



A Management Model for University Drone Sport Clubs Based on the POLC Framework

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Received 24/09/2025

Revised 07/10/2025

Accepted 30/10/2025

Abstract

Background and Aims: Drone sport has rapidly emerged as a new form of physical and technological education in Chinese universities, yet the management of university drone sport clubs still faces challenges, including insufficient planning, a lack of organizational clarity, limited leadership capacity, and weak evaluation mechanisms. This study aimed to construct and validate a comprehensive management model for university drone sport clubs based on the POLC (Planning, Organizing, Leading, and Controlling) framework.

Methodology: This study employed a mixed-methods design to investigate the management of university drone sports clubs in Guangdong Province. The quantitative phase surveyed 368 participants, including 41 teachers and 327 student members, to assess the current management status and identify key issues. Purposive sampling was used to select experts for interviews, Delphi consultation, and focus group discussions. In-depth interviews with five key stakeholders and case studies of selected universities provided contextual insights into operational challenges, leadership practices, and resource management. Based on the integrated analysis, a preliminary management model was developed and refined through two rounds of Delphi consultation with 19 experts, including drone coaches, physical education specialists, and sports managers. Finally, a seven-person focus group discussion was conducted to validate and finalize the model, ensuring its theoretical soundness, practical applicability, and alignment with university and policy requirements. Quantitative data were analyzed using descriptive statistics (mean and standard deviation), while qualitative data from interviews, case studies, and focus group discussions were examined through content analysis. Delphi results were evaluated using median and interquartile range (Median ≥ 3.50 , IQR ≤ 1.50), and questionnaires were validated using the Index of Item-Objective Congruence (IOC).

Results: The findings revealed that universities often lack systematic activity planning, resource integration, and leadership mechanisms, thereby hindering the sustainable development of drone sports clubs. The proposed management model addressed these problems by integrating POLC principles with supporting theories such as 4M, Constructivist Learning Theory, and



Collaborative Governance Theory.

Conclusion: The developed model is practical and effective in enhancing club operations, improving member satisfaction, and supporting the sustainable growth of drone sport in universities. It provides valuable insights for both policymakers and educational institutions to strengthen drone sport education and extracurricular management. And this is the first validated POLC-based model applied to drone sports in Chinese universities.

Keywords: Drone Sport; University Club; POLC Theory; Management Mode; Higher Education

Introduction

In recent years, due to the significant development of sensing, communication and energy technologies, the development of the low-altitude economy (refers to the commercial, civil, entertainment, and sports economic activities below 1,000 meters) has accelerated, and the application scenarios of unmanned aerial vehicles (UAVs) continue to expand (Di, 2023; Federal Aviation Administration, 2019; General Administration of Sport of China, 2024, 2023). The diffusion and in-depth integration of drone technologies will drive the development of new industries such as logistics, aerial imaging, and aviation sports, and the emerging applications of drones are also combined with the current hotspots of the digital economy and financial technology (Hu & Li, 2025; Sun et al., 2025; Wang & Lin, 2025; Yuan et al., 2025).

At present, with the continuous enrichment and expansion of the connotation of drone sports, there is an urgent need to strengthen the construction of drone sports in universities. However, for most universities, the governance of drone sports is not in place, there is a lack of unified guidance on the governance resources allocation, course setting and management mechanism to improve the long-term stability of students' interests, resulting in the drone sports training in most universities falling into the disorganized, short-term and one-sided state that is common in the primary stage of club training (Chen & Lv, 2018; Luo, 2020; Su, 2020; Wang, 2020).

The Drone Sports Club in the School of Leisure and Digital Sports at Guangzhou Sport University is a new sports form pilot club in the school. The club has developed drone piloting contests and is also committed to interdisciplinary learning in drone maintenance, design, and training, but in the face of the in-depth construction of drone sports in the university, it is also found that there are many problems in the planning, organizing, and leading stages of the operation, so there is a lack of a more authoritative, complete, and feasible club management model (General Administration of Sport of China, 2024, 2023).

On this basis, taking the drone sports club in the School of Leisure and Digital Sports in Guangzhou Sport University as the research object, this study will establish a university drone





sports club management model based on the classical management theory and operation method (Mintzberg, 1973). At the same time, with the help of the planning–organizing–leading–controlling (POLC) management thinking and 4M factors that affect organizational activities (refers to people, materials, machines, and money) (McKean et al., 2023), a more systematic, reliable, and effective university drone sports club management model will be formed and explored (General Administration of Sport of China, 2024, 2023).

Objectives

To develop a management model to promote university drone sport clubs in Guangdong Province, China.

Literature Review

The governance of University clubs has been frequently theorized under traditional management perspectives. A common reference framework for understanding managerial functions and processes is the POLC model, an acronym representing Planning, Organizing, Leading, and Controlling. In the context of Sports Management, it has helped many scholars align organizational goals, rationalize resource allocation, encourage leadership and management participation, and develop control mechanisms for institutional and operational sustainability and accountability (Slack, 2020; Misener, 2014).

Originating in Henri Fayol’s classic management theory, the POLC framework derives from five initial managerial functions: planning, organizing, commanding, coordinating, and controlling. Later research integrated the last three functions into four by categorizing “commanding” and “coordinating” into “leading.” This semantic streamlining has facilitated the legacy of the framework in multiple management and sports administration research. However, authors such as Mintzberg (1973) have criticized the rigidity of the POLC model, as it poorly translates the dynamic, processual, interpersonal, and emergent reality of managerial behavior.

Critiques aside, the picture may be different in technology-emerging and mediated sports environments. In drone sports clubs, the very formalization of processes and the clear identification of managerial functions are central to providing and instilling a sense of organizational stability. This developmental stage – not yet consolidated in a self-sustained, multidisciplinary model – calls for semantic precision and generally agreed-upon institutional steps as signposts for sustainability and interdisciplinary cooperation. In this case, therefore, the POLC framework – far from hindering and constraining institutional modeling – can actually be a strategic opportunity to impose a governance order by simple commonality.





In recent years, scholars have evidenced the incremental degree of flexibility in POLC interpretations, as the sports industry has gone through accelerated periods of digitalization. For example, Slack (2020) highlights the need for a complementary planning of competitive and commercial imperatives in sports organizations. Misener (2014) acknowledges the hybridization of the bureaucratic and project-based models as a result of, and imperative for, efficient resource allocation and control in mass-based sport. More recently, Ratten (2023) has discussed how the digital transformation of sports via artificial intelligence (AI) software, automated data collection, and athlete performance systems through sensors and networking is redefining “control” and “leadership” in management functions.

From that, drone sports clubs have materialized at the interstices of conventional and technology-oriented sports. As such, these organizations need both the human capital required in terms of physical and competitive training, plus cohesion and team agency – typical of “traditional” sports, according to the POLC framework – and the incorporation of technological governance, operational digital skills and competencies, as well as an innovation culture at their institutional core. Therefore, while the POLC model can remain a useful conceptual reference point, its practical application in the arena of drone sports management requires re-interpretation in the light of technology integration and leadership-oriented innovation (Mintzberg, 1973; Ratten, 2023).

Table 1 Definition of POLC

Planning	Organizing	Leading	Controlling
1.Vision&Mission	1. Organization	1. Leadership	1. Systems/Processes
2. Strategizing	2. Culture	2. Decision Making	
3.Goals&Objectives	3. Social Networks	3. Communications	2. Strategic Human Resources
		4. Groups/Teams	
		5. Motivation	

Conceptual Framework

To strengthen the model, the POLC framework is integrated with three supporting theories. The 4M highlights the effective utilization of institutional and external resources to sustain club operations, emphasizing the educational function of drone sport clubs, where students learn through practice, problem-solving, and collaboration. Collaborative Governance Theory underlines the need for multi-stakeholder cooperation, including partnerships between universities, local communities, and policy authorities.



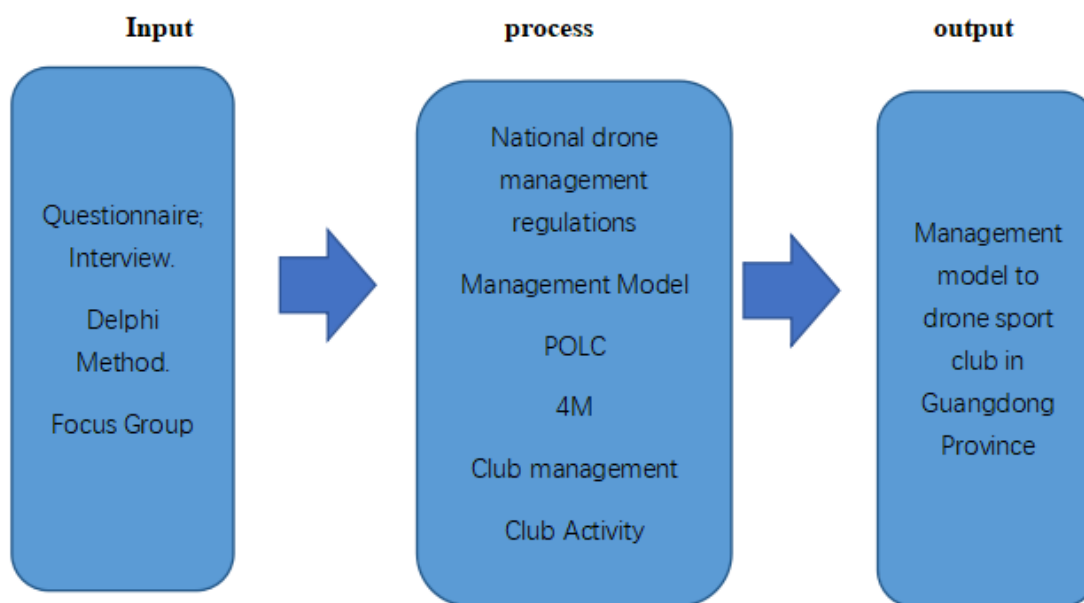


Figure 1 Conceptual Framework

Methodology

This study used a mixed-methods approach to develop and validate a management model for university drone sports clubs, integrating a quantitative survey, expert interviews, a two-round Modified Delphi process, and a focus group discussion.

Data source

Design & scope: Mixed-methods study (quantitative survey + qualitative interviews, two-round Modified Delphi, and a focus group) conducted May 2024–May 2025.

Population: Eleven university drone sports clubs in Guangdong Province, comprising 41 teachers and 2,072 student members.

Samples:

Survey: Simple random sampling per Krejcie & Morgan → 41 teachers and 327 students.

Experts (purposive): 5 for questionnaire validation (IOC = 0.80–1.00), 5 for in-depth interviews, 19 for Delphi rounds, and 7 for the focus group, confirming the final model.

Instruments for collecting data

Questionnaire (quantitative):

52 items grounded in POLC (Planning–Organizing–Leading–Controlling) and 4M (Man–Machine–Material–Method) frameworks.

Pilot tested; content validity established via Index of Item–Objective Congruence (IOC = 0.80–1.00).

Five-point Likert response format.

Interview guides (qualitative):

Semi-structured guides for expert interviews and Delphi rounds (open-ended prompts), content-validated via IOC.

Focus group protocol:

Structured prompts to verify, refine, and confirm the draft management model.

Data-collection process

Step 1: Literature review to map constructs and draft initial indicators for the management model.

Step 2: Survey administration (teachers and students) was conducted online and in person across the 11 clubs to identify current practices, needs, and pain points.

Step 3: Expert interviews (n = 5) to elaborate domain insights and inform item/model refinement.

Step 4: Modified Delphi (two rounds; n = 19): experts rated and commented on model components/indicators until predefined consensus criteria were met.

Step 5: Focus group (n = 7) to confirm model structure, terminology, and implementation guidance.

Step 6: Reporting: synthesis of quantitative and qualitative findings into the final model and documentation for transparency and replicability.

Field period: Continuous collection and iteration from May 2024 to May 2025.

Data analysis*Quantitative (survey & Delphi ratings):*

Descriptive statistics (frequencies, percentages, means, SD) for item and domain summaries.

Likert-scale evaluation of indicators and model components.

Delphi consensus criteria: median ≥ 3.50 and interquartile range (IQR) ≤ 1.50 to retain items/components; items failing criteria were revised or removed between rounds.

Qualitative (interviews & focus group):

Thematic coding (open $\rightarrow$ axial) to derive categories aligned with POLC and 4M, capturing operational, organizational, and governance themes unique to drone sports clubs.

Triangulation across data sources (survey, interviews, Delphi comments, focus group) to enhance credibility and refine model specifications.

Integration: Convergent synthesis used to reconcile quantitative priorities (e.g., highly rated, consensus items) with qualitative insights (e.g., implementation barriers, contextual nuances), yielding the validated comprehensive management model for university drone sports clubs.



Results

The Delphi research validated the following university drone sports club management model (Fig. 2). According to the analysis of the five core problems existing in the management of the university drone sports clubs at present, combined with the existing research on university drone sports clubs, and the research results of the preliminary survey of this study, we tried to establish a university drone sports club management model according to the management theory of POLC and 4M management.

Through two rounds of Delphi surveys, we calculated the IOC values and median scores of each indicator. The differences between the two rounds were analyzed, and the final model and indicator levels were decided. In the first and second rounds of Delphi surveys, we obtained the median scores of the 33 experts on each indicator level. The average and standard deviation of the expert scores for each indicator of the management model of the university drone sports club were calculated to ensure that the validity of the indicators in the management model met the requirements. At the same time, based on the threshold, the level of agreement among the experts on the overall management model was calculated. At this stage, the model and indicators were preliminarily determined after being revised by the experts according to the two rounds of Delphi surveys. Finally, the overall management model and the levels of each indicator were agreed upon by the experts (median ≥ 3.50 , IQR ≤ 1.50), with no other suggestions from the experts, and the current management model of the university drone sports club was determined.

Based on the drone sports club management model under the learning situation, this study first proposed an effective and executable management model under the university learning situation in terms of management level. It provides a reference for the management of drone sports clubs in universities. In addition, this study supplemented some specific indicators in each index level of the management model of drone sports clubs in universities according to the management practice in universities and the results of the two rounds of Delphi surveys. This management model will be further explored and verified in subsequent studies and will also provide a basis for universities to implement drone sports club management and a basis for related policy formulation.



Planning

- Member Surveys & Interviews
- Facilities & Resource Inventory
- SMART Goal Setting
- Annual & Milestone Planning
- Signature Projects Selection
- Brainstorming & Idea Vetting
- Integrated Yearly Calendar
- Budget Planning & Allocation
- Risk Identification & Mitigation
- Benchmarking Best Practices
- Cross-Program Collaboration
- Stakeholder Engagement Plan

Leading

- Leadership Participation in Events
- Recognition Systems
- Open Communication Channels
- Mentorship Pairing
- Conflict Resolution Process
- Wellbeing & Inclusion Monitoring
- Training & Delegation for Leaders
- Data-Driven Decision Making
- Designated Spokespersons
- Core Member Engagement
- Compliance with Rules
- Knowledge Sharing
- Funding Initiatives

Organizing

- Lean Structure & Clear Reporting Lines
- Job Descriptions & RACI Matrix
- Monthly Coordination Meetings
- SOP Documentation
- Shared Tools for Communication
- Equipment Tracking & Maintenance
- Standardized Procurement & Donations
- Onboarding & Backup Roles
- Volunteer Management
- MOUs with Enterprises
- Progressive Skill Ladders
- Event Scheduling Rules

Controlling

- Milestone Tracking Dashboards
- Post-Activity Feedback Collection
- Quantitative & Qualitative Evaluation
- External Evaluation
- Periodic Safety Audits
- Session Observations
- Equipment Checks
- Financial Transparency
- Goal Completion Scoring
- Action Tracking with Deadlines
- Data Governance Rules
- Benchmark Comparisons
- Member Satisfaction Polls

Figure 2 The drone sports club management model based on the learning situation

Discussion

The study in question built a management model for drone sports clubs in universities of Guangdong Province based on the POLC management principles and conducted empirical validation of the model. The national recognition of drone sports has risen substantially since their inclusion in the 15th National Games of China (General Administration of Sport of China, 2023), but their presence in higher education has not grown in parallel. Lacking integration into curricula, standardized structures, and institutional support are not unique to drone sports



management in universities but are problems commonly seen in Chinese university sports (Chen & Lv, 2018; Luo, 2020; Wang, 2020).

Insufficient funding, lack of equal access to facilities and equipment, and the lack of managerial and technical expertise are both long-standing problems and contemporary problems seen in university sports clubs and teams in China. The aforementioned challenges in drone sports are accompanied by relatively high requirements for operation and research and development costs due to the intensity of technological progress, unclear policy orientation, and airspace management (General Administration of Sport of China, 2024; Federal Aviation Administration, 2019). In addition, the lack of students' practice and the weak responsibility of leaders in sports have caused drone sports projects to have limited sustainability in some universities. The national and provincial policies of promoting aviation and digital sports, as well as university reform policies that support innovation in digital education and sports, are supportive of development (Hu & Li, 2025; Sun et al., 2025). However, the above findings demonstrate that the expansion of drone sports should be realized by clarifying its management goals and guiding the operation through strategic planning, resource allocation, leadership cultivation, and accountability mechanisms.

In response to the specific management needs and to differentiate the model from more general-purpose management models for university sports, the author complemented POLC with 4M (Man–Machine–Material–Method), the integrated model focused on curriculum and extracurricular activities, participation incentive systems, cross-school coordination, and smart information management platform utilization. The integrated management model, in addition to the 4Ps, also has a focus on systematic evaluation, multi-stakeholder governance, and data-driven decision-making, which can significantly improve the efficiency of drone sports club operation and administration in universities and improve their institutional and systematic support.

The theoretical and practical contribution of the study is its compatibility with the overall state direction of cultivating the digital economy and building innovative emerging sports, and its empirical implementation in a specific local and management area. Drone sports in universities is a good area for applying classical organizational theory (Mintzberg, 1973) to a high-tech environment and in the area of sports policy (Ratten, 2023; Yuan et al., 2025).

Recommendation

Immediate Applications

Universities and local clubs in Guangdong Province can adopt the proposed management model to strengthen the organization and operation of drone sports clubs. Implementation may include integrating clubs into both curriculum and extracurricular activities, coordinating school-level promotion plans, and aligning resources with local drone sports member units. Regular





assessment of venue facilities, teaching staff, and student engagement can ensure the model's effectiveness in practice.

Policy Recommendations

Provincial and national authorities can support drone sports development by providing systematic guidance, establishing funding mechanisms, and promoting instructor training programs. Collaboration between universities, local sports associations, and industry partners can enhance professional development, improve coaching quality, and create sustainable pathways for student skill acquisition.

Future Research Directions

The model can be tested and refined in other provinces or adapted for emerging sports with similar characteristics, such as technology-driven or high-cost activities. Future studies may also examine long-term outcomes, such as student participation, club performance, and integration with national sports initiatives, to further validate and enhance the model's applicability.

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