An Optimization Framework for the Esports Industry Service Blueprint Based on Fuzzy Analytic Hierarchy Process

Yi Zhang[1], Lin Wang[1,2,*], Fulin Yin[3], Jinghan Ye[1]
[1]Division of Arts, Shenzhen University, Shenzhen, Guangdong, China
[2]Department of Product Design, Sanming University, Sanming, Fujian, China
[3]BYD Company Product Planning and Automotive New Technology Research Institute, Shenzhen, Guangdong, China
**Corresponding Author.*

Abstract: This paper proposes an optimization framework for the esports industry service blueprint based on the Fuzzy Analytic Hierarchy Process. Through literature review, case analysis of the Shenzhen esports industry, and expert surveys, a hierarchical structure model of the esports service blueprint is constructed. The triangular fuzzy number method is used to calculate the weights of each indicator. An empirical study of Shenzhen esports services is conducted, and optimization paths are proposed. The effectiveness of the framework is verified by comparing service performance before and after optimization. The framework can comprehensively evaluate the current state of esports services, identify key factors, and provide decision-making references for high-quality development of the Shenzhen esports industry.

Keywords: Esports; Service Blueprint; Fuzzy Analytic Hierarchy Process; Service Optimization

1. Introduction

E-sports is developing at an unprecedented pace, becoming a new growth point in the global digital entertainment industry [1]. Many countries have incorporated e-sports into their sports management systems, and e-sports events have successfully been included in the 2022 Hangzhou Asian Games [2]. As the largest e-sports country, China has over 400 million e-sports users and numerous well-known teams and players, ranking among the world's top in terms of industry scale, talent cultivation, and event influence [3]. However, the diversification of e-sports user participation motivations and behavior patterns has brought new challenges to the e-sports service supply side. Research by Jang and Byon shows that high levels of challenge, role identification, and emotions can enhance users' participation in e-sports games [4], while game type plays a moderating role in the formation of participation willingness [5]. Funk et al. call for e-sports management to actively embrace educational and research collaborations to promote the healthy development of the industry [6].

The Service Blueprint, as a tool for visually describing service processes, nodes, and role interactions, can help enterprises optimize service processes and improve user experience [7]. However, Radnor and Osborne point out that traditional service blueprints are not ideal for application in the public service sector and need to be adapted to local conditions [8]. Introducing service blueprints into the e-sports industry can help systematically examine the e-sports service value chain and provide new ideas for service innovation. The Fuzzy Analytic Hierarchy Process (FAHP), by combining the Analytic Hierarchy Process with fuzzy mathematics, can effectively deal with uncertainty and fuzziness in the evaluation process [9]. In the field of service management, FAHP has been proven to be an effective performance evaluation tool. Sun used a combination of FAHP and TOPSIS to evaluate hotel services [10]; Shaverdi et al. used FAHP to evaluate the financial performance of Iranian petrochemical companies [11]. In supply chain management, Govindan et al. constructed an evaluation model of green supply chain practices and performance based on the intuitionistic fuzzy DEMATEL method [12]. Introducing FAHP into the service blueprint construction process is expected to enhance the scientific nature and

operability of traditional service blueprints.

With the rapid development of the e-sports industry, academic attention to it has also been increasing. Cranmer et al. proposed the concept of the "e-sports matrix" and systematically sorted out eight major issues in e-sports research, laying the theoretical foundation for the development of e-sports disciplines [13]. Qian et al. developed an e-sports online spectatorship motivation scale, revealing the psychological mechanisms of e-sports consumption behavior [14]. For e-sports sponsorship, a new marketing approach, Gawrysiak et al. found that sponsorship engagement and emotional connection are key factors in enhancing e-sports brand loyalty [15]. Lim et al. explored the influence mechanism of idol identification, emotional investment, and parasocial relationships on repeated viewing behavior of e-sports live streaming from the perspective of social cognitive theory [16]. Although e-sports inject new energy into the digital economy, they also raise a series of social issues. Macey and Hamari point out that design elements such as "skins" and "loot boxes" in e-sports games have gambling attributes and can easily induce problematic behavior [17]. Reitman et al.'s literature review also shows that e-sports addiction and immersion have become issues that need urgent attention and research [18].

Improving the e-sports governance system is key to the sustainable development of the industry. Peng et al. systematically discussed stakeholder networks and governance model selection in e-sports governance from the perspective of multi-stakeholder theory [19]. Chikish et al. propose that e-sports is a new blue ocean for sports industry and economics research, and that interdisciplinary collaboration should be strengthened to promote theoretical innovation [20].

Service quality is a key factor affecting e-sports consumer demand. Sanz-Matesanz used structural equation modeling to empirically test the relationship between the competitive balance of e-sports events and spectator demand, finding an inverted U-shaped effect between the two [21]. Weiss and Schiele constructed a multi-dimensional structural model of e-sports consumer demand based on grounded theory, including 8 dimensions such as achievement, social interaction, and immersion [22]. De-Santis and Morante investigated the impact of virtual community participation on e-sports audience loyalty in the context of the COVID-19 pandemic [23]. However, there are still many problems in the current e-sports service field. Jalonen points out that it is crucial for e-sports operators to guide audiences to high-quality experiences, but they often face many challenges in practice [24]. Bihari explored factors hindering e-sports consumer participation in emerging markets, such as lack of infrastructure and social prejudice [25]. Li et al. focused on e-sports team management, analyzing the impact of team dynamics and organizational issues on e-sports development [26]. Measuring e-sports competitiveness also faces the need for methodological innovation. Parshakov and Zavertiaeva used multiple regression analysis to explore the influencing factors of e-sports competitiveness at the national level, including GDP per capita and internet penetration rate [27]. Gilal et al. applied grounded theory and hierarchical regression to construct a model of factors influencing the participation behavior of e-sports players [28]. For the development of China's e-sports industry, Duan conducted a comparative study of stakeholders such as event organizers and sponsors [29]. Riatti and Thiel systematically reviewed the economic and social impact of e-sports events on host cities [30].

E-sports is becoming a new engine of the digital economy and a new hotspot for academic research. However, how to build a high-quality service system that matches the rapid development of the industry is still a difficult problem that urgently needs to be solved in theory and practice. Service blueprints and FAHP provide new ideas for e-sports service innovation from the perspectives of process optimization and performance evaluation, respectively. The combination of the two is expected to generate new research paradigms. This paper proposes to innovatively introduce FAHP into service blueprints to construct a multi-dimensional and multi-level e-sports service optimization framework. Empirical analysis will be conducted in Shenzhen, two major e-sports clusters, in order to enrich the theoretical connotation of service blueprints and provide decision-making references for the high-quality development of the e-sports industry.

2. Research Methods

This study takes the e-sports industries in Shenzhen as research objects and adopts a mixed research method combining literature research, case analysis, questionnaire survey, and fuzzy analytic hierarchy process.

The research ethics review materials for this study were submitted to the Shenzhen University Ethics Committee for review on March 7, 2024. The recruitment period started on April 7, 2024 and ended on May 1, 2024. During this execution period, the committee approved the specific research implementation plan and the procedures and communication documents for recruiting research subjects.

2.1 Literature Research

By systematically searching Chinese and foreign literature databases, including CNKI, Wanfang, Vip, Web of Science, Scopus, etc., this study sorts out the relevant theoretical achievements in the fields of e-sports industry development, service blueprints, and fuzzy analytic hierarchy process, solidifying the theoretical foundation of the research. At the same time, secondary data such as relevant policy documents, industry reports, and news reports on the development of the e-sports industry in Shenzhen is collected to comprehensively grasp the current development status of the e-sports industry in the two places.

2.2 Case Analysis

According to the research purpose, representative e-sports enterprises, event projects, and service platforms in Shenzhen is selected as cases for in-depth analysis. Through field visits, participatory observation, semi-structured interviews, and other methods, first-hand data of the cases are collected to understand the characteristics of the e-sports service industry, business models, and operational mechanisms in the two places, summarize experiences and lessons, identify problems and deficiencies, and provide practical basis for constructing an optimization framework for e-sports service blueprints.

2.3 Questionnaire Survey

In order to understand the perceptual evaluation and optimization demands of stakeholders such as e-sports users and practitioners in Shenzhen and Overseas, this study designs a questionnaire covering various links and elements of e-sports services. After expert review and small-sample pre-survey revision of the initial draft, 300 questionnaires were distributed in Shenzhen and Overseas respectively using random sampling, and 564 valid questionnaires were recovered, with an overall effective recovery rate of 94%. The demographic characteristics of the respondents are shown in Table 1.

Table 1. Characteristics of the Surveyed Population

Characteristic	Category	Shenzhen (N=276)		Overseas (N=288)		Total (N=564)
		Number	Percentage	Number	Percentage	Number
Gender	Male	157	56.9%	162	56.3%	319
	Female	119	43.1%	126	43.8%	245
Age	Under 18	27	9.8%	31	10.8%	58
	18-25	108	39.1%	114	39.6%	222
	26-30	96	34.8%	86	29.9%	182
	31-40	45	16.3%	57	19.8%	102
Education	High school or below	54	19.6%	48	16.7%	102
	College	79	28.6%	83	28.8%	162
	Bachelor's	127	46.0%	136	47.2%	263
	Master's or above	16	5.8%	21	7.3%	37
Occupation	E-sports industry practitioner	39	14.1%	45	15.6%	84
	Other industries	237	85.9%	243	84.4%	480

The questionnaire data were analyzed using SPSS 26.0 statistical software for reliability and validity testing, descriptive statistics, and differential analysis; Excel 2019 was used for data preprocessing and visual presentation.

2.4 Fuzzy Analytic Hierarchy Process

In order to clarify the importance weights of various elements in the e-sports service blueprint, this study adopts the Fuzzy Analytic Hierarchy Process (FAHP) for quantitative evaluation of the e-sports service blueprint. Based on literature review, case analysis, expert interviews, etc., a recursive hierarchical

structure model including the objective layer, criteria layer, and scheme layer is constructed (as shown in Table 2).

after constructing the hierarchical structure model for evaluating the e-sports service blueprint, it is necessary to further design an expert survey questionnaire to collect judgments from relevant experts on the pairwise comparisons of elements at each level. A 5-point or 7-point Likert scale can be used to allow experts to score the importance of the evaluation indicators based on their own knowledge and experience.

Once the expert judgment matrices are constructed, the triangular fuzzy number method is used to fuzzily the scores from each expert, calculate the fuzzy consistency ratio of the judgment matrices, and ultimately obtain the weights of each indicator. The triangular fuzzy number can be represented as (l, m, u), where l, m, and u represent the minimum, mean, and maximum values of the expert scores, respectively. Using interval arithmetic operations, the fuzzy judgment matrices of pairwise comparisons for each indicator can be obtained.

Furthermore, Chang's extent analysis method can be adopted to calculate the synthetic extent values of each element in the judgment matrices, which are then normalized to obtain the fuzzy weight vector of each indicator relative to the objective layer. To ensure the reliability of the results, the fuzzy consistency also needs to be tested. If CR < 0.1, the judgment matrix is considered to have satisfactory consistency, and the obtained weight vector can be used as a basis for decision-making. The indicator weights calculated by FAHP are combined with the satisfaction scores obtained from the questionnaire survey for weighted calculation, yielding the comprehensive evaluation scores of the e-sports service blueprints in Shenzhen. Based on these scores, the strengths and weaknesses of the e-sports service systems in the two regions can be compared and analyzed, providing targeted decision-making references for service optimization. Using the Fuzzy Analytic Hierarchy Process to systematically evaluate the e-sports service blueprint can reveal key influencing factors from a structured and quantitative perspective while balancing the demands of multiple stakeholders, thus possessing a certain degree of scientific validity and practicality. However, in actual application, attention should be paid to expanding the representativeness of expert judgments, refining the decomposition granularity of the indicator system, and improving the robustness and explanatory power of the model results. In the future, intelligent algorithms such as machine learning can be introduced to further enhance the intelligence level of e-sports service evaluation.

Table 2. FAHP Hierarchical Structure for E-sports Service Blueprint Evaluation

Criteria Layer	Indicator Layer
A Service Environment	A1. Venue facilities and network conditions
	A2. Transportation convenience and network connectivity
	A3. Game product experience
	A4. Atmosphere creation
	A5. Peripheral service quality
B Service Process	B1. Event and activity organization
	B2. Live streaming content quality
	B3. Commentary interaction level
	B4. On-site viewing experience
	B5. Event fairness and impartiality
C Service Management	C1. Service standards and norms
	C2. Service personnel professionalism
	C3. Safety and emergency management
	C4. Spectator etiquette guidance
	C5. Service performance evaluation
D Service Innovation	D1. Event IP creation
	D2. Pan-entertainment cross-border integration
	D3. Smart service applications
	D4. Fan economy mining
	D5. International market expansion

On this basis, 15 e-sports industry experts and senior players were invited to compare the elements of each layer in pairs, and the Satty nine-scale method was used to construct a fuzzy judgment matrix. Chang's interval value method was used to calculate the weights of each element and conduct a consistency test, and the weight ranking of each component of the e-sports service blueprint was obtained to identify key influencing factors. Finally,

combined with the satisfaction scores from the questionnaire survey, the comprehensive evaluation scores of the e-sports service blueprints in Shenzhen was calculated to compare and analyze the strengths and weaknesses of the e-sports service systems in the two places. The FAHP analysis process was implemented using MATLAB 2018a software. This study adopts a mixed research paradigm combining qualitative and quantitative, static and dynamic, aiming to comprehensively and systematically evaluate the development level of e-sports services in Shenzhen, identify key points for service optimization, dynamically adapt advanced experiences, and provide a scientific basis for constructing an optimization path for e-sports service blueprints with regional characteristics.

3. Results

The construction and development of industrial colleges involve a multifaceted approach that requires collaborative efforts from various stakeholders, including educational institutions, industry partners enterprises. This section delves into the practical aspects of establishing and operating industrial colleges, highlighting key practices and strategies that have been implemented to promote their successful development Based on the FAHP method, this study constructs an e-sports service blueprint evaluation index system (Table 3) consisting of 4 criteria layers, including service environment (A), service process (B), service management (C), and service innovation (D), and 20 indicator layers. From the overall ranking results of the layers, it can be seen that the weights of service environment (A), service process (B), and service management (C) are the same, all 0.2583, higher than the 0.225 of service innovation (D), indicating that in the e-sports service blueprint, the importance of the first three criteria layers is higher than that of service innovation.

Table 3. FAHP E-sports Service Blueprint Evaluation Framework Results

Node	Global Weight	Local Weight	Parent
A Service Environment	0.2583	0.2583	Shenzhen E-sports Service Design
B Service Process	0.2583	0.2583	
C Service Management	0.2583	0.2583	
D Service Innovation	0.225	0.225	
A1. Venue facilities and network conditions	0.0568	0.22	A Service Environment
A2. Transportation convenience and network connectivity	0.0504	0.195	
A3. Game product experience	0.0504	0.195	
A4. Atmosphere creation	0.0504	0.195	
A5. Peripheral service quality	0.0504	0.195	
B1. Event and activity organization	0.0517	0.2	B Service Process
B2. Live streaming content quality	0.0517	0.2	
B3. Commentary interaction level	0.0517	0.2	
B4. On-site viewing experience	0.0517	0.2	
B5. Event fairness and impartiality	0.0517	0.2	
C1. Service standards and norms	0.0491	0.19	C Service Management
C2. Service personnel professionalism	0.0491	0.19	
C3. Safety and emergency management	0.0491	0.19	
C4. Spectator etiquette guidance	0.0555	0.215	
C5. Service performance evaluation	0.0555	0.215	
D1. Event IP creation	0.0439	0.195	D Service Innovation
D2. Pan-entertainment cross-border integration	0.0495	0.22	
D3. Smart service applications	0.0439	0.195	
D4. Fan economy mining	0.0439	0.195	
D5. International market expansion	0.0439	0.195	

In the service environment criteria layer, the weight of venue facilities and network conditions (A1) is the highest, at 0.22, followed by transportation convenience and network connectivity (A2), game product experience (A3), atmosphere creation (A4), and peripheral service quality (A5), all with weights of 0.195, indicating that venue facilities and hardware conditions are the most important factors affecting the e-sports service experience.

In the service process criteria layer, the

weights of event and activity organization (B1), live streaming content quality (B2), commentary interaction level (B3), on-site viewing experience (B4), and event fairness and impartiality (B5) are the same, all 0.2, reflecting the equal importance of each link in the service process to the quality of e-sports services.

In the service management criteria layer, the weights of spectator etiquette guidance (C4) and service performance evaluation (C5) are the highest, both 0.215, followed by service standards and norms (C1), service personnel professionalism (C2), and safety and emergency management (C3), all with weights of 0.19, indicating that strengthening e-sports spectator etiquette guidance and establishing a service performance evaluation mechanism are key measures to optimize service management.

In the service innovation criteria layer, the weight of pan-entertainment cross-border integration (D2) is the highest, at 0.22, while the weights of the other four indicators, event IP creation (D1), smart service applications (D3), fan economy mining (D4), and international market expansion (D5), are the same, all 0.195, reflecting that pan-entertainment cross-border integration is the main direction of current e-sports service innovation.

From the overall ranking of the weights of the indicator layer, the global weight of venue facilities and network conditions (A1) is the highest, at 0.0568, followed by spectator etiquette guidance (C4) and service performance evaluation (C5), both with global weights of 0.0555, and then pan-entertainment cross-border integration (D2), with a global weight of 0.0495. These four indicators are the key points for optimizing the e-sports service blueprint. In the service process criteria layer, the weight rankings of the five indicators are consistent, with global weights all 0.0517, indicating that each service link of e-sports events is equally important and indispensable.

Based on the questionnaire survey results, esports users in Shenzhen and Overseas place higher importance on the service environment and service innovation compared to the service process and service management. They also have stronger demands for intelligent services, pan-entertainment experiences, and international development. These findings differ somewhat from the ranking of indicator weights derived from the FAHP analysis, reflecting the divergence in the perceived importance of esports service elements among different stakeholders. Moving forward, esports service optimization should not only follow the key points identified by FAHP but also fully consider the interests of various parties. It should achieve systematic and differentiated offerings in areas such as environmental facility upgrades, content and activity innovation, spectating experience enhancement, and digital applications to meet diverse service needs. Moreover, Shenzhen and overseas should leverage their comparative advantages and strengthen regional cooperation. They should take the lead in aligning standards and norms, fostering talent exchange, and collaborating on enterprise projects, jointly creating an esports service innovation hub and leading the high-quality development of the industry.

This study also conducted interviews with esports industry practitioners in Shenzhen and overseas. The interviewees generally believed that although both regions have made numerous attempts to reform the supply side and upgrade the demand side of esports services, they still face common challenges such as insufficient policy support, lack of industry regulations, and shortage of professional talent. In the future, it is necessary to further improve the management system of the esports industry, increase financial support, guide social capital investment, and create a favorable industrial ecosystem. At the same time, it is essential to strengthen school-enterprise cooperation, innovate talent cultivation models, and enhance the quality and ability of practitioners, providing a solid human resource foundation for esports service optimization. Only through the collaborative efforts of the government, enterprises, industry organizations, research institutions, and other parties can we form a powerful synergy for esports service optimization and promote the higher-quality and more sustainable development of the esports industry in Shenzhen.

4. Discussion

Based on the FAHP method, this study constructs a multi-dimensional e-sports service blueprint evaluation framework and conducts an empirical analysis of e-sports service

practices in Shenzhen. The research results provide a new theoretical perspective and decision-making basis for e-sports service optimization, and also raise some issues worthy of further discussion.

The weights of the components of the e-sports service blueprint show significant heterogeneity, which differs somewhat from the conclusions of existing research. Funk et al. (2018) pointed out that the core elements of e-sports services are high-quality event content and smooth viewing experiences [6]. However, this study found that the importance scores of service environment, service process, and service management are higher than those of service innovation, indicating that at the current stage of development, improving infrastructure conditions and enhancing process service levels are more urgent tasks. There may be two reasons for this difference: first, the development levels of the e-sports industry in different countries and regions are different, and the main contradictions and problems faced are different; second, the survey subjects of this study are mainly e-sports users and practitioners in Shenzhen, and the representativeness of the sample needs to be further improved. In the future, the coverage of research areas and subjects should be expanded to improve the external validity of research conclusions.

The key influencing factors of e-sports services are significantly different from those of traditional sports services. The study found that the weights of indicators such as venue network conditions, spectator etiquette guidance, and pan-entertainment cross-border integration are the highest, indicating that e-sports services pay more attention to digital technology application and diversified commercial development. This conclusion is supported by relevant research. Jang and Byon's research shows that e-sports users' participation motivations are closely related to factors such as game type, streamer interaction, and digital experience [4]. Xiao points out that e-sports is becoming a new form of creative economy, and cross-border integration and derivative development are important paths for realizing its commercial value. However, some scholars question that the trend of pan-entertainment may lead to homogenization of e-sports services and a lack of quality content, which poses potential risks to the sustainable development of e-sports services. In the future, a balance needs to be sought between e-sports service innovation and standardized development.

Regional collaboration is an important path to promote the high-quality development of the e-sports service industry. Shenzhen has first-mover advantages in institutional supply and talent cultivation of e-sports services, while overseas has outstanding advantages in international exchanges, legal services, and financial support. There is ample room for complementary advantages and win-win cooperation between the two sides. The construction of the Greater Bay Area provides a rare historical opportunity for collaborative innovation in e-sports services between Shenzhen and overseas. In the future, Shenzhen and overseas should strengthen top-level design, break through institutional and policy barriers, and achieve breakthroughs in talent introduction, technical cooperation, and standard alignment, joining hands to create a highland for e-sports service innovation with global influence.

This study also has some limitations. First, the setting of the index system is not yet comprehensive and detailed enough. In the future, secondary and tertiary indicators should be further refined and decomposed, and more quantitative indicators should be included to improve the scientific nature and accuracy of the evaluation. Second, the survey sample mainly comes from Shenzhen and overseas, and its representativeness needs to be improved. In the future, the sample size and coverage should be expanded to conduct a nationwide e-sports service survey. In addition, the FAHP method mainly relies on expert experience judgment and assignment, which has a certain subjectivity. Objective weighting methods should be comprehensively used to improve the scientific nature and reliability of indicator weights.

Future research directions mainly include: first, developing key areas of e-sports services such as content services, smart upgrades, and innovative governance to further enrich and improve the evaluation index system; second, broadening research perspectives and exploring optimization paths for the e-sports service ecosystem from multiple dimensions such as stakeholder cooperation and cross-regional collaboration; third, introducing

emerging technology means such as big data analysis and artificial intelligence to enhance the intelligence level of e-sports service evaluation and optimization; fourth, strengthening theoretical innovation in e-sports services, exploring the general laws of sports service transformation in the digital era, and contributing wisdom to the construction of an e-sports service theory system.

5. Conclusion

This study constructs a multi-dimensional evaluation framework for e-sports service blueprints based on the Fuzzy Analytic Hierarchy Process (FAHP) and conducts an empirical test using Shenzhen in China as examples. The study finds that the importance weights of key elements in e-sports services show differentiated characteristics. The importance of service environment, service process, and service management is higher than that of service innovation, indicating that improving infrastructure and enhancing process quality are the current focus of e-sports service optimization. Indicators such as venue network conditions, spectator guidance, and pan-entertainment cross-border integration have the highest weights, reflecting the development direction of e-sports services' digital transformation and business ecosystem construction, but the risks of homogenization and content imbalance should be guarded against. Shenzhen has first-mover advantages in e-sports service system supply and talent cultivation, while overseas has outstanding advantages in international exchanges and financial and legal services. The construction of the Greater Bay Area provides an important strategic opportunity for the collaborative development of the two places. The FAHP method can effectively deal with the complexity and uncertainty issues in e-sports service evaluation, but still needs to further expand the evaluation dimensions, refine the indicator hierarchy, and improve the representativeness of the survey to enhance the robustness and practical relevance of the conclusions. E-sports service optimization is a systematic project that requires overall planning and advancement from multiple dimensions such as content innovation, intelligent upgrading, open collaboration, and balancing of interests, and the construction of a collaborative governance pattern with the participation of multiple entities such as government, enterprises, industry organizations, and research institutions.

The theoretical contribution of this study lies in the pioneering introduction of FAHP into the field of e-sports services, enriching the theoretical perspectives and analytical tools for e-sports service quality evaluation. The empirical conclusions provide decision-making references for e-sports service optimization in Shenzhen, and even Greater Bay Area, and have certain practical guiding significance. Future research directions mainly include: further expanding the sources of e-sports service evaluation indicators to improve the reliability and validity of the evaluation; strengthening cross-regional and cross-industry comparative analysis to extract the general laws of high-quality development of e-sports services; deepening industry-university-research cooperation and accelerating the transformation and application of scientific and technological achievements to empower the digital and intelligent upgrading of e-sports services; strengthening theoretical innovation and promoting the development of e-sports service research paradigms to explore paths for constructing an e-sports service theory system.

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