions such as Shanghai and Zhejiang. It provides insight into the demographic profile and geographical distribution of our potential customers.

Our survey has found that almost half of the people who take high-speed trains are traveling. 24.24 percent took the train to visit relatives. (see Appendix C) 16.67% and 3.03% of those who use high-speed rail for commuting and business purposes, respectively. The remaining 9.09% of people take HSR most commonly for other purposes. Take high-speed rail for commuting and business purposes often take HSR frequency is relatively high, there are requirements for a good riding environment. People with business purposes, especially, usually want to have a quiet driving environment to facilitate their office. Most of the people who are used for tourism and leisure take a long time and need a more comfortable environment for them to rest. Through this data, we can roughly understand the needs of consumers so that we can better design our system.

The next question is about people's unpleasant experiences with high-speed rail. We asked if they had ever experienced disruptions on a high-speed rail trip. 71.21% of people have had such experiences, and only 28.79% have rarely had them (see Appendix D).

We also added a fill-in-the-blank question to find out what kinds of interruptions bothered them. It shows that these interruptions include noise from other passengers (e.g., children crying, a passenger talking loudly on the phone or playing a short video), passengers reclining their seats too far back, and rear passengers kicking the back of their seats(see appendix E). All of this demonstrates the need and importance of creating a personalized seat assignment system.

The product in the 4P model refers to the sum of things that people acquire through purchases that satisfy certain needs and wants. It includes both product units in concrete material form and benefits in intangible form. Our product is the service we provide to passengers through our system to select their seats based on their preferences. In order to determine the functions of our product, we must first investigate people's needs. We then asked what factors are most important to passengers when choosing a seat on an HSR, and we allowed participants to select more than one option from which to choose. We found that 81.82% of people think having a relatively quiet seat is most important; 59.09% think having enough room for their legs is important; 46.97% want to be closer to the charging station; 36.36% think it's important to have a nice view out the window; 19.7% think the price of the seat is the most important factor; 19. 7% want seats close to public services such as restrooms or food carts; 16.67% of respondents also think an aisle seat is important; only 4.55% cited

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accessible spaces, such as accessibility for passengers with mobility impairments, as the most important consideration(see appendix F). This shows that people are more concerned with physical comfort and their own experience on a high-speed rail journey.

Based on the survey results (see Appendix G), it is evident that 43% of the respondents are highly interested in our product, 50% are interested. In comparison, only 6.06% expressed general interest, with no respondents indicating disinterest. These survey findings strongly suggest that our product has a viable market.

In terms of user expectations for features, 75.76% of respondents chose "Select child-free seating," 65.15% selected "Choose seats near charging outlets," 66.67% preferred "Select spacious seats (e.g., front row)," and 50% opted for "Apply for seat change online to communicate with others."(see appendix H) The high proportion of respondents choosing these features indicates that our envisioned product features align well with public demand.

Furthermore, in the section where respondents could suggest additional features, some mentioned the need for "registering and labeling passengers with children" and suggested considering "implementing women-only carriages based on international precedents."(see Appendix I) These suggestions align with the previously identified sources of intervention and the gender distribution of our user base. These proposed features are highly relevant to the disturbances described by users in the earlier section, demonstrating that our product features can address some user pain points.

As for how to charge fees (see appendix J&K), 59.09% want to charge prices as a percentage of the face value, while the rest want to charge fees through a fixed price. We can see that most people still support charging a percentage of the face value as a more fair and reasonable way to set prices. According to the price in the 4P model, price refers to the amount that a customer must pay to obtain a product or service. It involves pricing strategy, discounts, payment terms, and many other decisions. At present, we have few competitors in the market, so there is no need to consider pricing based on competitors' prices. At present, our tentative plan is to charge 8% of the face price. As for discounts, we will also make some preferential policies for consumers. During some holidays, such as the Spring Festival and National Day, when people have more travel needs, we can provide this service for consumers free of charge. In terms of payment terms, we certainly support all domestic online payment methods, including but not limited to Alipay, WeChat, credit cards, etc.

4. Discussion

It is clear from this research that there is still a huge market for human comfort improvement in high-speed rail. The survey of high-speed rail passengers revealed that there are many problems in such a large market. For instance, there’s no way for passengers to choose a relatively ideal seat based on their own preferences or prevent themselves from being bothered by a crying infant or noisy children who sit next to them randomly all trip long. This blank space gives us the opportunity to enter the market and gives us an advantage. According to the placing strategy in the 4P model, the place refers to distribution channels. Our company does not directly face consumers but focuses on the cultivation of distributors and the establishment of sales networks, and the connection between enterprises and consumers is carried out through distributors. According to the monitoring report of China E-business, the yearly revenue in 2010 was 4500 billion RMB. The YOY growth is 22%. B2B revenue is 3800 billion RMB. The YOY growth is 15.8%. The total revenue from internet retail is 513 billion RMB. There are roughly 25,000 E-business vendors [5]. We, therefore, will use the selective distribution approach as a plug-in and collaborate with some main OTA platforms like XieCheng QvNaer, which have been used for a long time. This relates to the Place aspect of the 4P strategy and would definitely be a win-win approach. According to the survey, our plan to create such a seat selection system is well-received by most of people. And these OTA apps have already had a large customer base. Thus, our product will have easy access to our target customers, and these OTA platforms will enhance

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their customer satisfaction at the same time. The results of our group's survey were then used to determine the price of our service and the potential functions or features that our system will have. The next step for our business is likely to develop to a stand-alone app from a simple plug-in system. This means that we will have greater autonomy and be able to control user data completely independently. It will also allow us to expand our business further, and we may consider collaborating with other travel services. However, in the course of our research, we found that even though we have partnered with a few major OTA platforms, it is still difficult for us to cover all HSR passengers, so there is a risk that passengers purchasing HSR tickets through OTA platforms that are not our partners will not be taken into account and controlled by our system, and will tend to upset our categorization and allocation of seats to known passengers. This is an issue we need to address in the future.

5. Conclusion

The product we launched is a high-speed rail personalized seat selection system attached to the high-speed rail ticket purchase software. According to consumers' different preferences, they can choose the most suitable seat for them to provide the most comfortable riding environment. Through our survey, we found that most people have unpleasant experiences on high-speed trains. This also allows us to determine that this pain point does exist in the current market. At the same time, we also found that our customers, who are mostly younger and in more developed regions, also expressed a great interest in our products. Regarding the charging of fees, most people also expressed the hope that fees could be charged by a percentage of the face value. These are all consistent with our assumptions. In terms of the contribution of products, our surveys played a crucial role, which has not only helped us further target specific customer groups but also consummate our online seat allocation algorithm, which aims to cater to our customers with the best possible seat that meets their requirements. Regarding the limitations, since there is a wide range of potential needs customers may be willing to fulfill, as well as the fact that each customer would come with a different combination of seat preferences, it seems that there needs to be a well-designed algorithm in place to ensure the effectiveness and usefulness. With the mission of constant improvement, one of the recommendations could be employing more expert technicians to upgrade and maintain the algorithm from time to time to assure product satisfaction.

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Shuyao Zhou, Ziyi Zhou, Muhang Zou, and Yujie Zhang contributed equally to this work and should be considered co-first authors.

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Appendix

appendix A: The age groups of participants

第1题：请选择您所在的年龄段 [单选题] Please select the age group you are in

选项 Options	小计 Number	比例 proportion
18岁以下 Below 18	0	0%
18-24	50	75.76%
25-34	14	21.21%
35-44	2	3.03%
45-54	0	0%
55-64	0	0%
65及以上 older than 65	0	0%
本题有效填写人次 Total number of people	66	

Appendix B: Locations of participants

Serial number	Answer text
1	Shanghai - Minhang District
2	Zhejiang -- Ningbo
3	Zhejiang - Hangzhou
4	Fengxian District, Shanghai
5	Guangxi - Nanning
6	Shanghai - Minhang District
7	Shanghai - Minhang District
8	Shanghai - Fengxian District
9	Shanghai - Fengxian District
10	Shanghai - Fengxian District
11	Shanghai-songjiang District
12	Shanghai - Fengxian District
13	Shanghai-putuo District
14	Shanghai - Fengxian District
15	Fengxian District, Shanghai
16	Shanghai - Fengxian District
17	Shanghai - Fengxian District
18	Ningbo, Zhejiang
19	Liaoning - Shenyang
20	Henan - Jiaozuo
21	Anhui - Chizhou
22	Jilin-Changchun
23	Henan - Jiaozuo
24	Henan - Xinxiang
25	Shanxi - Taiyuan
26	Henan - Zhengzhou
27	Shanghai - Xuhui District
28	Henan - Zhengzhou
29	Beijing - Haidian District
30	Shanxi - Taiyuan
31	Tianjin - Hexi District
32	Shanghai - Minhang District
33	Shanghai - Pudong New Area
34	Hainan-Haikou
35	Jiangsu - Nanjing
36	Shanxi - Taiyuan
37	Anqing, Anhui Province
38	Shanghai - Minhang District
39	Hubei -- Wuhan
40	Shanxi - Taiyuan
41	Chongqing - Shapingba District
42	Guangxi - Nanning
43	Shanghai - Huangpu District
44	Beijing - Fangshan District
45	Tianjin - Nankai District
46	Henan - Jiaozuo
47	Zhejiang - Hangzhou
48	Guangdong - Guangzhou
49	Shanghai-songjiang District
50	Hubei - Wuhan
51	Guangxi - Nanning
52	Shanghai - Jing 'an District
53	Fujian - Fuzhou
54	Tianjin - Heping District
55	Jiangxi - Nanchang
56	Shanghai - Minhang District
57	Guangxi -- Nanning
58	Guangdong - Guangzhou
59	Sichuan -- Chengdu
60	Overseas - Asia
61	Guangdong - Guangzhou
62	
63	

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Appendix C: The main purpose of travelling by HSR

第6题：您乘坐高铁旅行的主要目的是什么？ [单选题] What is your main purpose of traveling by high-speed rail

选项 options	小计 number	比例 proportion
商务用途 business use	2	3.03%
休闲（如旅游出行等）leisure use （travel）	31	46.97%
通勤 commuting	11	16.67%
探亲 visit family	16	24.24%
其他（请详述） [详细] else	6	9.09%
本题有效填写人次 Total number of people	66	

Appendix D: Whether they have experienced interruptions

第8题：您在高铁旅行中是否遇到过干扰？(如他人大声交谈、孩子哭闹等) Have you experienced interruptions in your HSR travel [单选题]

选项 options	小计 number	比例 proportion
是 yes	47	71.21%
否 no	19	28.79%
本题有效填写人次 Total number of people	66	

Appendix E: Describe some experience they've experienced

第9题：请描述您坐高铁最常遇到的干扰。 [填空题]

Please describe some interruptions you have experienced

词频分析 词云图 详细作答情况

答卷数据有更新，您可以获取最新分析结果 提交更新

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Appendix F: The most important factors for passengers to choose a HSR seat

第10题：在选择高速列车座位时，以下哪些因素对您来说最重要？ [多选题]
Which of the following factors are most important to you when choosing a HSR seat

选项 options	小计 number	比例 proportion
安静的空间 quiet space	54	81.82%
腿部空间 legroom	39	59.09%
充电插口 charging socket	31	46.97%
窗景 window view	24	36.36%
靠近便利设施（洗手间，餐车） proximity to public facilities (like restrooms or dining carriage)	13	19.7%
价格 price	13	19.7%
过道 aisle seat	11	16.67%
无障碍环境（例如，为行动不便的乘客提供无障碍环境） barrier-free environment	3	4.55%
⊞ 其他（请详述） [详细] else	0	0%
本题有效填写人次 Total number of people	66	

Appendix I: The interest of using a platform to improve experience

第11题：您是否有兴趣使用一个能改善您高铁体验的平台？ [单选题]
Are you interested in using a platform that will improve your HSR experience

选项 options	小计 number	比例 proportion
非常感兴趣 really interested	29	43.94%
感兴趣 interested	33	50%
一般 do not care much	4	6.06%
不感兴趣 not interested	0	0%
非常不感兴趣 really uninterested	0	0%
本题有效填写人次 Total number of people	66	

Appendix J: The features and functions they expect the platform to have

第12题：您希望这样一个平台具有哪些特点或功能？ [多选题]
What features or functions would you like the platform to have

选项	小计 number	比例 proportion
选择无小孩空间 Choosing a child-free space	50	75.76%
选择靠近充电口座位 Choose a seat near a charging socket	43	65.15%
选择宽敞空间（如第一排位置） Choose a spacious space, like the first row	44	66.67%
线上与他人沟通申请换座的功能 Online communication with other passengers to change seats	33	50%
⊞ 其他（请详述） [详细] else	1	1.52%
本题有效填写人次 Total number of people	66	

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Appendix K: Participants' willingness to pay additional fee for the use of these features

第13题：如果我们的平台能够通过数据算法为您提供座位选择，使您尽可能地远离噪音等干扰，您是否愿意为使用这一功能支付额外费用？ If our platform was able to algorithmically provide you with seating options through data to keep you as far away as possible from distractions such as noise, would you be willing to pay an additional fee for the use of this feature

选项 options	小计 number	比例 proportion
愿意 willing	44	66.67%
不愿意 unwilling	15	22.73%
其他（请详述） [详细] else	7	10.61%
本题有效填写人次 Total number of people	66	

Appendix L: Which way they prefer to pay extra

第14题：您更愿意用什么样的方式支付额外费用呢？ Which way would you prefer to pay extra?

选项 options	小计 number	比例 proportion
按票面价值的百分比 Percentage of face value	26	59.09%
按照固定价格 fixed price	18	40.91%
本题有效填写人次 Total number of people	44	